

4. Research Project Statement

4.1. Research Context

4.1.1. Economic Context

During the last quarter of 2022, South Korea's total fertility rate (TFR) fell below 0.8 per woman. Considering the "replacement rate" of approximately 2.1 births per woman, this is a striking number. Regions are considered to have the "lowest-low fertility" if their TFRs are at or below 1.3. While South Korea is the most extreme case, other East Asian countries including China, Japan, and Singapore now have TFRs below 1.3 (OECD, 2023). A corollary to this secular trend is an ageing population.

The second relevant global trend is the immense growth in the importance of pension funds. Overall, global pension fund assets under management (AUM) reached USD 38.5 trillion by the end of 2021 (OECD, 2021). They are now often the single largest shareholder in their respective countries: the National Pension Service (NPS) of South Korea, with an AUM of approximately USD 575 billion (NPS, 2023), holds around 7% of all domestic stock market capitalization. The combined implication of these two global trends is that we should expect large capital outflows soon.

Due to the context described above, South Korea is an ideal laboratory to study the question at hand: will population ageing pose a risk of asset devaluation through the gradual depletion of public pension funds? In the past, the NPS' assets have mechanically grown due to population growth. Because NPS has an asset allocation mandate – it must allocate approximately 15% of its assets to domestic stocks, 32% to domestic bonds, etc. – this led to forced capital inflows into domestic markets, possibly contributing to higher valuations. This very mechanism poses a threat in the coming years as the population trend has already reversed.

Yet, various depletion scenarios and stress tests used by policymakers rely on past fund performances (Korea Ministry of Health, 2023). This is a practice that is widely adopted (OECD, 2021). In the same simulation exercise in Korea, a 1% change in expected fund performance shortens the depletion date by more than a year. This implies that the depletion dates discussed by policymakers and the media are likely to be excessively optimistic. Should we worry about a "depletion-performance downward spiral"? How will this impact the welfare of retirees? Will it affect the corporates' financing and investment?

4.1.2. Academic Context

Economists started to investigate the economic consequences of ageing going back as far as Samuelson (1958). Lee (2016) well summarizes the consensus prediction: "a tendency toward increased capital intensity, higher wages, and lower returns on capital." Most existing studies often focus on the macroeconomic implications of ageing. Gordon (2016) discusses the impact of ageing on growth; Mian et al. (2021) studies the natural rate of interest; Acemoglu and Restrepo (2022) deals with automation and other labor market implications; Hashimoto and Tabata (2016) looks at R&D activities.

Papers that are more closely related to this project are those that study the implications of ageing specifically on asset prices. Poterba (2001) and Krueger and Ludwig (2007) study the effects of demographics on factor prices; Mankiw and Weil (1989) and Takats (2010) study the effects on housing prices. However, even these papers do not study asset prices with a focus on pension funds.

Currently, studies that tie together ageing, asset valuations, and pension funds are largely missing. This is partly because the growing importance of pension funds in financial markets has been recognized more recently. Da et al. (2018) and Bernhardt and Cuevas (2022) show that pension-induced capital flows affect asset prices. Aldunate et al. (2023) argue that they also affect exchange rates. Other papers look at the effects of pension funds on consumption (Börsch-Supan et al., 2014), their effects on the global yield curve (Greenwood and Vissing-Jorgensen, 2018), or how the optimal strategy of pension funds should look like (Lucas and Zeldes, 2009; Bernstein et al., 2013).

In addition, studies in asset pricing increasingly highlight that markets may be more sensitive to capital flows than previously thought (Shleifer, 1986; Gabaix and Koijen, 2022). These findings further hint that ageing-induced outflows will cause significant price impacts going forward. In the context of mutual funds (Edelen, 1999; Coval and Stafford, 2007; Frazzini and Lamont, 2008; Edmans, Goldstein, and Jiang, 2012; Lou, 2012), common stocks (Lou, Polk, Skouras, 2019; van der Beck, 2022), and ETFs (Brown et al., 2020) capital flows have been shown to affect prices both in the short- and long-run.

Methodologically, we will adapt many of the ideas laid out by the demand system approach to asset pricing (Koijen and Yogo, 2019; Koijen, Richmond, and Yogo, 2023). In the context of ESG investing, van der Beck (2022) asks a similar question: what would the valuation of ESG stocks be, in absence of capital inflows into these “green” assets? We ask a closely related question in the context of pension funds and ageing-induced outflows, and the methodology introduced in van der Beck (2021) may prove to be especially useful.

4.2. Research Questions

Question 1: Do (non-fundamental) capital flows from a large public pension fund affect the aggregate stock market valuation? If so, is the impact short-lived or long-lasting?

Question 2: What is the long-term effect of repeated pension-induced flows on the cross-section of asset prices? Do they create a significant valuation wedge between the “inside assets” (held by the pension fund) and “outside assets”?

Question 3: Will an ageing-induced capital outflow impose an economically significant devaluation of domestic assets?

Question 4: Will such an effect have consequences for the real economy (e.g., corporates’ financing and investment decisions)?

4.3. Methodology

4.3.1. Data Construction

This project requires a comprehensive dataset that combines (1) demographic information, (2) pension fund income and expenditures history, (3) pension fund investment decisions, and (4) asset prices. Again, South Korea proves to be a well-suited setting in terms of data availability.

Demographic information in South Korea can be readily gathered online from Statistics Korea (KOSTAT), a government body under the Ministry of Economy and Finance. Data on monthly rate of birth, death, and marriage are all available. Labor market information (e.g., employment and income related data) is also available.

The NPS directly provides data on its investment decisions. It publishes annual guidelines for their asset allocation across different asset classes (e.g., domestic/foreign stocks and bonds, and alternative investments). It also publishes end-of-year asset holdings and annual performances online.

Another unique advantage of the Korean data is that KRX provides investor type-level stock trade flows at high-frequency (in principle up to trade-by-trade basis). One of the provided investor types is “pension funds.” While this is a category that includes the NPS and other public pension funds, most of the trades can be safely assumed to be those of the NPS given its dominant size. This means that we can observe and accumulate the flows of the NPS accurately and at any frequency we want (see Figure 1 as an example application). KRX also provides the price and volume related data of the domestic stocks.

While various data are directly available, through the website, some “semi-public” information needs to be requested separately through “requests for information” to the NPS or related government agencies. Information on the NPS’ detailed income and expenses should be acquired through this channel.

4.3.2. Estimation of “Macro Elasticity”

In this first empirical analysis, we estimate the “macro elasticity” of asset valuation to pension-induced flow (Gabaix and Koijen, 2022). This notion is related to the following statement: how much will the aggregate stock market capitalization increase in response to a \$1 increase in pension fund assets? In order to answer this question, we first test the following “accounting” hypothesis.

Hypothesis 1: The NPS’ capital inflows/outflows to the stock market are significantly affected by the demographic composition of South Korea’s working-age population. More specifically, there has been a mechanical net inflow in the past decades.

While this hypothesis may appear to be tautological, to our knowledge, not many studies are able to test this directly due to data constraints. While the AUMs and holdings of various important investment firms (e.g., any US institution of AUM larger than USD 100 million through 13F filings) are observable, the individual trades that these institutions make are often not easy to observe. However, the KRX data includes accurate and exhaustive trade flows at the institutional type level

and the NPS accounts for almost the entire “pension funds” investor type. These two factors allow us to capture the high-frequency stock market flows of the NPS.

Next, we will estimate the elasticity of interest along with testing the following hypothesis.

Hypothesis 2: Non-fundamental flows, caused by the rigid asset allocation mandates, of the NPS affects the aggregate stock valuation. Also, this price impact has a long-lived, permanent portion.

Using the trade flow data, we observe “how much extra dollars’ worth of stocks that the NPS purchased” on any given day. We also observe the change in aggregate valuation (e.g., daily index returns). A naïve way to attempt to test the above hypothesis is to regress the daily index returns on the net pension inflows. This regression faces both the omitted variables bias and simultaneity problem. In the short run, the NPS has some discretion on the timing of stock purchases, thus to the extent that that the NPS is a sophisticated investor, its flows are likely to be “informed.” In other words, the NPS will purchase *in anticipation* of price appreciation, rather than the purchase *causing* an appreciation. Also, the rise in price itself will affect the NPS’ purchase decision.

We will attempt to use various identification strategies here. The first possibility is to find a source of non-fundamental increases in pension flows. Etula et al. (2020) shows that because firms and pensions tend to have similar disbursement dates on a given month, in other words have similar “paydays,” this creates a non-fundamental flow that affects prices. We plan to search for similar seasonality in the pension’s incomes or expenditures.

Another option is to exploit the asset allocation constraints of the NPS. Every year, the NPS sets an asset allocation goal across different asset classes. While these are only guidelines, historically it has been averse to deviating more than 1pps or 2pps from the set goals. This means, for example, when the domestic stocks unexpectedly appreciate relative to other asset classes, they may have to divest them due to their own constraints. In Figure 2 we demonstrate this pattern in a preliminary analysis: when the domestic stocks’ proportion goes above the goal, the NPS tends to be net sellers of this asset class and vice versa when the domestic stock proportion decreases. We will attempt to identify similar non-fundamental pension flows and test its short-term and long-term price impact.

This “orthogonal flows” type of instrumental variables approach is like those proposed in Edmans et al. (2012) or van der Beck (2021) and will in fact also enlighten us about the next hypothesis.

Hypothesis 3: The NPS’ investment universe affects the cross-section of stock valuation. Stocks that are included in the NPS’ universe are more affected by the NPS’ AUM change.

When there are such forced flows, two variations are induced: variation at the extensive margin (between stocks that are in the NPS’ investment universe and those that aren’t) and the intensive margin (between stocks that are relatively over-weighted/under-weighted by the NPS). If both variations are significant, we can say that the cross-sectional stock valuations are also affected. We also plan to further improve this identification by exploiting “costly” disclosure rules that exist in South Korea. Any investor that owns more than 10% of a publicly listed firm is required to

continuously report their trading activity, rendering this ownership particularly costly to maintain. This will further create non-fundamental reasons for (in)activity and help with our identification.

4.3.3. Structural Model of Pension Flows and Counterfactuals

Once we obtain results from the previous section, we plan to build a structural model that can assess the equity valuation effects of counterfactual pension flow scenarios. This exercise resembles those of van der Beck (2021) and of Gabaix and Koijen (2023). A preliminary model that builds on Koijen and Yogo (2019) is provided as supplementary material. We hope to answer the following hypothesis through such counterfactual policy experiments.

Hypothesis 4: The pension depletion scenarios that use historical returns on domestic equities as input are too optimistic.

We will start with a benchmark depletion model for the projected pension fund depletion date. We hope to get this model from the NPS directly. We believe it is likely that the benchmark model uses assumptions about the future returns on domestic equity holdings. Instead of these past returns, we will use the endogenized (i.e., reflects the feedback between prices and pension flows) domestic equity returns using the empirical elasticities from above. The returns that account for the prospective capital outflows due to the shrinking size of the NPS will likely lead to more realistic depletion dates. One exercise we can perform is to compute the new disbursement amounts, likely less than those from the initial plans, that are required to maintain the same depletion date from the benchmark projections.

4.3.4. Extensions

Hypothesis 5: The NPS' investment decisions have spillover effects on firm financing, and thus on the real economy.

This is a remaining hypothesis of interest. However, directly regressing the outcome variables, such as revenue growth, financing costs, or leverage ratios, on the NPS' holdings again leads to the same problems as before: the NPS does not randomly choose which firms to hold. We put this in this section as we have not yet identified an exogenous source of variation here. This is important to investigate given that the expected outflows may prove to be especially costly for firms that are "at the margin" for the NPS.

Another extension, once we achieve the above research goals, is to test whether a similar pattern is observed in asset classes. In principle, the same mechanism should apply to bonds and alternative investments. However, we start with the equity due to the readily available data on pension funds' flows and equity prices. Similarly, we hope to address the external validity of the South Korean case. We chose this setting because South Korea, quite unfortunately, has all the problematic features of the concerning economic phenomenon. Will the lessons we draw from this project also be informative for other countries too?