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Pension plan sponsors are aware of one longevity risk in their plans – **the risk that plan members live longer than assumed**. There are steps that they have taken to mitigate this risk. Pension liabilities have been valued anticipating future increases in longevity, and some longevity exposure has been transferred to insurance companies through annuity purchases or pension “buy-ins”.

There is another longevity risk faced by plan sponsors that is not as well known – **the risk that aging populations will depress investment returns**. Academic work has examined the impact of changing population structures on various asset classes, but to our knowledge this has not been connected to the risk that this poses to pension plan finances. Examining this risk is the objective of a research project funded by the **National Pension Hub**. This article surveys some of the academic literature in this area and poses questions that will be addressed by this research project.

In a search of the academic literature published since 2000, we have found 35 articles that analyze the connection between population structure and equity markets<sup>1</sup>. These articles explore for the relationship between some equity market characteristic, such as a price index, P/E ratio or return, and some characteristic of the population structure, all the while controlling for certain economic variables. These papers use many different population characteristics and economic variables. Also, the underlying data that these analyses use covers many different time periods and many different equity markets<sup>2</sup>. Also, most of the papers

find a statistically significant relationship between the population characteristic and the equity market characteristic that the authors use.

## US MARKET ANALYSIS

Perhaps not surprisingly, the one paper that does not find a material impact on US equity markets is one written by the US Government Accountability Office (Bovbjerg and Scott (2006)). After controlling for economic variables, the authors do not find any material impact of changing population structure on the US equity market. This result contrasts with what is generally found. For example, Lim and Weil (2003) find that increasing levels of labour force participation are expected to push up US stock prices over the period 1990- 2012. On the other hand, Kedar-Levy (2006) finds that decreasing expected levels of labour force participation starting in 2016 are also expected to increase stock prices (by 0.22% per year).

Staying with the US equity market, Geanakoplos et al. (2004) find that both the Price to Book ratio and the equity premium increase as the ratio of the proportion of “middle aged” (40-64) to the proportion of “old aged”

<sup>1</sup> Of note, there are many other articles that analyze other asset classes.

<sup>2</sup> Almost half of the papers focus on the US equity market. The rest look at different developed equity markets.



(65+) increases. Using a different demographic characteristic, Jamal and Quayes (2004) find that as the proportion of the population in the prime working ages (40-64) increases by 1%, stock prices increase by 5%. Using US census bureau projections

at the time, the proportion of the population in their prime working ages was expected to decrease from 30.4% in 2000 to 28% in 2030. This represents a reduction of 7.9%, which would be expected to result in a decline in stock prices of 39%. They updated their paper more recently (Quayes and Jamal (2016)) where they found that a 1% increase in the proportion of the population in the prime working ages resulted in only a 1% increase in stock prices. They also found that a 1% increase in the proportion of the “old age” population (65+) resulted in 2.3% decline in stock prices. Still in the US market, another author in a series of papers (Favero et al. (2009), Favero and Tamoni (2010), and Favero et al. (2011)) considers the ratio of the “middle aged” (40-49) to the “young” (20-29) and determines that the equity premium should decline over time.

Coming at the problem from a conceptual standpoint, Lee (2013) argues in favour of dividend yield strategies because these strategies are favoured by the old. Finally, Kedar-Levy (2014) determines that the future aging of the US population should cause a reduction in equity returns of 1.85% per year.

## INTERNATIONAL MARKET ANALYSIS

The rest of the articles we consider analyze developed equity markets other than the US. Ang and Maddaloni (2003) consider both the G5 equity markets and a broader grouping of 15 OECD equity markets. They find that an increase in the proportion of the population over age 65 reduces the equity risk premium. Davis and Li (2003) examine the effect of an increase in the proportion of the population in the age ranges 20- 39 and 40- 64. They find that equity prices increase by 2%

to 3% for each 1% change in either of these ratios. Both Brooks (2006), looking at 10 developed equity markets, and Park (2010), looking at G5 equity markets, find that an increase in the proportion of the population under 35 or over 65 tends to reduce equity prices. While an increase in the proportion of the population ages 60 to 64 tends to increase equity prices.

Roy et al. (2012) examine the relationships within 4 large equity markets. They find that in the US, the ratio of the “middle aged” to “old aged” has a correlation of 0.73 to the Price/Earnings ratio of the S&P 500. However, the association is much less strong in the equity markets of France, Germany, and the UK. In the UK, Ratanabanchuen (2013) finds a statistically significant relationship between the 5-year change in the proportion of the population between ages 35 and 49, and 5-year real equity returns.

Marekwica et al. (2006) examine the equity markets of the G7 countries, both separately and pooled together. They try to find a relationship between equity returns and two ratios.

$$Y = \frac{\text{Pop. age 20 - 39}}{\text{Pop. age over 65}}$$

$$M = \frac{\text{Pop. age 40 - 64}}{\text{Pop. age over 65}}$$

Unlike most other articles, they generally fail to find a significant relationship. The one exception is Canada, where the ratio M is positively associated with Canadian equity returns.

Brunetti and Torricelli (2010) examine the Italian equity market and find that an increase in the proportion of the “young” population (20-39) is positive for equity returns, while an increase in the proportion of the “middle aged” population (40-64) depresses equity returns. Finally, Arnott and Chaves (2012) examine 22 developed equity markets. They find a link between an increasing proportion of the “old” (65+) and downward pressure on both equity returns and economies in general.

Other papers in this literature examine relationships such as the impact of population structure on total market capitalization and individuals’ portfolio allocations.

## SUMMARIZING THE OTHER LONGEVITY RISK

So, having run through a summary of many papers published since 2000, what can we say about the link between population structure and equity returns? These articles cover a range of time periods and geographic areas. While the details of their results vary, the general conclusion that is often reached is **that aging populations will dampen the future returns on equities.**

- An increase of 1% in the proportion of the population that is working age, increases equity returns by somewhere in the range of 1.5% to 5% per year.
- An increase of 1% in the proportion of the population that is over age 65, reduces equity returns by roughly 0.5% per year.

Having said this, the results are not completely satisfying. The reasons for this are threefold:

- a variety of measures are used that are not consistent, both population measures and equity market characteristics;
- the data used covers a wide range of time periods; and
- a variety of different equity markets are analyzed.

In the coming months, we will be releasing research through the **National Pension Hub** to address these shortcomings. This work will include an illustrative example of the impacts of our results on the finances of a stylized Canadian pension plan. Stay tuned!

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