Demographics and Asset Returns in Japan

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Abstract

Theory predicts that changes in demographics affect excess returns. This paper investigates whether this prediction from theory is empirically relevant. We construct demographic indicators from long-term Japanese demographic data and measure the predictive content of these indicators in regressions on equity and bond excess return data. We then assess the quantitative significance of the measured predictability by verifying whether trading on these indicators enhances portfolio returns for risk-averse investors. We find that demographics are important predictors of excess returns.

Section 1 Introduction

In the past decade Japan has experienced a steady decline in the price of equity. Individuals who put their savings in a simple savings account in 1983 would have realized a higher return than those who bought the Nikkei in 1983 and sold it in April of 2004. A second fact that has received considerable attention is the aging of the Japanese population. Birth rates have fallen by 1% and life expectancy has increased (see e.g. Braun, Joines and Ikeda (2003)). Finally, if we measure a baby boom by the fraction of the total population between 40-64, then Japan is the first industrialized country to have seen its baby boom peak.

One hypothesis is that there is a causal relationship between the negative realized equity premium and the aging of the Japanese. This hypothesis has a basis in economic theory. Campbell and Viceira (2002) consider partial equilibrium optimal asset allocation strategies for lifecycle individuals and find that allocations to different asset classes vary significantly over the lifecycle. Young individuals hold large shares of an implicitly riskless future labor income asset and equity then gradually shift toward bonds as they age. Storresletten, Telmer and Yaron (2001) consider a general equilibrium overlapping-generations model. Their model, which treats labor income as being risky, predicts that households accumulate equity as they move towards middle age and then gradually deccumulate equity and acquire bonds as they reach retirement. Their general equilibrium model accounts for both the average equity premium and the Sharpe ratio in U.S. data. Donaldson and Maddaloni (2000), and Luo (2000) consider overlapping-generations models with population growth. Donaldson and Maddaloni (2000) find that the risk premium on equity falls with the population growth rate. But their calibrations suggest that the magnitude of this effect is small. Luo (2000) finds that aggregate hedging demand for equity falls as the share of 40-64 year olds in the total population rises. Including the change in the share of 40 to 64 year olds improves the forecasting performance of nonlinear regressions of equity excess returns on standard financial variables using post WWII US data.

The goal of this paper is to empirically assess whether changes in demographics also induce predictable variations in excess returns on bonds and equity using Japanese data. We extend the previous research in this field by constructing long time-series that run from 1920 to 2001 and by comparing the performance of active portfolios that trade on demographic indicators with several passive benchmark portfolios. Since demographics only change very gradually over time longer time-series are helpful in detecting predictability. Our comparison of active portfolios with passive portfolios has several motivations. First, it provides a way to check whether regression based evidence of predictability is spurious or not. Second, the literature surveyed above has found that anticipated changes in demographics affect excess returns on risky assets. Even though this literature focuses on anticipated changed in demographics, the results suggest that shocks to demographics are likely to be important sources of aggregate risk.[1] As noted in e.g. Cochrane (1999) predictability is a market mechanism for compensating investors for holding assets that are correlated with aggregate risk factors. If demographic variation is an aggregate risk factor, then trading on demographic indicators should enhance returns.

[1] Rios (2001) is the only example we know of that considers demographic shocks in an general equilibrium overlapping generations model, but Rios doesn't look at the properties of excess returns.

Our analysis proceeds by constructing long time-series on excess returns of bonds and equity over risk free rates. In order to assess the predictability hypothesis, we project excess returns on demographic variables. The results from these forecasting regressions indicate that demographic variables predict bond excess returns in pre WWII and post WWII data. Moreover, the information content provided by demographic variables is independent of the information in historical excess returns. Demographic variables are less important in predicting movements in excess returns in equity.

As a second step we conduct a quadratic asset allocation exercise to investigate whether the measured predictability from these regressions actually rewards investors who take on these risks. The resulting asset allocation rules are optimal for myopic investors with quadratic objectives defined over risk and return. Moreover, as Viceira and Campbell (2002) note, myopic asset allocation rules are also optimal dynamic allocation rules for risk-averse investors with constant relative risk aversion when consumption growth and returns are log-normal and the consumption wealth ratio is constant.

For pre WWII data we find that active portfolios that trade on demographic indicators out-perform a buy and hold portfolio of equities only for investors with moderate degrees of risk aversion. In addition, active portfolios of cash and bonds match the performance of a buy and hold portfolio consisting of only corporate bonds.

Active portfolios that trade on demographic indicators also do well in post WWII data. In most cases, trading on demographic indicators in portfolios of cash, equity and bonds enhances expected returns and produces about the same Sharpe ratios as comparable allocation schemes that omit demographic information.

The remainder of the paper is organized as follows. Section 2 reports regression results on predictability. Section 3 reports results on asset allocation. And Section 4 concludes.

Section 2 Using demographic variables to predict asset returns

In this section we report regression results from projecting demographic variables on excess returns for bonds and equity using annual data running from 1920 through 2001. World War II creates a break in our dataset. To deal with this problem we divide our sample into two sub-samples: 1920 through 1940 and 1952 through 2001.[2]

Equity returns and bond returns are converted into excess returns over a risk free rate. Details on the construction of these variables are reported in the data appendix. Next we project demographic variables on respectively the one-year ahead excess equity return and excess bond return using a recursive OLS estimation strategy. The first one-step ahead forecast is produced conditioning on the first 10 observations. Then subsequent one step ahead forecasts are produced by adding one new observation and re-estimating the parameters of the forecasting equation via OLS. We assess the predictive content of a set of candidate variables using Theil ratios which are defined as the ratio of the root mean squared error from the predictive model over the root mean squared error of a no change forecast which is taken here to be a constant mean model of the excess return.

[2] Equities were traded in Japan up until one week before the end of WWII. However, this data has not been compiled into an index. Equity markets did not formally reopen until May 1949. These disruptions make it difficult to include the period 1941-1951 in our analysis.

More information on how the recursive forecasts and Theil ratios are constructed can be found in the data appendix.

We initially experimented with individual demographic variables and combinations of these variables used in previous studies. Variables such as the average age of the population (see Bakshi and Chen (1994)), and changes in the proportion of retired adults (see Ang and Maddaloni (2002)) do not produce results of predictability that are consistent across sub-samples and also enhance returns in active portfolios that traded on this information.

We next investigate whether the joint information in a large list of demographic variables might offer more information. We estimate common factors using principal components of the log-levels of 9 population age-group categories. Although the population data is in levels, by taking logarithms we allow for changes in demographics.[3]

Table 1 reports the factor sensitivities and percent variance explained by the first 5 principal components estimated from the pre WWII and post WWII subsamples.[4] Considering first the upper panel of Table 1 we see that the first two principal components explain over 90% of the variation in these data. The first principal component shifts up the entire population distribution and can be interpreted as reflecting overall movements in the level of population. The second principal component resembles a butterfly or curvature factor.

Demographic patterns in post WWII data are more complicated. Here three principal components are needed to account for more than 90% of the data. Now the first principal component only captures 72% of the overall variation in the data and has a butterfly shape. The remaining principal components don't have any readily discernible pattern.

Next we report the forecasting performance of regressions that condition on these demographic variables. Table 2 reports results for three forecasting models of excess bond returns and three forecasting models of excess equity returns. In each instance, the forecasting results are based on regressing the excess return variable from period t to $t+1$ on the following three sets of right hand side variables:

> *Demographic model* – the period t-1 values of the first three principal components reported in Table 1.
>
> *Financial model* – the period t value of the respective excess return.
>
> *Demographic and financial model* – the period t-1 values of the first three principal components reported in Table 1 and the period t value of the respective excess return.

The dating of the demographic variables in the regressions reflects the fact that period t values of these variables were not in agents' time t information set.

[3] For instance, since this year's 2 year olds were one year 1 year old last year our choice of variables reflects log growth rates of 1 year olds.

[4] When constructing the one step ahead forecasts we also re-estimated the common factors as we added each new observation. However, the principal components reported in Table 1 use all observations from the respective sub-sample.

Consider the results for bonds. In pre WWII data there is considerable evidence that demographic variables have predictive content for bonds. The bonds regression labeled *Demographic model,* outperforms a no change forecast by about 25% and produces an $\bar{R}^2$ of 0.63.[5] The *demographic and financial model* performs even better with a Theil Ratio of 0.71 and the best forecasting model for bonds in this sub-sample is the *financial model* which produces a Theil Ratio of 0.64. In post WWII data the best bonds model is the *demographic model*. It outperforms the no change model as well as the *financial* and *demographic and financial* models. Finally, note that all of the bonds forecasting models produce forecasts that are positively correlated with the actuals.

There is less evidence that demographic variables help predict excess returns on equity. In the pre WWII sub-sample, the Theil ratio for the *demographic model* specification is larger than one. This specification outperforms the *demographics and financial model* but underperforms the equity *financial model*. All three forecasting models have negative $\bar{R}^2$'s and produce negative correlations between predicted and actual excess returns. Turning next to the Post WWII sub-sample we see that the pattern of results is similar. Once again the equity *demographic model* outperforms the *demographic and financial model* but underperforms relative to the *financial* model. The *financial model* is the only specification that outperforms the no change model.

Overall, these results suggest that demographic indicators help predict excess returns on bonds. However, there is considerably less evidence that demographics help predict excess returns on equity. We are not particularly, concerned by this result as it may reflect measurement error in population estimates. As noted in e.g. Cochrane (2001, pg.127-8), horse races between specifications that include macroeconomic factors and financial specifications are likely to favor financial specifications since financial variables are more accurately measured.

Section 3 Asset allocation and market price of risk

In this section we assess the quantitative relevance of the regression results by comparing the performance of active portfolios that trade on our demographic signals versus passive buy and hold strategies. The active equity portfolios are constructed by solving a sequence of myopic quadratic portfolio choice problems for either three assets, cash, bonds and equity or two assets – equity versus cash or bonds versus cash. To find the optimal portfolio weights in period t we need conditional expected excess returns as of period t, the conditional expected covariance matrix of excess returns as of period t and a value for the risk aversion coefficient, k. We use the one step ahead forecasts of excess returns on bonds and equity described in Section 2 to measure conditional expected excess returns. We also assume conditional homoscedasticity and estimate the conditional expected covariance matrix as of period t from the sample covariance matrix calculated using all historical data available at the beginning of period t. Below we report results for a range of values for k. More details on the construction of the optimal portfolio weights are available in the data appendix.

[5] The $\bar{R}^2$ reported here uses all of the observations from the respective subsample. See the data appendix for details.

Table 3 contains results for the *demographic model* and two passive buy and hold strategies: a 100% allocation to bonds in each period and a 100% allocation to equity in each period. Absent short-selling constraints the optimal portfolios involve shorting equity and longing bonds. Since such borrowing opportunities were not possible for large parts of our sample period, we choose to constrain the portfolio weights on equity and bonds to be non-negative and less than one.

Consider first the pre WWII sub-sample. During this period the annual excess return from buying and holding equity was 3.84% with a Sharpe ratio of 0.26. The excess return for a 100% allocation to bonds was 1.35% and its Sharpe ratio was 1.70. Table 3 also reports optimal portfolio allocations with the risk aversion coefficient *k* ranging from one to 5000. For levels of the risk aversion coefficient of 5 or less, the optimal portfolios outperform the buy and hold equity portfolio both in terms of portfolio excess returns and in terms of the Sharpe ratio. For higher levels of risk aversion, the optimal portfolios assign less weight to equity and portfolio returns fall. The results are qualitatively the same when we calculate optimal portfolios of equity and cash only. Overall, these results indicate that for moderately risk averse investors, active portfolios that trade on demographic indicators outperform a reference portfolio of buying and holding equity.

Suppose instead that the reference portfolio is a 100% allocation to bonds in each and every period. Relative to this reference, optimal portfolios of cash, equity, and bonds produce higher expected returns for $k<5000$ but *lower* Sharpe ratios. To get some insight into why demographic variables are producing lower Sharpe ratios than the bonds benchmark portfolio, consider the optimal portfolios of bonds and cash only. These two-asset optimal portfolios produce the same expected returns and Sharpe ratios as the reference portfolio when *k* is between 1 and 10. But no optimal portfolio outperforms bonds.

The reason why the optimal two asset portfolios don't outperform the reference portfolio of bonds only can be seen by inspection of Figure 1. Figure 1 reports excess returns for bonds and equity in the pre WWII period. Notice that the excess return on bonds over cash is positive in each and every period of this sub-sample. Given this pattern of actual excess returns the best that a two-asset allocation rule between bonds and cash can do during this period is to allocate 100% of wealth to bonds in each and every period.[6]

Consider next results for the post WWII period. The three asset optimal portfolios continue to outperform a reference portfolio of equity when *k* is one or two. Trading on demographic indicators offers moderately risk averse investors higher excess returns and higher Sharpe ratios relative to the alternative of a 100% allocation to equity. When *k* is five or ten, excess returns on the optimal portfolios are lower than a passive position in equity but the Sharpe ratios are higher. A comparison of the two-asset active equity portfolios with the passive equity portfolio suggests that only a small amount of this performance gain can be attributed to forecasting the equity premium. When k=1 the two-asset optimal portfolio produces only slightly higher returns (6.35%) than the passive portfolio (6.26%) and a slightly higher Sharpe ratio (0.28 versus 0.24). For settings of k>2, however, the passive portfolio does better along both dimensions.

[6] We also considered other combinations of bond return and cash data and excess returns on bonds were also uniformly positive during the pre WWII period.

The three asset optimal portfolios now also outperform the reference portfolio of bonds. For all settings of k less than 5000, investors benefit from higher excess returns and higher Sharpe ratios when trading on demographic indicators. Inspection of the two-asset optimal bond portfolios shows that demographic indicators are providing valuable information on future bond returns. For all settings of $k< 5000$, the active optimal cash and bonds portfolio produces higher returns and higher Sharpe ratios than the passive bond portfolio. And the magnitude of the gains are quite substantial e.g. when $k=1$, the active two-asset bond portfolio outperforms the passive bonds portfolio by 0.95% per annum. These results are consistent with Figure 2 which reports excess returns on bonds and equity for Post WWII data. In this sub-sample the excess return on bonds crosses zero many times.

Overall the results in Table 3 indicate that the measured predictability from the regressions is systematic and quantitatively important. In the post WWII period trading on demographic indicators enhances returns for moderately risk averse households by as much as 2.25% per annum as compared to a passive buy and hold position of equity and as much as 7% per annum as compared to a passive bond portfolio.

There is a possibility though that demographic variables are proxying for other indicators that have been left out of the forecasting equation. In order to investigate this possibility we compare the performance of two three-asset active portfolios that include financial indicators. The *financial model* estimates the excess return for equity and bonds using respectively the equity and bonds *financial* forecasting models reported in Section 3. The covariance matrix is estimated in the same way as before. The *demographic and financial model* estimates the excess returns on equity and bonds using the *demographic and financial models* reported in Section 3.

Optimal portfolios for these two models are reported in Table 4. In the pre WWII period when $k=1$, both models do equally well. When $k=2$, the *demographic* model, which is reported in Table 3, turns in higher portfolio returns than either of these models. For higher settings of the risk aversion parameter the *demographic and financial model* performs slightly better than the *demographic model.* The *demographic model* produces higher returns than the *financial* model but lower Sharpe ratios.

The results for post WWII data are somewhat stronger. We see that for $k=1$, the *financial* model produces higher returns than the other two models, but a lower Sharpe ratio. For $k=\{2,5\}$, however, the *demographic* model has the highest returns. Then for $k=10$, the *demographic and financial model* is the best performing model. Overall, these results indicate that demographic indicators do contribute to overall portfolio returns even when financial indicators are included in the forecasting model.

Section 4 Conclusion

In this paper we have used long-term Japanese data to measure the predictive content of demographic indicators in explaining excess returns of bonds and equity. Our regression results indicate that demographic indicators help predict future bond excess returns in both pre and post WWII data. However, the regression results do not show much evidence that demographic variables help predict equity excess returns.

We have also found that trading on demographic indicators enhances returns for investors with moderate risk aversion relative to several benchmark buy and hold portfolios and also relative to other active portfolios that trade on the basis of financial signals only. Optimal portfolios that trade on this information increase returns by as much as 2.5% per annum in post WWII data as compared to buy and hold positions of equity and increase returns by as much as 7% per annum as compared to buy and hold positions of bonds. Taken together the evidence presented here indicates that demographics are important predictors of future bond returns. The role of demographics in explaining equity returns, however, is less clear and is the subject of our current research.

Appendix

In this appendix we describe how we construct the data, estimate the regressions and calculate the optimal portfolio weights.

Asset Return Data

For the pre WWII period, the stock return is P1(L) Rate of Yield on Equity Shares (Y3) of All Industries based on price index of equity shares (base year 1914-1916) from page 294 of Fujino and Akiyama (1977). The bond return is Corporate Bonds (P(L)) from Table 12-2 Rate of Yields on Bonds (i1) – Based on Price Index of Bonds (Base Years = 1934~1936) –(Unit : %) on page 387 of Fujino and Akiyama (1977). The risk free rate is from Table 14-A30 Interest0Rate on Postal Ordinary Savings on page 549 of Fujino and Akiyama (1977).

For the post WWII period, the stock return, bond return and risk free return are taken from the "Stock, Bonds, Money & Inflation – Japan" series of the Ibbotson Associates Japan database. The stock return is the value weighted total return on the First Section of the Tokyo Stock Exchange. The bond return is the return on government bonds with an approximate maturity of 10 years. The risk free return is the daily average of overnight call money rates.

Population Data

The population data was taken from the following annals:

1920-1939: Population Estimate Series (Population by Prefecture and five-year age group, 1956)
1940: Japan Statistical Yearbook for corresponding years
1947-1949: Population Estimate Series (Population by Prefecture and five-year age group, 1956)
1950: Japan Statistical Yearbook for corresponding years
1951-1977: Population Estimate Series for corresponding years
1978-1999: Japan Statistical Yearbook for corresponding years
2000-2001: Population Estimate Series for corresponding years
.

Construction of the Principal Components

For the pre WWII and post WWII period, we report the first five principal components from nine series of demographic variables. First, we collected nine series of observations on the annual level of population between 0 and 9 (pop09), 10 and 19 (pop1019),…,70 and 79 (pop7079) and 80 and beyond (pop80p) between 1920 and 1940 for pre WWII period and between 1952 and 2001 for post WWII period.

Second, for each year, five principal components, PC1(t), PC2(t), PC3(t), PC4(t) and PC5(t), are estimated from the log of pop09(t), pop1019(t), pop2029(t), pop3039(t), pop4049(t), pop5059(t), pop6069(t), pop7079(t), pop80p(t).

The one-step ahead forecasting regression

For the pre and post WWII period we will only explain the case for equity excess returns, as those for excess bond returns are derived in a similar manner.

First, we estimate the following one-step ahead regression using the first eleven observations of data:

$$R_{t+1}{}^{e} - R_{t+1}{}^{f} = a_0 + a_1 PC1_t + a_2 PC2_t + a_3 PC3_t + \varepsilon_t \qquad \text{(A1)}$$

Second, we construct the one-step ahead forecast for excess return at period *t+1* with the following formula:

$$(\widehat{R_{t+1}{}^{e} - R_{t+1}{}^{f}}) = \widehat{a_0} + \widehat{a_1} PC1_t + \widehat{a_2} PC2_t + \widehat{a_3} PC3_t \qquad \text{(A2)}$$

using the estimated coefficients from (A1). Third, we repeat the above procedure by adding one additional observation, re-estimating regression (A1) and producing a new 1 step ahead forecast using (A2). The result is a series of one step ahead forecasts for equity excess returns

$$(\widehat{R_{12}{}^{e} - R_{12}{}^{f}}, \widehat{R_{13}{}^{e} - R_{13}{}^{f}}, ..., \widehat{R_{T}{}^{e} - R_{T}{}^{f}})^{T}.$$

Theil ratio

Root mean squared error for the regressions and root mean squared error for the no change model are derived as follows

$$RMSE = \sqrt{\frac{\sum_{i=12}^{T} \{\widehat{R_i^e - R_i^f} - (R_i^e - R_i^f)\}^2}{T - 12 + 1}}$$

$$RMSE_{no\ change} = \sqrt{\frac{\sum_{i=12}^{T} [\{ \frac{1}{i-1} \sum_{k=1}^{i-1} (R_k{}^{e} - R_k{}^{f})\} - (R_i{}^{e} - R_i{}^{f})]^2}{T - 12 + 1}}$$

The Theil ratio is defined as the root mean squared error for each model divided by the root mean squared error for the no change model.

Optimal Asset Allocation

We consider three asset (equity, bonds and risk free) and two asset (equity vs risk free and bond vs risk free) optimal asset allocation problems for risk averse investors with a mean-variance utility function. The optimization problem for the three asset case in each period can be written as follows:

$$\max_{a_t^e, a_t^b} [\begin{pmatrix} a_t^e & a_t^b \end{pmatrix} \begin{pmatrix} E_t R^e{}_{t+1} - R^f{}_{t+1} \\ E_t R^b{}_{t+1} - R^f{}_{t+1} \end{pmatrix} - \frac{1}{2} k \begin{pmatrix} a_t^e & a_t^b \end{pmatrix} \begin{pmatrix} (\sigma_t{}^e)^2 & \sigma_t^{eb} \\ \sigma_t^{eb} & (\sigma_t{}^b)^2 \end{pmatrix} \begin{pmatrix} a_t{}^e \\ a_t{}^b \end{pmatrix} | \Omega_t]$$

where $(a_t{}^e, a_t{}^b)$ are the weights on equity and bond at time t, $E_t R^e{}_{t+1} - R^f{}_{t+1}$ and $E_t R^b{}_{t+1} - R^f{}_{t+1}$ are conditional expected excess return on equity and bond at time t, and $(\sigma_t{}^e)^2$, $\sigma^{eb}{}_t$, $(\sigma^b{}_t)^2$ are the conditional variance for the excess return on equity, the conditional covariance between the excess equity return and excess bond return, and the conditional variance for the excess bond return at time *t*, respectively. The weight on the risk free asset is $1 - a_t{}^e - a_t{}^b$. We put the following constraints on the weights $0 \le a_t{}^e, \quad a_t{}^b \le 1$.

The weight on risk free asset is not constrained. Optimal portfolios for the case where the only constraint is that $a^e + a^b \leq 1$ are available from the author upon request.

For each period, we solved the above optimization problem by substituting the conditional expected excess returns with those forecasted from the appropriate regression model and by substituting the conditional variance and covariance by using the variance covariance matrix of historical data available at the start of period *t*. Optimal portfolios for the two-asset models are calculated in a similar way.

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Table 1
Principal components estimation of demographic variables for population levels

Factor sensivitities				
first eigenvector	second eigenvector	third eigenvector	fourth eigenvector	fifth eigenvector
0.973	0.210	0.073	0.052	0.012
0.993	-0.090	-0.006	-0.030	0.001
0.944	0.271	0.036	-0.157	-0.075
0.985	0.051	-0.145	0.048	-0.041
0.928	-0.300	-0.111	-0.175	0.073
0.960	0.253	0.095	0.009	0.016
0.913	-0.178	-0.349	0.108	-0.032
0.829	-0.433	0.346	0.051	-0.047
0.976	0.140	0.089	0.095	0.086
0.895	0.953	0.986	0.995	0.998

Factor sensivitities				
first eigenvector	second eigenvector	third eigenvector	fourth eigenvector	fifth eigenvector
0.792	0.131	0.438	0.389	0.111
0.622	-0.636	0.207	-0.389	0.114
-0.418	0.822	0.183	-0.334	0.069
-0.686	-0.126	0.690	-0.051	-0.183
-0.944	-0.084	0.218	0.072	0.215
-0.977	-0.195	-0.025	0.069	0.002
-0.993	-0.064	-0.086	-0.007	0.043
-0.989	-0.093	-0.061	0.091	-0.006
-0.984	-0.126	-0.112	0.023	0.014
0.716	0.847	0.938	0.987	0.999

Table 2

One-Step Ahead Forecast for Excess Returns from Demographic, Demographic and Financial and Financial Models

1930-1939	$\bar{R}^2$	Root Mean Squared Error	Theil Ratio	RMSE no-change	correlation between forecast and actual excess return
BONDS					
Demographic model	0.629	0.00579	0.75106	0.0077	0.258
demographic and financial model	0.681	0.00550	0.71413	0.0077	0.337
financial model	0.646	0.00495	0.64251	0.0077	0.441
EQUITY					
Demographic model	-0.082	0.15976	1.25880	0.1269	-0.635
demographic and financial model	-0.153	0.18470	1.45535	0.1269	-0.543
financial model	-0.050	0.14650	1.15431	0.1269	-0.489

1962-2001	$\bar{R}^2$	Root Mean Squared Error	Theil Ratio	RMSE no-change	correlation between forecast and actual excess return
BONDS					
Demographic model	0.115	0.06724	0.99818	0.06736	0.119
demographic and financial model	0.096	0.06939	1.03017	0.06736	0.136
financial model	0.019	0.06840	1.01553	0.06736	0.116
EQUITY					
Demographic model	-0.014	0.29052	1.02135	0.28445	-0.073
demographic and financial model	-0.026	0.29861	1.04980	0.28445	-0.088
financial model	-0.019	0.28093	0.98762	0.28445	-0.252

Table 3

Mean Excess Retuns and Sharp Ratios for Demographic Model and Passive Model

Sample Period: 1930-1939	Mean Excess Return	Sharpe Ratio
100% equity	3.84%	0.26
100% bond	1.35%	1.70
50% equity , 50% bond	2.60%	0.36
3 asset demographic model		
k=1	5.47%	0.60
k=2	5.43%	0.59
k=5	4.05%	0.59
k=10	3.20%	0.67
k=5000	0.13%	0.17
2 asset demographic model, equity		
k=1	3.95%	0.43
k=2	3.91%	0.43
k=5	3.88%	0.47
k=10	2.25%	0.48
k=5000	0.00%	0.01
2 asset demographic model, bonds		
k=1	1.35%	1.70
k=2	1.35%	1.70
k=5	1.35%	1.70
k=10	1.35%	1.70
k=5000	0.01%	0.15

Sample Period: 1962-2001	Mean Excess Return	Sharpe Ratio
100% equity	6.26%	0.24
100% bond	1.55%	0.27
50% equity , 50% bond	3.90%	0.28
3 asset demographic model		
k=1	8.54%	0.37
k=2	8.00%	0.39
k=5	5.60%	0.37
k=10	3.83%	0.48
k=5000	0.01%	0.00
2 asset demographic model, equity		
k=1	6.35%	0.28
k=2	5.77%	0.28
k=5	3.50%	0.23
k=10	1.75%	0.22
k=5000	0.00%	0.00
2 asset demographic model, bonds		
k=1	2.50%	0.53
k=2	2.54%	0.54
k=5	2.43%	0.52
k=10	2.34%	0.55
k=5000	0.01%	0.00

Table 4

Mean Excess Retuns and Sharp Ratios for 3 asset optimal portfolios that trade on Demographic and Financial Indicators or Financial Indicators only

Sample Period: 1930-1939	Mean Excess Return	Sharpe Ratio
demographic and financial model		
k=1	5.47%	0.60
k=2	5.41%	0.59
k=5	4.43%	0.58
k=10	3.46%	0.66
k=5000	0.13%	0.18
financial model		
k=1	5.47%	0.60
k=2	5.12%	0.58
k=5	3.48%	0.66
k=10	2.42%	0.91
k=5000	0.11%	0.15

Sample Period: 1962-2001	Mean Excess Return	Sharpe Ratio
demographic and financial model		
k=1	8.45%	0.37
k=2	7.02%	0.33
k=5	5.13%	0.36
k=10	3.99%	0.53
k=5000	0.03%	0.01
financial model		
k=1	8.75%	0.34
k=2	5.11%	0.30
k=5	3.61%	0.45
k=10	2.83%	0.55
k=5000	0.02%	0.01

Figure 1
Excess Returns in Pre WWII Period

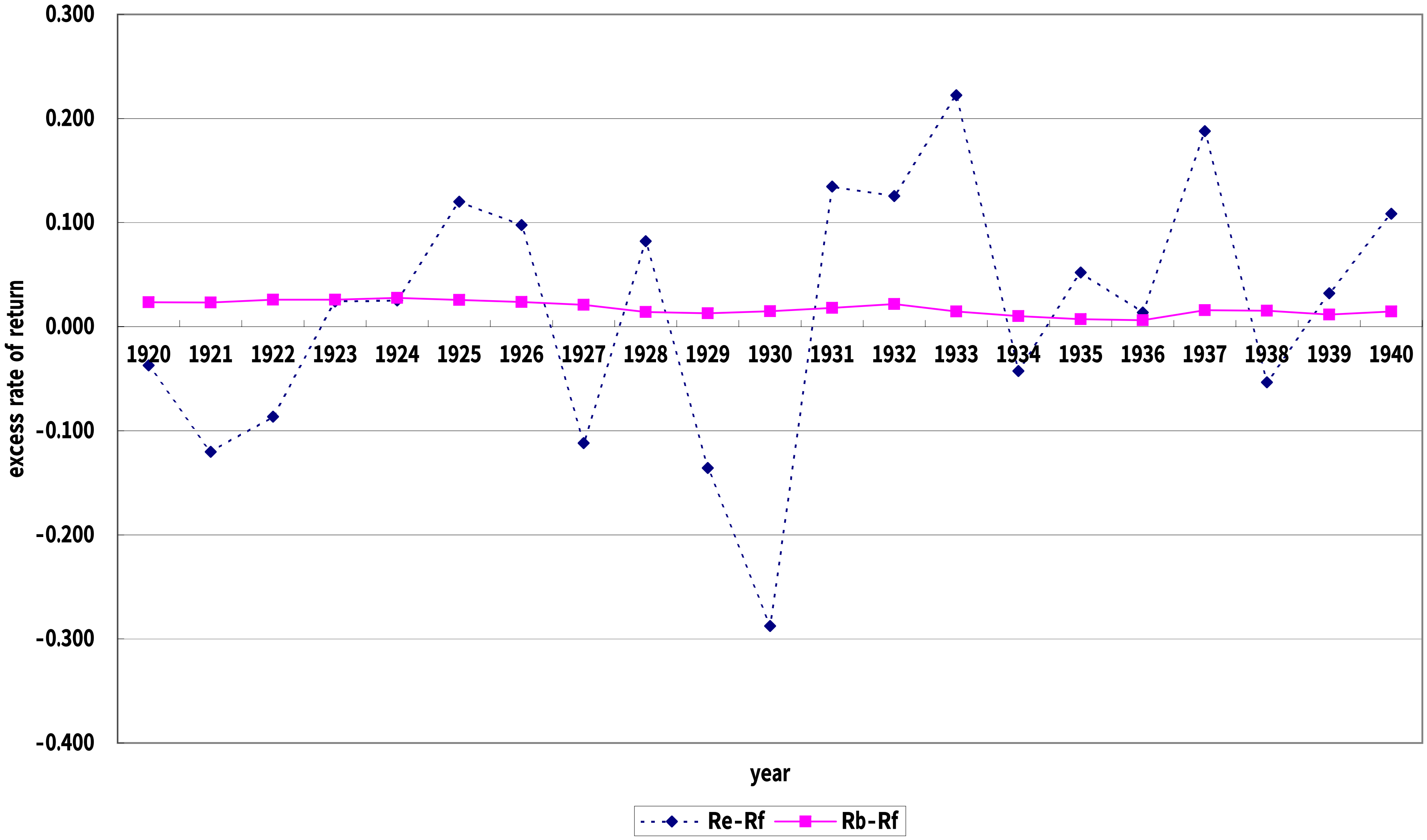

Figure 2
Excess Returns in Post WWII Period