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Abstract

This paper investigates the relationship between demographic changes and the long-run returns of dividend-yield investment strategies in the US. We hypothesise that in a world where components of wealth are mentally treated as being non-fungible, the preference for high dividend-paying stocks by older investors means that the excess returns of high dividend-yielding stocks, relative to other stocks, should be positively related to demographic clientele variation. In particular, we find that, as consistent with the behavioural life-cycle hypothesis, the long-run returns of dividend-yield investment strategies are positively driven by changes in the proportion of the older population. Our results are robust when controlled for the Fama-French factors, inflation rate, consumption growth rate, interest rates, time trend and alternative definitions of both dividend-yield strategies as well as demographic variation.

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1. Introduction

The traditional life-cycle model of consumption and savings introduced by Modigliani and Brumberg (1954, 1980) assumes that individuals try to smooth their consumption over their lifetimes. And because labour income flows are uneven over the course of life, therefore savings rate will also vary over the course of life. In particular, the model posits that individuals have low savings rates during their early adult years, but will save more with age as their incomes increase, before dissaving in their retirement as earnings fall.

One of the implications of the life-cycle model is that financial asset prices are linked to changing demographics. The intuition behind this is simple: the middle-aged, who are at the peak of their earnings potential, tend to be heavily involved in the accumulation of net assets as they save for their retirement. Prices of financial assets such as stocks and bonds are therefore likely to rise from the higher demand induced by a relative increase in the size of the middle-aged. This also means that as this age group enters retirement, they will start to decumulate their wealth which will then cause a fall in financial asset prices. This in fact forms the basis for the asset meltdown hypothesis which posits that, just as the higher demand for financial assets by the baby boomers saving for their retirement had led to the rise in US stock prices in the 1990s (Shiller, 2000; Sterling and Waite, 1998), the impending retirement of these baby boomers is also likely to cause a stock market meltdown around 2020.

Given the theoretical importance of demographics to stock markets, it is therefore little wonder that there has been a wealth of empirical studies examining the relationship between them. While Poterba (2001, 2004) did not find any systematic relationship between demographic structure and returns on stocks, Jamal and Quayes (2004) analysed the impact of demographic structure on stock prices in the US and UK and showed that the proportion of population in the prime earning age has had a direct influence on stock prices. Bakshi and Chen (1994) similarly found that a rise in the average age in the US corresponded to a risk in the risk premium of an S&P500-portfolio, while Claude, Campbell and Viskanta (1997) also discovered a positive relationship between the average age of the US population and the long-horizon returns of the S&P500. Davis and Li (2003) extended their analysis to the seven OECD countries and found that generally an increase in the proportion of middle-aged people tends to boost financial asset prices. Arnott and Chaves (2011) adapted a polynomial curve-fitting technique on a cross-section of 22 countries, and found strong links between demography and capital markets returns, net of the effects of valuation and yield levels. In particular, they found that stocks perform best when the roster of people age 35–59 is particularly large, and when the roster of people age 45–64 is fast-growing.

Despite empirical evidence generally supporting the linkage between demographic structure and stock markets, there has been little work done investigating the effects of demographics on the performances of investment strategies within stock markets, particularly dividend-yield investment strategies.

The effectiveness of dividend-yield strategies in enhancing portfolio returns is well-documented. Studies have generally identified a positive relationship between share price performance and dividend yield (Fama and French, 1988; Hodrick, 1992; Grant, 1995; Christie, 1990). For example, McQueen, Shields, and Thorley (1997) found that over a 50-year period, a high dividend-yield strategy outperformed the Dow Jones Industrial Average by 3.06%, while Visscher and Filbeck (2003) applied a variant of the high-dividend-yield strategy, the "Dogs of Dow"strategy, on the Toronto 35 index and found that the strategy produced higher risk-adjusted returns compared to the index.

Several papers have tried to explain the effectiveness of dividend-yield investment strategies. Brennan (1970) proposed a tax-effect hypothesis that predicts that investors receive higher returns to compensate for the higher taxes on the dividend income of these stocks relative to capital gains. Naranjo, Nimalendran and Ryngaert (1998) however determined that the positive correlation between dividend yield and return holds true even after adjusting for risk and tax effects. Gombola and Liu (1993a) attributed the efficacy of dividend-yield strategies to the stability of beta, while Gombola and Liu (1993b) tied it to the economic cycle.

This paper investigates the driver of the efficacy of dividend-yield strategies by exploring the relationship between demographic changes and the long-run returns of dividend-yield investment strategies in the US. In particular, we find that, as consistent with the behavioural life-cycle hypothesis, the long-run returns of dividend-yield strategies are positively driven by demographic clientele variation as represented by changes in the proportion of the older population. Our results are robust when controlled for the Fama-French factors, inflation rate, consumption growth rate, interest rates, time trend and alternative definitions of both dividend-yield strategies as well as demographic variation.

This paper therefore contributes to current literature by adding to the understanding of the drivers of the long-horizon returns of dividend-yield investment strategies through an examination of demographic clientele changes as a source of the time-varying demand for high dividend-yielding stocks. To our knowledge, there has not been any work done in this aspect.

The rest of this paper is structured as follows: Section 2 discusses the behavioural life-cycle hypothesis, and introduces our hypothesis. Section 3 describes the data sample and the methodology pursued. The empirical findings are reported in Section 4, while robustness tests are conducted in Section 5. Section 6 highlights potential further work that can be done in this area, while Section 7concludes the paper.

2. Demographic Clientele Variations and Dividend-Yield Investment Strategies

2.1 Behavioural Life-Cycle Theory and the Dividend Preferences of Older Investors

According to the behavioural life-cycle theory (Thaler and Shefrin, 1988), households treat components of their wealth as nonfungible. In particular, wealth is assumed to be broken into three mental accounts, namely current income, current assets and future income, with the temptation to spend being greatest for current income and least for future income. The behavioural life-cycle theory therefore hypothesises that in the later stage of a household's life cycle when they reach retirement and begin to dis-save, the investor perception of the non-fungibility between dividends and capital gains should lead to a preference for high dividend-paying stocks by older investors for consumption purposes.

Empirical evidence has generally been supportive. Graham and Kumar (2006) studied the stock holdings and trading behaviour of 77,995 households over the period of 1991-1996 and found that, compared to younger investors, older investors allocate a greater proportion of their equity portfolios to dividend paying stocks. This suggests that senior investors have a greater preference for dividends. Lee (2011) investigated the importance of demographic clienteles as a source of the time-varying demand for dividend payers, and found that the dividend premium, defined as the log difference in the average market-to-book ratio of dividend payers to nonpayers, is positively driven by demographic clientele variation as represented by changes in the proportion of the older population. . In essence, the larger the increase in the proportion of the older population is, the higher is the dividend premium.

2.2 Hypothesis Development

We hypothesise that in a world where components of wealth are mentally treated as being non-fungible, the preference for high dividend-paying stocks by older investors means that the excess returns of high dividend-yielding stocks, relative to other stocks, should be positively related to changes in the proportion of the older population. In essence, the larger the increase in the proportion of old population, the greater the relative demand for high dividend-paying assets, and hence the stronger the relative performance of dividend-yield investment strategies.

We formalise our hypothesis in a simple model that highlights the many strong assumptions that are needed for our conclusion. We start with the model of Poterba (2001) which expresses the relation between demographic structure and asset prices as

$$p * K = N_y * s \qquad (1)$$

where p is the relative price of assets in terms of the numeraire good,

K is the fixed supply of durable assets,

N_y is the proportion of young individuals in a world where they work when young (y) and retire when old, and

s is the saving rate out of labour income for young workers.

Thus according to the model of Poterba (2001), asset prices are positively related to the size of the working cohort.

We can re-write equation (1) with respect to high dividend-paying stocks (DY) to incorporate the stronger preferences by older investors for these assets:

$$p_{DY,t} * K_{DY,t} = N_{o,t} * w_{o,t} \qquad (2)$$

where $p_{DY,t}$ is the relative price of high dividend-paying assets in terms of the numeraire good at time t,

$K_{DY,t}$ is the fixed supply of high dividend-paying assets,

$N_{o,t}$ is the proportion of old individuals, and

$w_{o,t}$ is the rate of equity ownership out of wealth for old individuals.

The price return of high dividend-paying assets $R_{DY,t}$ is therefore expressed as

$$R_{DY,t} = p_{DY,t}/p_{DY,t-1} = N_{o,t}/N_{o,t-1} * w_{o,t}/w_{o,t-1} * K_{DY,t-1}/K_{DY,t} \qquad (3)$$

It can be seen from equation (3) that the relative price returns of high dividend-paying assets are a function of three factors: the change in the proportion of old individuals, the change in the rate of equity ownership of old workers, and the rate of change in the supply of high dividend-paying assets. In particular, our paper is more focused on exploring the relationship between changes in the demographic structure, or demographic variation, to the price returns of high dividend-yielding assets i.e. dividend-yield investment strategies.

It is worth noting that in our study examining the returns of dividend-yield investment strategies, we have chosen to focus on the long-horizon rather than shorter-term time frames. This is done for several reasons. Firstly from a practical perspective, investors typically re-position their portfolios gradually over long periods of time. It is therefore useful to know how returns of dividend-yield strategies move with demographic changes over longer horizons. Secondly, stock returns in the short horizon can be particularly susceptible to short-term noise and market vagaries which then obscure the true long-run relationship. For example, when Yoo (1994) estimated the multivariate time-series regressions of annual U.S. stock, corporate and government bond returns to shares of total population for different age groups, he found that even as the statistical significance of his results are weak when the analysis is performed on annual data, the statistical significance increases dramatically when three- and five-year centered moving average data is used instead. Thirdly, as pointed out by Fama (1998), because "stock prices adjust slowly to information, one must examine returns over long horizons to get a full view of market inefficiency". This is especially important when examining stock prices against slowly-changing demographic variation because "long horizons provide a better test for low frequency population changes" (Arnott and Chaves , 2012).

3. Data Sample and Methodology

This section briefly discusses the data sources and the variables' definitions.

Following Gwilym, Clare, Seaton and Thomas (2009), we define a dividend-yield investment strategy as zero-cost long-short directionally-neutral strategy comprising of equal positions in both a long and short portfolio of value-weighted stocks that are in the highest and lowest quintiles of stocks ranked by dividend yield respectively. The portfolios are formed on the dividend yield at the end of each June using NYSE breakpoints, with the dividend yield that is used to form portfolios in June of year t being the total dividends paid from July of t-1 to June of t per dollar of equity in June of t. The annual performance of the portfolio is then measured from January to December of year t.

Because of the observation of a "U-shaped" relationship between dividend yield and return in the US and UK by Keim (1985) and Morgan and Thomas (1998) respectively, Gwilym et al (2008) had highlighted the potential need to consider zero-dividend firms as a separate group rather than incorporating them into the lowest dividend quintile. We have therefore defined our long-short dividend-yield strategies to allow for both the inclusion and exclusion of zero-dividend stocks. We have also defined a third long-short dividend strategy consisting of long positions in high dividend-yielding stocks and short positions in the market portfolio. It is worth pointing out that the returns from this strategy can be interpreted alternatively as being the excess market returns of a long-only portfolio of high dividend-yielding stocks.

As highlighted in our hypothesis development, this study is focused on investigating the relationships over the long-run horizon. The definition of long-horizon that we use here is 10-years, a time frame that is also consistent with that of studies like Campbell and Shiller (1998) and Rapach and Wohar (2005). This long-run 10-year number is also close to the intuition of Arnott and Casscells (2003) who suggested that the effects of the demographic crisis in the U.S. which begins in earnest in 10 years are more likely to already have an impact on capital markets now. The long-run returns of our investment strategies are therefore calculated as the ten-year returns of our variously defined dividend-yield investment strategies and denoted as variables $R_{Q1\text{-}Q5,\text{Excl zero-div}}$, $R_{Q1\text{-}Q5,\text{Incl zero-div}}$ and $R_{Q1\text{-}Rm}$. The data used for our calculations are downloaded from the website of Kenneth French[2].

Following Graham and Kumar (2006) and Poterba (2001), we use the old-to-population ratio *Old/Population*, defined as the proportion of population aged above 65 to the total population, as the variable representing the demographic structure. Demographic variation is

[2] Available at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

therefore expressed as the annual change in the old-to-population ratio *dOld/Population*. We also employ an alternative measure of the demographic variation variable *dOld/PSavers*, defined as the annual change in the old-to-prime savers ratio, in our robustness test. The US population data used for the calculations of the two measures of demographic variations is downloaded from the US Census Bureau[3] website.

In our robustness checks, we employ the Fama-French factors and measures of inflation rate, consumption growth rate and interest rates.

The Fama/French factors are constructed using the 6 value-weighted portfolios formed on market capitalisation and book-to-market. The small cap effect *SMB* is calculated as the average return on the three small portfolios minus the average return on the three big portfolios i.e. SMB = 1/3 (Small Value + Small Neutral + Small Growth) - 1/3 (Big Value + Big Neutral + Big Growth), while the value effect *HML* is calculated as the average return on the two value portfolios minus the average return on the two growth portfolios i.e. HML = 1/2 (Small Value + Big Value) - 1/2 (Small Growth + Big Growth). R_m-R_f is the excess return on the market and is calculated as the value-weighted return on all NYSE, AMEX, and NASDAQ stocks minus the one-month Treasury bill rate.

Inflation rate is calculated as the percentage change in the Consumer Price Index CPI over the last ten years and is denoted by *dCPI/dt*, while the real consumption growth rate *dC/dt* represents the percentage change in the real per capita consumption over the last ten years. For interest rates, we define the short-term interest rate *R* as the one-year interest rate while the long-term interest rate *RLong* is the long government bond yield. The term structure or yield curve *YC* is therefore calculated as the difference between RLong and R, while the short-term interest rate

[3] Available at http://www.census.gov

movement *dR/dt* is the change in the one-year interest rate over the last ten years. All the data used for our calculations here is downloaded from the website of Robert Shiller[4].

The time period employed in this study is from 1937 to 2011 which represents the period for which the data for the ten-year returns of the dividend-yield strategies is available.

Following the methodology of Fama and French (1992), Fama and French (1998) and Poterba (2001), we employ multivariate OLS regression on overlapping data to estimate the relation. The regression is expressed as

$$R_{Q1\text{-}Q5,t} = \alpha_0 + \alpha_1\, dOld/Population_{\mathrm{t}} + \alpha_2\, ControlVar_{\mathrm{t}} + \varepsilon_{\mathrm{t}}$$

where $ControlVar_t$ represents the relevant control variables and ε_t is the random disturbance term. As is well known, even though using overlapping data in regression helps achieve greater efficiency, it also induces a moving average process in the errors which invalidates the usual OLS standard errors. We therefore adjust for this by calculating the standard errors using the Newey-West (1987) heteroscedasticity and autocorrelation consistent variance matrix that is based on the Bartlett kernel. This thus provides asymptotically valid hypothesis tests when using data with overlapping observations.

4. Empirical Findings

Figure 1 shows the time series plots of long-run excess returns of the dividend-yield investment strategy ($Q1 - R_m$) and the annual change in old-to-population ratio. It is observed that

[4] Available at http://www.econ.yale.edu/~shiller/data.htm

while both variables are not perfectly synchronous, they are visibly positively related to each other. Indeed it can be seen from the correlation matrix in Table 2 that the contemporaneous correlation between the dividend-yield strategy and the demographic variation measure of annual change in older-to-population ratio is 0.427 at 5% significance level.

Figure 2 shows the time series plots of long-run excess returns of the dividend-yield investment strategy (Q1 – Q5 excluding zero-dividend stocks) and the annual change in old-to-population ratio, while Figure 3 shows the plots of long-run excess returns of the dividend-yield investment strategy (Q1 – Q5 including zero-dividend stocks). It can be seen that the returns of both dividend-yield investment strategies also appear to be positively related to the demographic variation variable. In fact it can be seen in Table 2 that the correlations stand at 0.337 and 0.286 respectively, and are significant at 5% levels.

Table 1 shows the descriptive statistics of the dividend-yield strategies, the demographic variation variables as well as the control variables, while Table 2 shows their unit root test statistics and the correlation matrix. The unit root test employed here is the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test (Kwiatkowski, Phillips, Schmidt and Shin, 1992) which uses the null hypotheses of linear stationarity and trend stationarity respectively. It can be seen that for the dividend-yield strategy variables, the demographic variation variables and the control variables, the unit root tests generally accept the null hypotheses of linear stationarity and trend stationarity. This supports our employment of Ordinary Least Squares (OLS) regressions in our empirical analysis, as consistent with Fama and French (1992), Fama and French (1998) and Poterba (2001).

Column 1 of Table 3 shows the OLS regressions of the 10-year returns of the dividend-yield strategy (Q1-Q5 excluding zero-dividend stocks) $R_{Q1\text{-}Q5,Excl\ zero\text{-}div}$ against the annual change in old-to-population ratio over the period of 1937 to 2011. It can be seen from our regression results that the annual change in the old-to-population ratio is a positive and statistically-significant determinant of the long-run returns of the dividend-yield strategy. This means that the returns of the dividend-yield strategy are high when the proportion of older population to total population increases, while the returns are low when the proportion of older population to total population falls.

Column 2 of Table 3 shows the regression of the 10-year returns of the dividend-yield strategy (Q1-Q5 including zero-dividend stocks) $R_{Q1\text{-}Q5,Incl\ zero\text{-}div}$ against the annual change in the old-to-population ratio over the period of 1937-2011, while Column 3 of Table 3 shows the regression of the 10-year returns of the dividend yield strategy (Q1-R_m) $R_{Q1\text{-}Rm}$ against the demographic variation variable. The relationships are positive and highly significant at 5% and 1% levels respectively, and show that the both dividend-yield strategies outperform over the long-run when the proportion of older population increases, and underperform when the proportion of older population falls.

Our results therefore confirm our hypothesis that demographic variations are important determinants of the long-run performance of dividend-yield investment strategies in the US.

5. Robustness Checks and Control Variables

5.1 Fama-French Factors

Fama and French (1993) proposed that the excess returns on US portfolios can be predominantly captured by a three-factor model that uses the market portfolio as well as mimicking portfolios for the factors related to size and value-growth. In particular, they find that the expected return on a portfolio in excess of the risk-free rate is largely explained by the sensitivity of its return to the three factors: (i) the excess return on a broad market portfolio (R_m - R_f); (ii) the difference between the return on a portfolio of small stocks and the return on a portfolio of large stocks (SMB, or small minus big); and (iii) the difference between the return on a portfolio of high-book-to-market (growth) stocks and the return on a portfolio of low-book-to-market (value) stocks (HML, or high minus low).

We therefore employ the three Fama-French factors as control variables in our robustness test. This is particularly apt as high dividend-yield investment strategies are frequently also classified under the broader category of value strategies that includes low market-to-book strategies and low price-to-earnings strategies. It is therefore of interest to investigate whether the relationship between dividend-yield strategies and demographic variation reflects a broader relationship between value strategies and demographics.

It is worth noting here that while there is much controversy among academics about whether the average SMB and HML returns are rewards for risk or the result of security mispricing, the need to take a stance on this issue is not required for our purposes. We can simply interpret SMB and HML as diversified passive benchmark returns that capture patterns in the average returns during our sample period of 1937-2011, whatever the source of the average returns.

Columns 4-6 in Table 3 show the multivariate regressions of the dividend-yield strategies against the three Fama-French factors. It can be seen that the demographic variation variable remains a statistically-significant positive determinant of $R_{Q1\text{-}Q5,\text{Excl zero-div}}$ and $R_{Q1\text{-}Rm}$ at 5% levels, and of $R_{Q1\text{-}Q5,\text{Incl zero-div}}$ at 1% level. The Fama-French factors of market premium R_m-R_f and small cap effect SMB are not significant. However, the Fama-French factor of the value effect HML is significant at 1% level for $R_{Q1\text{-}Q5,Excl\ zero\text{-}div}$ and $R_{Q1\text{-}Q5,Incl\ zero\text{-}div}$, and at 5% significance level for $R_{Q1\text{-}Rm}$, a finding that is consistent with Kothari and Shanken (1997) who found reliable evidence that both dividend yield and book-to-market track time-series variation in expected real one-year stock returns over the period 1926-91 and the sub-period 1941-91.

We have therefore shown that our hypothesis of demographic variation as an important determinant of the long-run returns of dividend-yield investment strategies is robust to the inclusion of the Fama-French factors.

5.2 Inflation Rate

Conventional wisdom holds that stocks, particularly dividend-paying stocks, are good hedges against inflation. For example, Carrel (2010) advised that "one of the best ways to keep inflation from taking a bite out of your investment earnings is to invest in dividend-paying stocks. The big advantage dividends hold over other income generating investments is they have the potential to keep pace with inflation. As prices rise, profits also tend to rise, and companies can afford to raise their dividend payments." His view is similarly echoed by Arnott (2003) who pointed out that "the importance of dividends for providing wealth to investors is self-evident [because] dividends [...] dwarf inflation".

Empirical evidence has however been mixed. While earlier studies (Geske and Roll, 1983; Fama and Schwert, 1977) have generally found a negative relationship between short-horizon stock returns and inflation, recent studies (Boudoukha and Richardson, 1993; Kolari and Anari, 2001) have found that stocks can serve as effective long-term inflation hedges. In particular, Basse (2009) and Basse and Reddemann (2011) have found positive cointegrating relationships between inflation and dividends in Australia and US respectively. Their results appear to support the conventional wisdom of buying high dividend-paying stocks as hedges against inflation.

We therefore include inflation as a control variable in our study.

Columns 7-9 in Table 3 show the results of our multivariate regressions. The annual change in old-to-population ratio remains a statistically significant determinant of the long-run returns of all three dividend-yield strategies. It can also be seen that inflation rate is not a significant explanatory variable, thus supporting the empirical findings of Geske and Roll (1983) and Fama and Schwert (1977) while casting doubts on the conventional belief of high dividend-yielding stocks as inflation hedges. Our results also show that our earlier findings hold even with the inclusion of inflation rate considerations.

5.3 Consumption

The mental accounting theory (Thaler, 1980; Shefrin and Thaler, 1988) posits that households do not view dividends and capital gains as fungible, and instead place them into one of three mental accounts, namely current income, current assets and future wealth. According to the theory, households then have a higher propensity to consume out of the mental account for dividends than for capital gains. Empirical evidence has generally been supportive of this concept of mental accounting by investors. For example, Baker, Nagel and Wurgler (2006) examined the micro data sets from the Consumer Expenditure Survey and a large discount brokerage, and found strong evidence that the marginal propensity to consume out of dividend income is much higher than that of capital gains income.

It is worth noting here that the prediction by mental accounting theory that households prefer to consumer out of dividends than out of capital gains applies to the general household and is not unique to certain age groups. While the behavioural life-cycle hypothesis extends on the prediction to imply a stronger preference for dividend-paying stocks by the older population, compared to the rest of the population, in order to help fund their consumption during their retirement, it is still within the theoretical framework for the general population to also have a stronger preference for dividend-paying stocks if they are planning to increase their overall consumption.

It is therefore conceivable that the price performance of high dividend-yielding stocks simply reflects the greater purchase of these stocks by investors in general as they fund their increased consumption. We therefore include the consumption growth rate as a control variable in our robustness check.

Columns 10-12 in Table 3 show the results of the multivariate regressions. The demographic variation variable remains a statistically significant positive determinant of the long-run returns of the dividend-yield strategies $R_{Q1-Q5,Excl\ zero-div}$, $R_{Q1-Q5,Incl\ zero-div}$ and R_{Q1-Rm}. The consumption growth rate variable is not significant for $R_{Q1-Q5,Excl\ zero-div}$ and $R_{Q1-Q5,Incl\ zero-div}$ although it is significant at 10% level for R_{Q1-Rm}. Our hypothesis that the long-run returns of dividend-yield strategies are driven by demographic changes is therefore robust to the inclusion of consumption growth considerations.

5.4 Interest Rates

Because the yield of a dividend-paying stock is a significant component of its total return, high dividend-yielding stocks are often compared against other income-generating options such as putting the money into savings accounts or money market accounts, or buying bonds or certificates of deposits (Carrel, 2010). Mladjenovic (2009) thus highlighted that "income stocks can be sensitive to rising interest rates. When interest rates go up, other investments (such as corporate bonds, U.S. treasury securities, and bank certificates of deposit) are more attractive. [...] As more and more investors sell their low-yield stock, the prices for those stocks fall."

Given the potential sensitivity of dividend-yielding stocks to interest rates, we therefore include measures of interest rate as control variables in our robustness checks. We use four different measures of interest rates in our tests. They are the short-term interest rate represented by the one-year interest rate, the long bond yield, the term structure or yield curve, and the change in short-term interest rates.

Columns 13-15, 16-18, 19-21 and 22-24 in Table 4 show the results of the multivariate regressions of the long-run returns of the three dividend-yield strategies to both the demographic variation variable as well as the short-term interest rate, long bond yield, yield curve and annual change in short-term interest rate respectively. In all the regressions, the annual change in old-to-population ratio remains an important determinant of the long-run returns of the dividend-yield strategies, with the significance levels at either 1% or 5%. It can also be seen that the various interest rate measures are generally not significant except for the yield curve which is a positive and statistically-significant determinant of long-run returns of dividend-yield strategies at 5% levels.

Our earlier hypothesis is therefore robust to the inclusion of interest rate considerations.

5.5 Time Trend

While a visual observation of the graphs as well as the results of our earlier unit root tests will suggest that the demographic variation variable and the three measures of dividend-yield strategies are trend-stationary, it is nevertheless prudent to include the time trend as a control variable to test the robustness of our results.

Column 25-27 of Table 5 shows the results of the multivariate regressions. Even with the inclusion of the time trend as a control variable, the annual change in the proportion of old population continues to be positively related to the long-run returns of $R_{Q1,Q5,Excl\ zero\text{-}div}$ and $R_{Q1\text{-}Rm}$. The explanatory power of the demographic variation variable is however not significant for the dividend-yield strategy that includes zero-dividend stocks, $R_{Q1\text{-}Q5,Incl\ zero\text{-}div}$.

Our results therefore largely support our earlier conclusions even when controlled for the time trend.

5.6 Alternative Definition of Demographic Variation Variable

While our measure of demographic structure is intuitive from our hypothesis, we acknowledge that there are alternative definitions to the demographic structure used in other research. In their analysis of the effects of demographic structure on asset prices in Asia, Eskesen, Lueth, and Syed (2008), for example, have defined the demographic structure as the ratio of prime consumers (aged 65+) to prime savers (aged 40-65).

We have therefore adopted the definition of Eskesen, Lueth and Syed (2008) as an alternative definition of the demographic structure and calculated the equivalent demographic variation variable as the annual change in the old-to-prime savers ratio.

Table 2 shows that the correlations between the annual change in old-to-prime savers and the three measures of long-run dividend-yield strategy returns are all positive and statistically significant at 5% level. The results of the univariate regressions are shown in Columns 28-30 of Table 5. It can be seen that the alternative definition of demographic variation remains an important determinant of the ten-year returns of the $R_{Q1\text{-}Q5,\text{Excl zero-div}}$, $R_{Q1\text{-}Q5,\text{Incl zero-div}}$ and $R_{Q1\text{-}Rm}$ at 5%, 10% and 1% significance levels respectively. Our earlier finding is therefore robust to the alternative definition of the demographic variation measure.

5.7 Alternative Definition of Dividend-Yield Strategies

We have also varied the definition of the dividend-yield investment strategies in our robustness checks. This is done in two ways: Firstly, we vary the dividend yield threshold cut-off points used in the construction of the long-short portfolios to capture the top/bottom deciles of stocks rather than the top/bottom quintiles. Secondly, we shorten the time horizon of the strategies to five-years instead of ten-years.

Columns 31-33 in Table 5 shows the multivariate regressions where the long-short directionally neutral portfolios are calculated as long and short positions in the highest (D1) and lowest (D10) deciles of stocks ranked by dividend yield respectively. It can be seen that the demographic variation variable is a highly significant determinant of the long-run returns of the alternatively-defined dividend-yield strategies, $R_{D1\text{-}D10,\text{Excl zero-div}}$, $R_{D1\text{-}D10,\text{Incl zer-div}}$ and $R_{D1\text{-}Rm}$, at 1% levels. In fact it appears that the R-squared of the regressions are also higher when the definition of high dividend-yielding stocks is tightened. This supports our hypothesis that the preference for high dividend-yielding stocks by the old population leads to the long-run outperformance of these stocks as their prices are being bidded up by the higher demand over time.

Columns 34-36 in Table 5 show the multivariate regressions when the definition of the long-run time frame is shortened to five-years. It can be seen that the annual change in old-to-population ratio continues to be a positive determinant of the dividend-yield strategies $R_{Q1\text{-}Q5,Excl\ zero\text{-}div}$ and $R_{Q1\text{-}Q5,Incl\ zero\text{-}div}$ at 10% and 5% significance levels respectively, although it is not significant for $R_{Q1\text{-}Rm}$. Our results therefore largely support our hypothesis even when alternative time horizons are employed. We however note that the r-squared of the regressions also drop when the time horizon is reduced, thus supporting our choice, as well as the recommendations of Fama (1998) and Arnott and Chaves (2012), of using a longer time horizon in the analysis of the effects of demographics on dividend-yield strategies.

Our robustness checks have therefore shown that changes in the demographic clientele is an important determinant of the long-run returns of dividend-yield strategies in the US even when controlled for the Fama-French factors, inflation rate, consumption growth rate, interest rates and the time trend. Our findings are also robust to alternative definitions of both the dividend-yield strategies as well as demographic variation.

6. Further Work

While this paper only seeks to investigate the relation between demographic variation and the long-horizon returns of dividend-yield investment strategies, the next step of work can be focused on constructing forecasting models for predicting these long-run returns. Although it is not within the scope of this paper, we have taken a whimsical initial attempt at forecasting the long-run returns of $R_{D1\text{-}Rm}$ in Figure 4. Our fitted model, based on the regression coefficients in Column 33 of Table 5 and the demographic projections from the US Census Bureau, is forecasting an increase in the long-run returns of the dividend-yield investment strategy from now until 2025 before the shift in the demographic structure starts to negatively impact returns of the strategy.

We also note that the control variables employed in our robustness checks are, by no means, exhaustive as we are constrained by the availability of long-dated data. Future work can therefore also examine the relationship of demographic variation and dividend-yield strategies in the presence of changes in equity ownership as well as the supply of dividend-paying assets, two other important factors highlighted in Equation (3).

7. Conclusion

According to the behavioural life-cycle theory, households treat components of their wealth as nonfungible. As such, in the later stage of a household's life cycle when they reach retirement and begin to dis-save, the investor perception of the non-fungibility between dividends and capital gains should lead to a preference for high dividend-paying stocks by older investors for consumption purposes.

We hypothesise that this stronger preference for high dividend-paying stocks by older investors should mean that the excess returns of high dividend-yielding stocks, relative to other stocks, are positively related to changes in the proportion of the older population. In particular, we find empirical evidence that, as consistent with the behavioural life-cycle hypothesis, the long-run returns of dividend-yield investment strategies are positively driven by demographic clientele variation that is represented as changes in the proportion of the older population. Our results are robust when controlled for the Fama-French factors, inflation rate, consumption growth rate, interest rates, time trend and alternative definitions of both dividend-yield strategies as well as demographic variation.

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Figure 1: Time Series Plots of Long-Run Excess Returns of Dividend-Yield Investment Strategy (Q1 – R_m) and Annual Change in Old-to-Population Ratio, 1937 - 2011

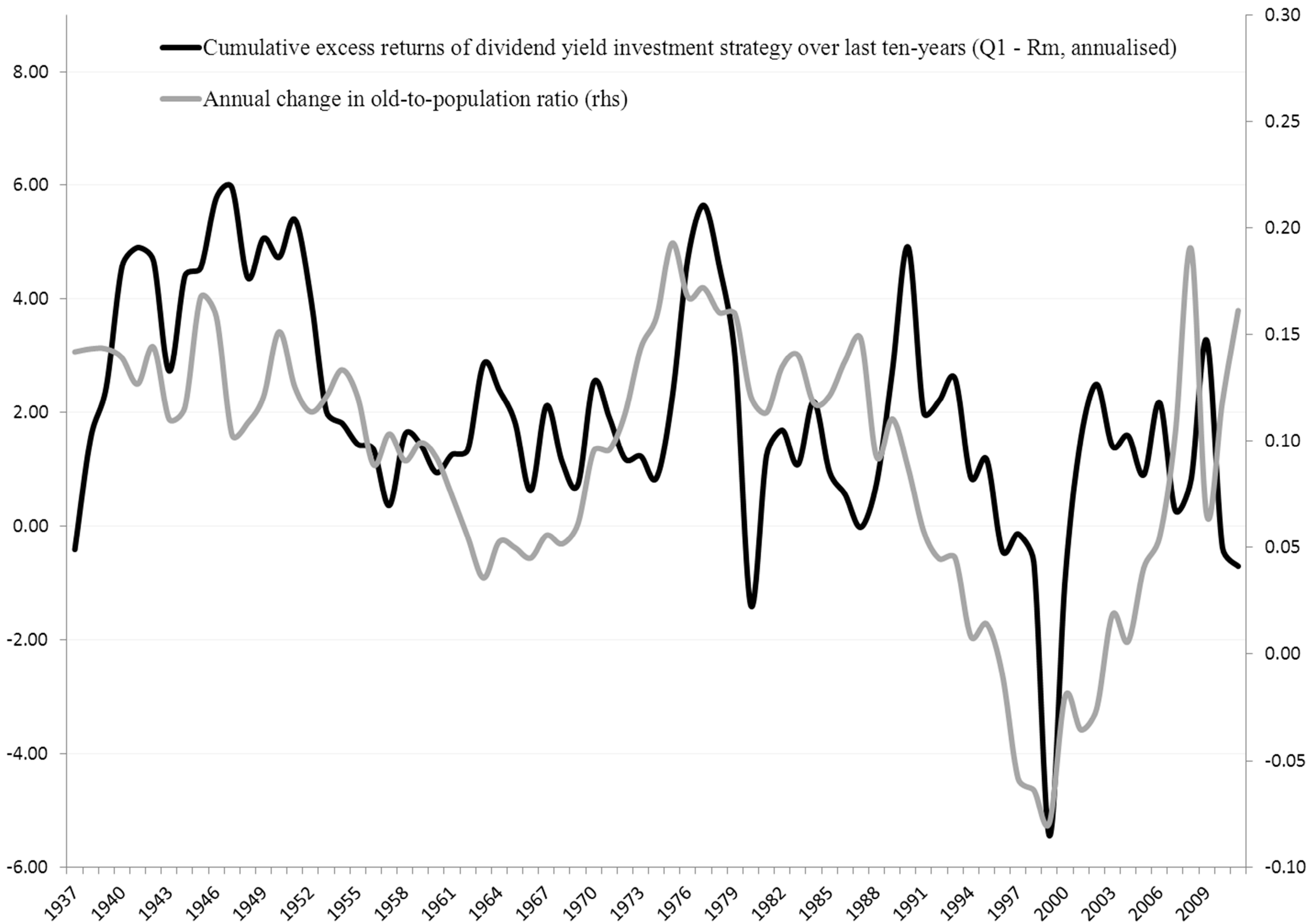

Figure 2: Time Series Plots of Long-Run Excess Returns of Dividend-Yield Investment Strategy (Q1 – Q5 Excluding Zero-Dividend Stocks) and Annual Change in Old-to-Population Ratio, 1937 - 2011

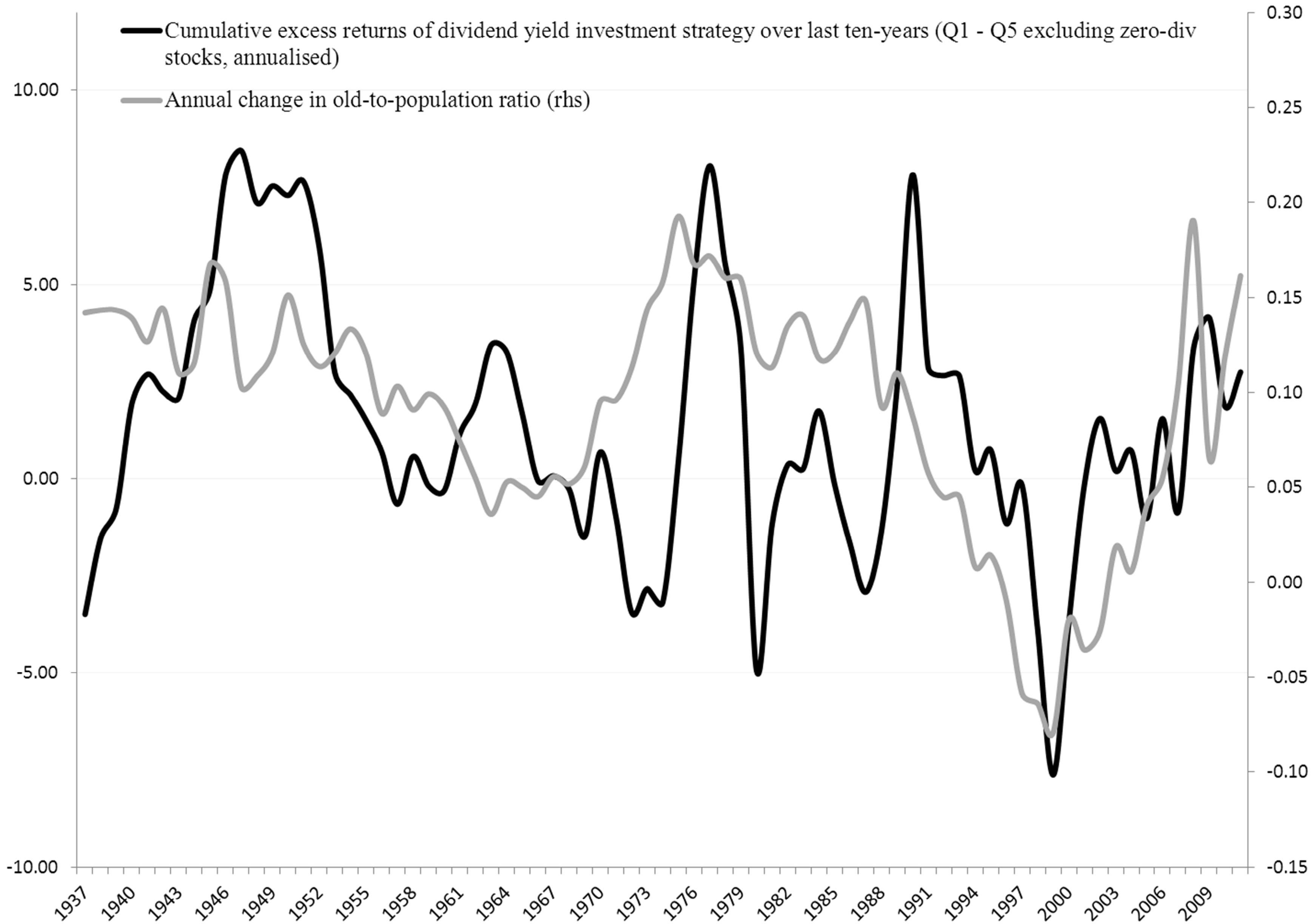

Figure 3: Time Series Plots of Long-Run Excess Returns of Dividend-Yield Investment Strategy (Q1 – Q5 Including Zero-Dividend Stocks) and Annual Change in Old-to-Population Ratio, 1937 - 2011

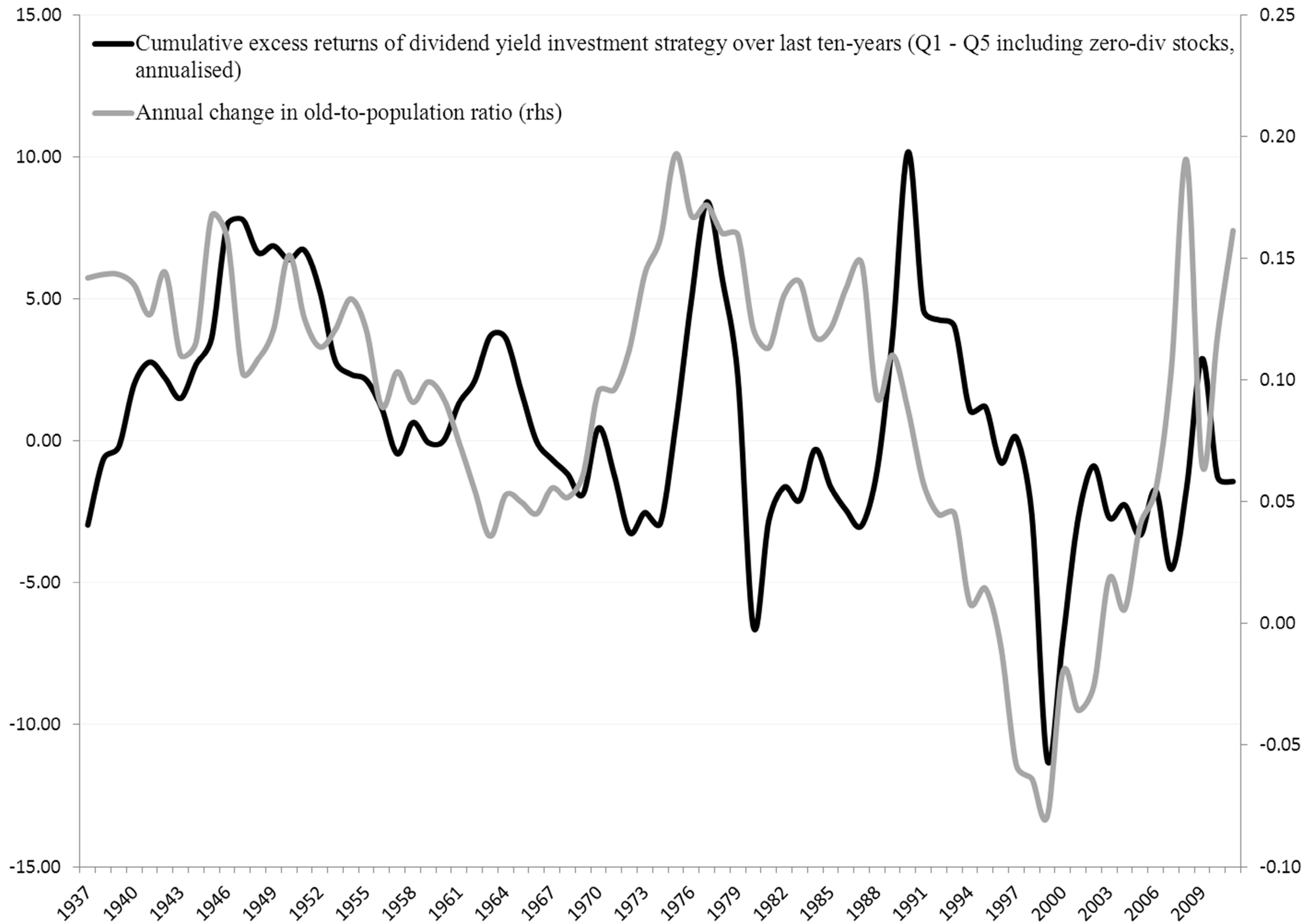

Figure 4: Time Series Plots of Long-Run Excess Returns of Dividend-Yield Investment Strategy (D1 – R_m) and Fitted Model, 1937 - 2050

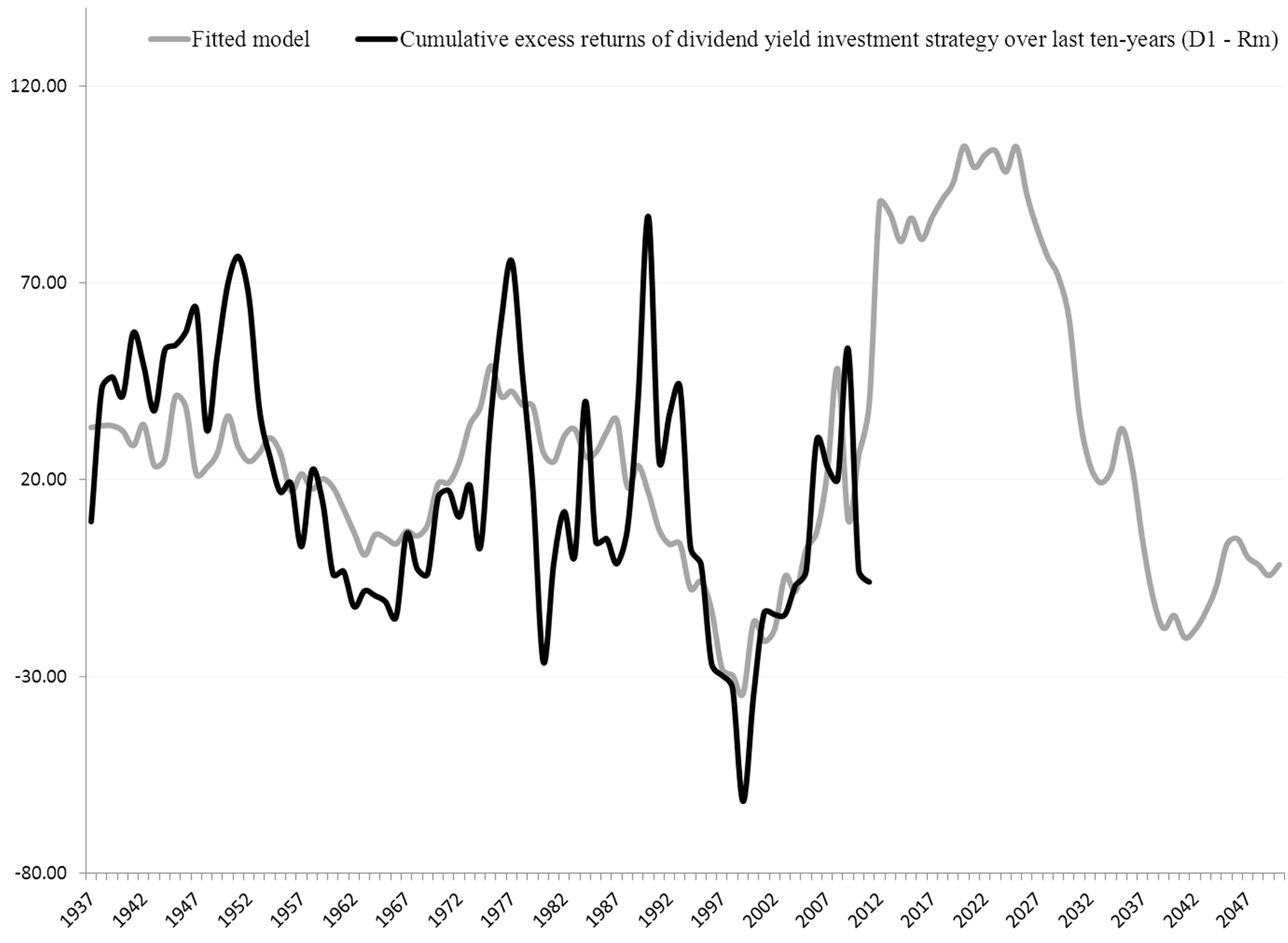

Table 1: Descriptive Statistics, 1937-2011

Variable	Mean	Standard deviation	Maximum	Minimum	No. of observations
$R_{Q1\text{-}Q5,Excl\ zero\text{-}div}$	19.704	40.601	124.918	-54.769	75
$R_{Q1\text{-}Q5,Incl\ zero\text{-}div}$	14.384	43.938	163.375	-69.668	75
$R_{Q1\text{-}Rm}$	23.479	23.626	78.287	-42.897	75
dOld/Population	0.091	0.062	0.193	-0.079	75
dOld/PSavers	0.209	0.525	1.082	-1.103	75
R_m - R_f	111.736	105.124	388.266	-39.523	75
SMB	44.367	59.381	215.548	-37.119	75
HML	64.196	46.620	238.947	-37.921	75
R	64.040	49.443	169.347	7.171	75
RLONG	72.657	45.657	172.197	25.691	75
dCPI/dt	44.991	33.866	129.577	-19.429	74
dC/dt	25.924	7.941	42.066	2.188	73
YC	6.610	8.018	19.622	-9.322	75
dR	-0.147	3.677	12.199	-10.418	75

Table 2: Unit Root Statistics and Correlation Matrix, 1937-20101

	$R_{Q1\text{-}Q5,Excl\ Zero\text{-}Div}$	$R_{Q1\text{-}Q5,Incl\ Zero\text{-}Div}$	$R_{Q1\text{-}Rm}$	dOld/Pop	dOld/PSavers	R_m - R_f	SMB	HML	R	RLong	dCPI/dt	dC/dt	YC	dR
Unit root test														
KPSS: Level stationarity	0.258	0.347*	0.410*	0.275	0.254	0.162	0.193	0.095	0.303	0.331	0.171	0.097	0.161	0.225
KPSS: Trend stationarity	0.089	0.080	0.076	0.063	0.102	0.071	0.079	0.090	0.126*	0.111	0.102	0.094	0.148**	0.147**
Correlation matrix														
$R_{Q1\text{-}Q5,Excl\ Zero\text{-}Div}$	1.000	0.933**	0.871**	0.337**	0.297**	0.086	0.096	0.653**	-0.272**	-0.239**	0.163	0.240**	0.332**	-0.086
$R_{Q1\text{-}Q5,Incl\ Zero\text{-}Div}$	0.933**	1.000	0.854**	0.286**	0.257**	0.131	-0.043	0.558**	-0.177	-0.144	0.119	0.179	0.256**	-0.119
$R_{Q1\text{-}Rm}$	0.871**	0.854**	1.000	0.427**	0.400**	-0.012	0.287**	0.514**	-0.272**	-0.270**	0.046	0.279**	0.250**	0.011
dOld/Pop	0.337**	0.286**	0.427**	1.000	0.893**	-0.322**	0.491**	0.243**	-0.029	-0.131	0.259**	0.091	-0.219*	0.268**
dOld/Psavers	0.297**	0.257**	0.400**	0.893**	1.000	-0.213*	0.406**	0.292**	-0.106	-0.265**	0.245**	0.149	-0.414**	0.519**
R_m - R_f	0.086	0.131	-0.012	-0.322**	-0.213*	1.000	-0.355**	0.150	-0.388**	-0.342**	-0.111	-0.047	0.309**	0.042
SMB	0.096	-0.043	0.287**	0.491**	0.406**	-0.355**	1.000	0.055	-0.014	-0.045	0.114	0.019	0.058	0.096
HML	0.653**	0.558**	0.514**	0.243**	0.292**	0.150	0.055	1.000	0.121	0.093	0.597**	0.350**	-0.095	0.259**
R	-0.272**	-0.177	-0.272**	-0.029	-0.106	-0.388**	-0.014	0.121	1.000	0.974**	0.680**	-0.019	-0.593**	0.048
RLong	-0.239**	-0.144	-0.270**	-0.131	-0.265**	-0.342**	-0.045	0.093	0.974**	1.000	0.627**	-0.041	-0.402**	-0.133
dCPI/dt	0.163	0.119	0.046	0.259**	0.245**	-0.111	0.114	0.597**	0.680**	0.627**	1.000	0.181	-0.438**	0.343**
dC/dt	0.240**	0.179	0.279**	0.091	0.149	-0.047	0.019	0.350**	-0.019	-0.041	0.181	1.000	-0.038	0.188
YC	0.332**	0.256**	0.250**	-0.219*	-0.414**	0.309**	0.058	-0.095	-0.593**	-0.402**	-0.438**	-0.038	1.000	-0.610**
dR	-0.086	-0.119	0.011	0.268**	0.519**	0.042	0.096	0.259**	0.048	-0.133	0.343**	0.188	-0.610**	1.000

*Note: Significance levels: ** = 5%, * = 10%. The KPSS test employs a Newey-West type variance estimator of the long-run variance of u(t), with truncation lag m = [c.n^s] where c=5, s=.25, n=74.*

Table 3: Regressions of Long-Run Returns of Dividend-Yield Investment Strategies against Annual Change in Old-to-Population Ratio and Control Variables, 1937-2011

Multivariate regressions of various long-run returns of dividend-yield investment strategies against demographic variation and the control variables of Fama-French factors, inflation rate and consumption growth rate.

$$R_{Q1\text{-}Q5,t} = \alpha_0 + \alpha_1\, dOld/Population_t + \alpha_2\, ControlVar_t + \varepsilon_t$$

The long-run returns of the dividend-yield investment strategy $R_{Q1\text{-}Q5}$ is the ten-year cumulative return of a zero-cost long-short directionally neutral portfolio comprising of long and short positions in the highest (Q1) and lowest (Q5) quintiles of stocks ranked by dividend yield respectively. The demographic variation measure is given by *dOld/Population* which represents the annual change in old-to-population ratio. *ControlVar* represents the relevant control variable that is used in the robustness checks.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Long-short directionally neutral											
	Ten-year cumulative excess returns			*Ten-year cumulative excess returns*			*Ten-year cumulative excess returns*			*Ten-year cumulative excess returns*		
Dependent variable	$R_{Q1\text{-}Q5}$		$R_{Q1\text{-}Rm}$	$R_{Q1\text{-}Q5}$		$R_{Q1\text{-}Rm}$	$R_{Q1\text{-}Q5}$		$R_{Q1\text{-}Rm}$	$R_{Q1\text{-}Q5}$		$R_{Q1\text{-}Rm}$
	Excl zero-div	*Incl zero-div*		*Excl zero-div*	*Incl zero-div*		*Excl zero-div*	*Incl zero-div*		*Excl zero-div*	*Incl zero-div*	
Explanatory variables												
dOld/Population	222.370	204.156	163.766	149.358	201.912	102.444	209.446	206.707	182.102	211.050	208.242	169.492
	(2.740)***	(2.134)**	(3.145)***	(2.611)**	(2.783)***	(2.333)**	(2.535)**	(2.233)**	(3.540)***	(2.867)***	(2.286)**	(3.938)***
Fama-French: R_m - R_f	-	-	-	0.024	0.036	0.015	-	-	-	-	-	-
	-	-	-	(0.561)	(0.694)	(0.541)	-	-	-	-	-	-
Fama-French: SMB	-	-	-	-0.018	-0.132	0.062	-	-	-	-	-	-
	-	-	-	(0.886)	(-0.887)	(0.632)	-	-	-	-	-	-
Fama-French: HML	-	-	-	0.514	0.458	0.218	-	-	-	-	-	-
	-	-	-	(4.824)***	(3.226)***	(2.593)**	-	-	-	-	-	-
dCPI/dt	-	-	-	-	-	-	0.098	0.057	-0.054	-	-	-
	-	-	-	-	-	-	(0.437)	(0.232)	(-0.507)	-	-	-
dC/dt	-	-	-	-	-	-	-	-	-	1.093	0.849	0.702
	-	-	-	-	-	-	-	-	-	(1.201)	(1.021)	(1.878)*
Constant	-0.641	-4.295	8.495	-28.783	-31.669	-4.263	-3.810	-6.525	9.826	-27.831	-25.669	-9.203
	(-0.117)	(-0.455)	(2.246)**	(-4.217)***	(-2.852)***	(-0.972)	(-0.449)	(-0.5738)	(2.186)**	(-1.240)	(1.211)	(-0.943)
R-squared	0.114	0.082	0.183	0.464	0.372	0.379	0.119	0.092	0.214	0.158	0.116	0.276
No. of observations	75	75	75	75	75	75	74	74	74	73	73	73

*Note: T-statistics are shown in parentheses and are based on the Newey-West (1987) heteroscedasticity and autocorrelation consistent variance matrix. Significance levels: *** = 1%, ** = 5%, * = 10%.*

Table 4: Regressions of Long-Run Returns of Dividend-Yield Investment Strategies against Annual Change in Old-to-Population Ratio and Control Variables, 1937-2011

Multivariate regressions of various long-run returns of dividend-yield investment strategies against demographic variation and the control variables of Fama-French factors, inflation rate and consumption growth rate.

$$R_{Q1\text{-}Q5,t} = \alpha_0 + \alpha_1\, dOld/Population_t + \alpha_2\, ControlVar_t + \varepsilon_t$$

The long-run returns of the dividend-yield investment strategy $R_{Q1\text{-}Q5}$ is the ten-year cumulative return of a zero-cost long-short directionally neutral portfolio comprising of long and short positions in the highest (Q1) and lowest (Q5) quintiles of stocks ranked by dividend yield respectively. The demographic variation measure is given by *dOld/Population* which represents the annual change in old-to-population ratio. *ControlVar* represents the relevant control variable that is used in the robustness checks.

	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
	Long-short directionally neutral											
	Ten-year cumulative excess returns			*Ten-year cumulative excess returns*			*Ten-year cumulative excess returns*			*Ten-year cumulative excess returns*		
Dependent variable	$R_{Q1\text{-}Q5}$		$R_{Q1\text{-}Rm}$	$R_{Q1\text{-}Q5}$		$R_{Q1\text{-}Rm}$	$R_{Q1\text{-}Q5}$		$R_{Q1\text{-}Rm}$	$R_{Q1\text{-}Q5}$		$R_{Q1\text{-}Rm}$
	Excl zero-div	*Incl zero-div*		*Excl zero-div*	*Incl zero-div*		*Excl zero-div*	*Incl zero-div*		*Excl zero-div*	*Incl zero-div*	
Explanatory variables												
dOld/Population	217.417	200.717	160.913	205.278	194.069	152.877	283.990	256.443	194.148	255.758	244.574	175.267
	(2.965)***	(2.191)**	(3.415)***	(2.922)***	(2.158)**	(3.336)***	(3.087)***	(2.445)**	(3.389)***	(2.975)***	(2.384)**	(3.054)***
R	-0.216	-0.150	-0.124	-	-	-	-	-	-	-	-	-
	(-1.479)	(-0.822)	(-1.732)*	-	-	-	-	-	-	-	-	-
RLong	-	-	-	-0.177	-0.104	-0.113	-	-	-	-	-	-
	-	-	-	(-1.103)	(-0.499)	(-1.424)	-	-	-	-	-	-
YC	-	-	-	-	-	-	2.160	1.833	1.065	-	-	-
	-	-	-	-	-	-	(2.527)**	(2.136)**	(2.445)**	-	-	-
dR	-	-	-	-	-	-	-	-	-	-2.099	-2.524	-0.718
	-	-	-	-	-	-	-	-	-	(-1.650)*	(-1.506)	(-0.996)
Constant	13.635	5.616	16.720	13.765	4.206	17.673	-20.557	-21.195	-1.324	-3.999	-8.364	7.338
	(1.306)	(0.445)	(2.937)***	(1.035)	(0.261)	(2.514)**	(-2.201)**	(-1.759)*	(-0.230)	(-0.701)	(-0.955)	(1.808)*
R-squared	0.183	0.110	0.250	0.153	0.094	0.229	0.287	0.189	0.307	0.147	0.123	0.194
No. of observations	75	75	75	75	75	75	75	75	75	75	75	75

*Note: T-statistics are shown in parentheses and are based on the Newey-West (1987) heteroscedasticity and autocorrelation consistent variance matrix. Significance levels: *** = 1%, ** = 5%, * = 10%.*

Table 5: Regressions of Long-Run Returns of Dividend-Yield Investment Strategies against Annual Change in Old-to-Population Ratio and Control Variables, 1937-2011

Multivariate regressions of various long-run returns of dividend-yield investment strategies against demographic variation and the control variables of Fama-French factors, inflation rate and consumption growth rate.

$$R_{Q1\text{-}Q5,t} = \alpha_0 + \alpha_1\, dOld/Population_t + \alpha_2\, ControlVar_t + \varepsilon_t$$

The long-run returns of the dividend-yield investment strategy $R_{Q1\text{-}Q5}$ is the ten-year cumulative return of a zero-cost long-short directionally neutral portfolio comprising of long and short positions in the highest (Q1) and lowest (Q5) quintiles of stocks ranked by dividend yield respectively. The demographic variation measure is given by *dOld/Population* which represents the annual change in old-to-population ratio. *ControlVar* represents the relevant control variable that is used in the robustness checks.

	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)
	Long-short directionally neutral											
	Ten-year cumulative excess returns			*Ten-year cumulative excess returns*			*Ten-year cumulative excess returns*			*Five-year cumulative excess returns*		
Dependent variable	$R_{Q1\text{-}Q5}$		$R_{Q1\text{-}Rm}$	$R_{Q1\text{-}Q5}$		$R_{Q1\text{-}Rm}$	$R_{D1\text{-}D10}$		$R_{D1\text{-}Rm}$	$R_{Q1\text{-}Q5}$		$R_{Q1\text{-}Rm}$
	Excl zero-div	*Incl zero-div*		*Excl zero-div*	*Incl zero-div*		*Excl zero-div*	*Incl zero-div*		*Excl zero-div*	*Incl zero-div*	
Explanatory variables												
dOld/Population	170.585	106.116	99.705	-	-	-	493.960	366.111	306.424	156.620	180.374	83.057
	(2.384)**	(1.239)	(2.106)**	-	-	-	(4.523)***	(3.324)***	(5.887)***	(1.855)*	(2.182)**	(1.398)
dOld/PSavers	-	-	-	22.950	21.503	18.007	-	-	-	-	-	-
	-	-	-	(2.120)**	(1.642)*	(3.176)***	-	-	-	-	-	-
t	-0.328	-0.620	-0.405	-	-	-	-	-	-	-	-	-
	(-0.900)	(-1.788)*	(-2.398)**	-	-	-	-	-	-	-	-	-
Constant	650.836	1229.085	814.409	14.914	9.895	19.720	-27.267	-26.574	-10.142	-2.933	-7.380	3.957
	(0.899)	(1.786)*	(2.422)**	(2.317)	(1.200)	(5.447)***	(-3.754)***	(-2.276)**	(-1.921)*	(-0.359)	(-0.918)	(0.646)
R-squared	0.139	0.158	0.294	0.088	0.066	0.160	0.236	0.155	0.389	0.066	0.078	0.046
No. of observations	75	75	75	75	75	75	75	75	75	75	75	75

*Note: T-statistics are shown in parentheses and are based on the Newey-West (1987) heteroscedasticity and autocorrelation consistent variance matrix. Significance levels: *** = 1%, ** = 5%, * = 10%.*