경영학 석사 학위논문

The sooner, the better? Timing of cash flows and equity return

회수기간이 짧은 주식일수록 수익률이 높다?

2021년 8월

서울대학교 경영대학원

재무금융 전공

신 금 철 (2002-20776)

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지도 교수: 고 봉 찬

이 논문을 경영학석사 학위논문으로 제출함

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신금철의 경영학석사 학위논문을 인준함

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The sooner, the better? Timing of cash flows and equity return

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Abstract:

A downward sloping term structure of equity returns is observed in Korea market. Holding the shortest duration stocks and short selling the longest duration stocks earn more than 2% of monthly excess return. Duration premium explains a significant part of pricing errors unexplained by CAPM and Factor models. Higher return on equity and lower sales growth leads the downward-sloping term structure to be more pronounced. Short sale constraints account for duration premium: the most short sale constraint stocks earn double the excess return of the least short sale constraint stocks. Short sale constraints only affect the highest duration stocks.

key words: duration premium, term structure, short sale constraint, value stocks, growth stocks, price of risk

Contents

1 Introduction

The term structure of equity return is downward sloping (Weber 2018). Contrarily bonds have upward sloping term structure in normal times. In economic recessions, however, bonds' term structure tends to be downward sloping. Upward sloping term structure supports our intuition: longer term indicates more variability which will drive investors to require more compensation for the risk they will bear. Recent studies report conflicting views on the equity return term structure: most of asset pricing models indicate upward sloping or flat term structure whereas some imply downward sloping term structure(see Weber 2018 for previous studies). Downward-sloping term structure of equity implies lower duration stocks are given more compensation than are high duration stocks even though high duration stocks have higher betas. The short duration premium is useful for explaining value premiums which are not explained by CAPM. CAPM predicts growth stocks to have higher returns than do value stocks as growth stocks have higher betas than value stocks. Stock price is a discounted expected pay off attributable to shareholders. In other term, price can be split into two parts: cashflows and discount rate. Value stocks tend to have shorter durations than do growth stocks as value stocks have more cash flows generated in near term while growth stocks have more cash flows in distant future. As a result, low duration stocks more covary with cash flows than with discount rate while high duration stocks have co-movement with discount rate rather than cash flows. Lettau and Wachter (2007) provides a theoretical ground to explain the return spread driven by differences in timing of cash flows. Their model suggests that investors do not fear price of risk, a part of stochastic discount factor, rather they do care about variability in cash flows. Investors' differential perception on the risks in discount factor and cash flows rationalizes more compensation for short horizon stocks. On the other hand, Mohrschladt and Nolte(2018) and Gonçalves(2021) posit the short duration premium is driven by reinvestment risks embedded with low duration stocks. Gonçalves(2021) sees the relation between reinvestment risk and mispricing complementary in accounting for the short duration premium.

The puzzling research results motivate me to find whether the downward sloping term structure of equity returns holds in Korea stock market. The counterintuitive downward-sloping term structure of equity returns also compels me to examine whether the equity return's term structure can account for the pricing errors not explained by standard stock pricing models. Based on the assumption that duration premium is driven by mispricing, I go further to explore short sale constraints as a possible source to drive the duration premium in the market. For an apple-to-apple comparison between US- and Korea market, I follow Dechow(2004) and Weber(2018) for the models and methodologies used in estimating durations and testing hypothesis. To estimate duration at a firm level, I project future free cash flows attributable to equity shareholders and use a discount rate to discount the future payoffs. To derive ex ante term structure of equity return, I match the durations as at end of year *t* to annual or monthly returns for the subsequent year of *t+1* at a firm level first. Then I cluster firm year returns or firm month returns into deciles or tertiles of portfolios sorted on durations.

2 Model and data

2.1 Equity duration

Duration concept is widely used by financial institutions as a means to hedge their interest rate risk. In this context, duration is an interest rate elasticity of price. It represents percentage change in price due to a percentage change in interest rate. On the other hand, duration is used as a concept of maturity translated into present value as an alternative to maturity which does not consider time value of money. In this paper, I use duration as a factor to explain stock return in the context of maturity rather than elasticity. As a result, I define duration as present value weighted maturity: a period to future cash flows weighted by present values of future cash flows over price at a point in time:

$$Dur_{i,t} = \frac{\sum_{s=1}^{T} S \times CF_{i,t+s} / (1+r)^s}{P_{i,t}} \qquad (1)$$

where $Dur_{i,t}$ is a duration of firm *i* as at end of financial year *t*, $CF_{i,t+s}$ indicates future cash flows to equity shareholders deemed to be dividend cash flows of firm *i* for the period of *t+s*, $P_{i,t}$ represents a market capitalization of firm *i* at the end of a financial year *t*, and *r* denotes expected return on equity, i.e. cost of capital.

When estimating durations of firms, I encounter two challenges: 1) how to measure a maturity of equities which is denoted as T in the equation above, 2) how to estimate future dividend cash flows at each firm year.

In contrast to bonds, equities do not have fixed maturities. To address the challenge, cash flow periods are broken down into a 15-year finite period and the period beyond the finite period. The cashflows for the infinite period are assumed to grow at nil % (level perpetuity) following Weber(2018). Level perpetuity assumption simplifies duration estimation and enables decoupling cash flow projections into two terms as presented in equation (2):

$$Dur_{i,t} = \frac{\sum_{s=1}^{T} S \times CF_{i,t+s}/\,(1+r)^s}{P_{i,t}} + \left(T + \frac{1+r}{r}\right) \times \frac{P_{i,t} - \sum_{s=1}^{T} CF_{i,t+s}/(1+r)^s}{P_{i,t}} \quad (2)$$

Equation (2) indicates a firm's duration is a sum of a duration up to the finite period of 15 years and a duration for the infinite period beyond the finite period. Equation (2) provides a more operable way to project future cash flows without duration concept impaired.

To address the 2nd challenge, for the first 15-year window, I project cash flows in detail based on a "clean surplus relation (Dechow et al.,2004)" between dividends and book values of equity by which a current year equity is a prior year equity plus current year earning minus dividends. The dividend cash flows are indicated as *CF* in the equation (3) below.

$$BV_{i,t+s} = BV_{i,t+s-1} + E_{i,t+s} - CF_{i,t+s}$$

$$CF_{i,t+s} = E_{i,t+s} - \left(BV_{i,t+s} - BV_{i,t+s-1}\right) \quad (3)$$

$$= BV_{i,t+s-1} \times \left(\frac{E_{i,t+s}}{BV_{i,t+s-1}} - \frac{BV_{i,t+s} - BV_{i,t+s-1}}{BV_{i,t+s-1}}\right)$$

$$= BV_{i,t+s-1} \times \left(ROE_{i,t+s} - SG_{i,t+s}\right) \quad (4)$$

where E, BV and SG denotes net income, book value of equity and sales growth, respectively.

To derive factors to drive current year earnings and book values of equity at current year end, equation (3) is divided by prior year end book value. Equation (4) indicates current year earning is a product of prior year end book value of equity and current year ROE, and current year end book value of equity is prior year end book value of equity multiplied by equity book value gross growth rate(Dechow et al.,2004). Firm's sales growth is used as a proxy for the firm's equity book value growth as the firm's sales growth is better explainer of the firm's equity growth according to Nissim and Penman (2000).

2.2 Cash flows estimation and data used

Nissim and Penman (2000) also demonstrates that firms' sales growth reverts to a long-term growth of GDP and firms' ROEs revert to a long-term average return on equity. Leveraging the study result, I use Korea GDP growth for sales growth of each firm and long-term average return on market portfolio as proxies for sales growth and ROEs, respectively.

I obtain Korea GDP growth rates from World Bank for the past 33-year period from 1987 through 2019. As a proxy of each firm's long-term sales growth, I use the 33-year average GDP growth rate. Based on the assumption that ROEs revert to long-term average of return on equity, I obtain KOSPIs for the 33-year period from 1987 through

2019 from TS2000 and derive average time series annual return for the period as a proxy for long-term ROE. Reversion to longer term average of sales growth and ROE allows me to derive sales growth and ROE for the year *t* from the sales growth and ROE for the year *t-1* using regression coefficients for each variable:

$$SG_{i,t} = \beta_{SG}(SG_{i,t-1} - AVE_{GDP}) + \quad AVE_{GDP}$$

$$ROE_{i,t} = \beta_{ROE}(ROE_{i,t-1} - AVE_{ROE}) + \quad AVE_{ROE}$$

where SG denotes sales growth and AVE indicates long term averages.

Sales growth and ROE betas are a result of auto-regressing sales growths and ROEs of a pool of all firms in scope against GDP growth and return on a market portfolio proxied by KOSPI for the period from 1987 through 2019, respectively.

$$SG_{\ p,t} - AVE_{GDP} = \beta_{SG}\left(SG_{p,t-1} - AVE_{GDP}\right) + \ \varepsilon_{p,t-1}$$

$$ROE_{\ p,t} - AVE_{ROE} = \beta_{ROE}(ROE_{p,t-1} - AVE_{ROE}) + \ \varepsilon_{p,t-1}$$

Listed below are the regression results and long-term averages of GDP and return on equity:

$beta_{SG}$ = 0.4634

$beta_{ROE}$= 0.7279

AVE_{GDP} = 0.0566

AVE_{ROE} = 0.1173

According to equation (4), earning for year *t* is a product of book value of equity at *t-1* and ROE for year *t*. Book value of equity at *t* is calculated by multiplying book value of equity at *t-1* by sales growth. Resultingly, earning minus change in book value of equity represents equity cash flows, or expected dividends. Sales growth, ROEs and cash flows are updated annually on a rolling basis. Accordingly equity durations are annually roll forwarded based on prior year sales growth and ROE.

Following equation (2), a duration for each firm year is sum of duration up to 15-year period and duration for the infinite period beyond the 15-year period. Each firm is allocated to one of decile portfolios for each period depending on the renewed duration. Each decile represents a portfolio of firms with similar durations. Portfolios are reformed on an annual basis. Accordingly I observe 330 deciles for the 33-year period from 1987 through 2019.

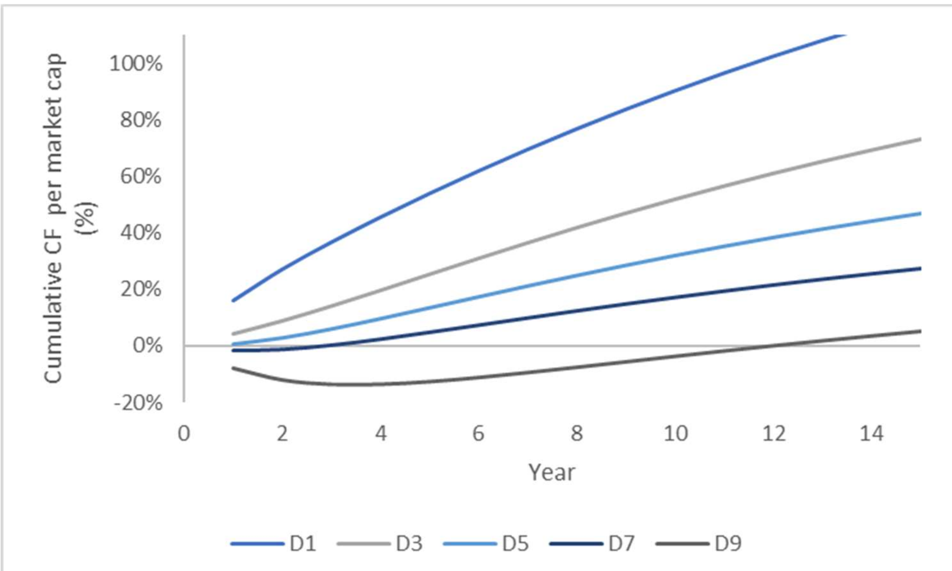
Book values of equity, earnings, sales growths, ROEs, and stock price data come from TS2000. Market capitalization data are from KISVALUE. I obtain stock return data from Data Guide. I comprehend all KOSPI and KOSDAQ firms as of 25 October 2020. To avoid survivorship bias, I include delisted firms into the data pool. Financial institutions are excluded from the sample. As a result of data cleansing work, I observe 2,361 firms and 27,986 firm years for the period from 1987 through 2019. I select 1987 as a starting point because 'monetary stabilization bond' I use as a risk-free rate proxy becomes available in the year. To minimize impact of extreme outliers, I winsorize durations and annual returns at 1% and 99%.

2.3 Cash flow profiles

Figure 1 presents time series of cumulative cashflow collection of decile portfolios sorted on duration. Cash flows are estimated following the method stated in 2.1 and 2.2. By construction of duration, the collection is denoted as a ratio of cumulative amount of present values of future cash flows to market capitalization. Low duration stocks have more cash flows distributed in nearer term while long duration stocks in longer term. In other words, it takes a shorter time for low duration stocks to collect market equity and a longer time for high duration stocks. Given earlier collection of cash flows, short duration stocks may be exposed to relatively higher reinvestment risk than may long duration stocks be if we have long-term investors in mind.

Figure 1: Timing of cash flows

This figure presents percentage of cumulative cash flows per market capitalization over years. Cash flows are denominated in present values. Durations are estimated following Dechow(2004). Stocks are sorted into deciles on duration and annually rebalanced. The sample covers the period from 1987 through 2019. Delisted firms are included in the scope of analysis while financial institutions are excluded. Book values of equity, earnings, sales growths, ROEs, and stock price data come from TS2000. Market capitalization data are from KISVALUE. For long-term average sales growth used to estimate equity book value growth, I obtain Korea GDP growth rates from World Bank for the past 33 years from 1987 through 2019. For long-term average cost of capital, I use KOSPIs for the past 33 years from 1987 through 2019 and obtain it from TS2000. Stocks below the 20th quantile of market capitalization are excluded.



2.4 Descriptive statistics

Table 1 shows that average duration of firms in Korea stock market is 19.14 years with standard deviation of 9.23 years. Average duration of firms in the US market is 18.77 years with the standard deviation of 5.37 years according to Weber(2018). Korea stocks have a slightly high durations with more variability than US ones. The difference between the two stock markets might imply Korea firms pay out lower dividends for their shareholders than their counterparts in US. It also implies US firms' dividends are more stable than its counterparts in Korea. It is notable duration is negatively correlated with ROE whereas it has positive correlation with sales growth. Similarly to the US market which reports negative relationship between book to market ratio and duration, Korea firms' durations and book to market ratio go into the opposite directions. These hint that value stocks have lower durations and growth stocks have higher durations. Foreign investment ratio(FIR) is positively correlated with ROE and market capitalizations. But FIR has a negative correlation with durations. This indicates foreign investors might prefer to invest in larger companies with higher ROEs but lower durations. Other than between market capitalization and duration and between market capitalization and sales growth, correlations between each variable are statistically significant.

Table 1: Descriptive statistics
The table below summarizes statistics on the firm characteristics and variables used for estimating duration. Panel A shows time series averages and standard deviations of annual cross-sectional ROEs and sales growths for the period

from 1987 through 2019 and durations, book to market ratios, foreign investment ratios and market capitalizations as at the calendar year ends for the observation period on a firm-year basis. In Panel B, I report correlations between the firm characteristics.

	Duration	Book to market	Foreign Investment Ratio(%)	ROE	Sales growth	Market capitalization (KRW'000)
Panel A: means and standard deviation						
Mean	19.14	1.16	6.83	0.01	0.10	578,800,704
Standard deviation	9.23	1.01	11.78	0.37	0.39	4,709,017,624
Panel B: contemporaneous correlations						
Duration		-0.29***	-0.08***	-0.49***	0.37***	-0.01
Book to market			-0.04***	0.06***	-0.08***	-0.05***
Foreign Investment Ratio				0.11***	0.01**	0.25***
ROE					0.12***	0.03***
Sales growth						0.00

*** significant at a confidence level of 99.9% ** significant at a confidence level of 95%

3 Equity term structure

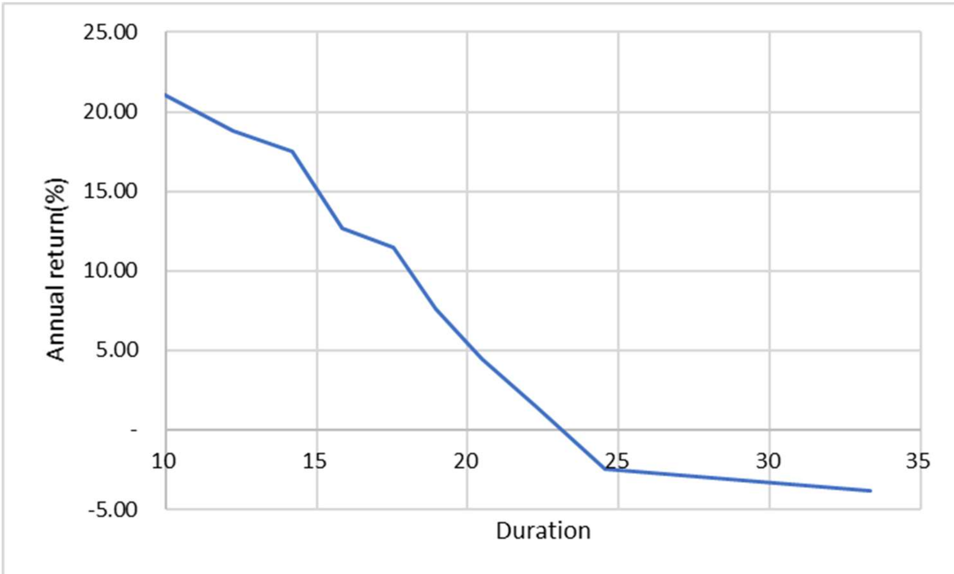
3.1 Term structure of portfolios sorted on duration

Each firm year is sorted into deciles based on durations. Each firm's duration is annually renewed reflecting updates in earning, book value of equity and market capitalization as at preceding year end. Duration at end of year *t* corresponds to annual stock return or monthly stock returns for year *t+1*.

I cluster firm year returns into deciles from the lowest to the highest based on durations. To obtain a more parsimonious term structure, I calculate time series average median duration and the time series average returns of each portfolio sorted on durations. I plot the median portfolio durations and the mean portfolio returns in the Figure 2.

Figure 2 presents negative relation between duration and return. Portfolio with the lowest duration has an average annual return of 22% whereas portfolio with the highest duration yields -4%. Resultingly the lowest duration stocks earns more than the highest one by 26% annually. Returns monotonically decreases over durations. In other term, annual returns over durations report a downward sloping term structure.

Figure 2: Duration and annual stock return
The figure plots time series average median of durations and time series average mean of annual returns of 10 portfolios sorted on duration. Annual returns are equally weighted. Durations are annually reestimated at each year end and durations at year *t* is mapped to annual returns at year *t+1.* As a result, portfolios are rebalanced based on each firm's reestimated duration. Delisted firms are included in the scope of analysis while financial institutions are excluded. Book values of equity, earnings, sales growths, ROEs, and stock price data come from TS2000. Market capitalization data are from KISVALUE. I obtain stock return data from Data Guide. For long-term average sales growth used to estimate equity book value growth, I obtain Korea GDP growth rates from World Bank for the past 33 years from 1987 through 2019. For long-term average cost of capital, I use KOSPIs for the past 33 years from 1987 through 2019 and obtain it from TS2000. Stocks below the 20th quantile of market capitalization are excluded.



3.2 Alphas of duration portfolio returns

I perform regression to find whether conventional pricing models can explain the equity returns' downward sloping term structure. As a first step, I regress monthly excess returns against monthly market excess returns under CAPM. Table 2 reports monthly excess returns, sensitivity(betas) to market portfolio and pricing errors(alphas) of ten portfolios sorted on durations. Monthly excess returns slope downward in response to durations. Monthly mean excess returns decline over durations from 1.53% for the lowest duration portfolio to -0.62% for the highest duration portfolio. An arbitrage portfolio strategy of holding the lowest duration portfolio(D1) and shorting the highest duration portfolio(D10) earns an excess return of 2.15% per month which is statistically significant and economically large. Figure 3 provides a positive correlation between duration and CAPM betas but a negative relationship between duration and alphas. High duration stocks have a CAPM beta of 1.11 relative to 0.95 for the lowest duration portfolio. In contrast to beta, CAPM alpha declines from 1.47% per month to -0.68% as duration increases with pricing errors decreasing due to increasing beta. Sharp ratios have a negative relationship with duration. A long-short portfolio of going long with the shortest duration portfolio and shorting the longest duration portfolio brings a reward of 0.05 against the risk borne.

For robustness, I allow for a six-month time lag between duration and monthly excess returns by mapping duration as at *t-1* year end to monthly excess returns for the subsequent 12-month period from July in year *t* through June in year *t+1.* I do not tabulate the testing results in the paper, but I find the downward term structure still holds.

Table 2: Mean excess returns, CAPM beta and CAPM alpha of ten portfolios sorted on duration
The table below reports monthly mean excess returns, coefficients (alphas and betas) and sharp ratios for ten portfolios sorted on duration and an arbitrage portfolio in which the shortest duration portfolio(D1) is held for long position and the longest duration portfolio(D10) is sold short. Mean excess returns and alphas are denominated in percent. T statistics are based on the standard errors corrected following Newey and West(1987,1994) and provided in each t stat row. Monthly excess returns are equally weighted. Durations are reestimated at each year end on an annual basis and portfolios are annually rebalanced. Durations at the end of year *t* correspond to monthly returns for the year *t+1.* Each firm month is sorted into deciles based on durations. I observe all common stocks listed on KOSPI and KOSDAQ for the 33-year period from 1987 through 2019. Delisted firms are included while financial institutions are excluded. As a proxy of risk-free rate I use rates of 'Monetary Stabilization Bonds (MSBs)' issued and used by the Bank of Korea as means of the Bank's open market operation. Since there is no MSBs whose maturity is one month, an annual rate is converted to a monthly rate by monthly compounding. Market excess return is value weighted return of all common stocks listed on KOSPI and KOSDAQ minus one-month MSB rate.
Book values of equity, earnings, sales growths, ROEs, and stock price data come from TS2000. Market

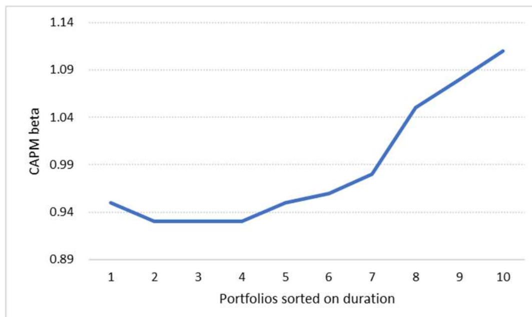
capitalization data are from KISVALUE. Stock return data are obtained from Data Guide. For long-term average sales growth, I obtain Korea GDP growth rates from World Bank for the past 33 years from 1987 through 2019. For long-term average cost of capital, I use KOSPIs for the past 33 years from 1987 through 2019 which come from TS2000. Stocks below the 20th market capitalization are excluded to avoid possible small firm anomaly.

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D1-D10
Mean	1.53	1.26	1.26	0.89	0.72	0.41	0.25	0.04	-0.56	-0.62	2.15
t stat	*13.91*	*12.60*	*14.00*	*9.89*	*8.00*	*4.10*	*2.50*	*0.31*	*-4.31*	*-4.13*	*15.36*
β_{CAPM}	0.95	0.93	0.93	0.93	0.95	0.96	0.98	1.05	1.08	1.11	-0.16
t stat	*19.00*	*23.25*	*23.25*	*31.00*	*31.67*	*24.00*	*24.50*	*21.00*	*18.00*	*15.86*	*-4.00*
α_{CAPM}	1.47	1.20	1.21	0.83	0.66	0.36	0.19	-0.02	-0.63	-0.68	2.15
t stat	*7.74*	*7.06*	*7.56*	*5.19*	*4.13*	*2.12*	*1.06*	*-0.09*	*-2.63*	*-2.62*	*16.54*
Sharp ratio	0.10	0.09	0.08	0.06	0.05	0.03	0.02	-0.00	-0.03	-0.03	0.05

Figure 3: Mean excess returns, CAPM beta and CAPM alpha of ten portfolios sorted on duration
The figure below presents patterns over durations of mean excess returns per month, CAPM betas and alphas of duration portfolios exhibited in the Table 2.

Monthly mean excess returns

CAPM beta



CAPM alpha

Sharp ratio

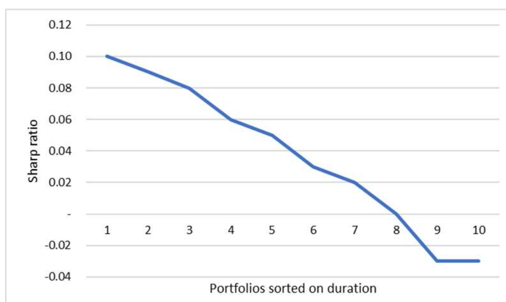


Table 3 presents the downward sloping term structure of equity returns holds when controlling for the market, size, value, and momentum factors under Fama and French three factor model and the model augmented with momentum. Pricing errors decrease as durations increase. Going long with low duration stocks(D1) and shorting high duration stocks(D10) generates an excess return of 1.58% per month when controlling for market, size and value and 1.51% when controlling for momentum in addition to market, size and value. The long-short portfolios' excess returns are statistically significant with t statistic greater than two and economically large with annualized excess return of 19.01% and 18.09% under the three- and four factor models, respectively. Duration accounts for residual returns after controlling for the common risk factors. This suggests that duration is not priced under the factor models. High duration portfolios tend to have greater betas on market and size but lower beta on value.

Table 3: Fama and French factor alphas of ten portfolios sorted on duration

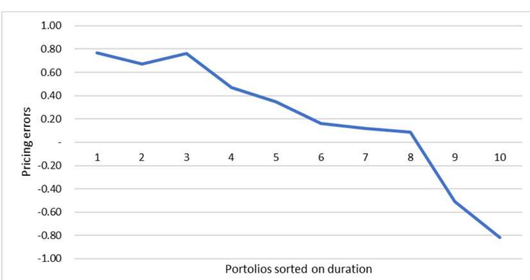
The table presents pricing errors under Fama and French's three factor model ($\boldsymbol{\alpha_{FF3}}$) and momentum augmented factor model ($\boldsymbol{\alpha_{FF4}}$) for the ten portfolios sorted on duration and an arbitrage portfolio composed of going long with the portfolio with the lowest duration(D1) and short selling the portfolio with the highest duration(D10). T statistics are based on the standard errors corrected following Newey and West(1987,1994) and provided in each t stat row. Monthly excess returns are equally weighted. Durations are reestimated at each year end and portfolios are annually reformed. As a result, durations at end of year *t* correspond to subsequent 12 monthly returns for year t+1. Each firm month is sorted into deciles based on the estimated durations.

I observe all common stocks listed on KOSPI and KOSDAQ for the 33-year period from 1987 through 2019. Delisted firms are not excluded while financial institutions are excluded. I follow Fama and French (1993) for market, size and value factors(RMmRF, SMB, HML) and Carhart(1997) for momentum factor(WML). As a proxy of risk-free rate I use rates of 'Monetary Stabilization Bonds (MSBs)' issued and utilized by Bank of Korea as means of the Bank's open market operations. As there is no MSBs whose maturity is one month, one month rate is calculated by monthly compounding using yearly rates. Market excess return is value weighted return of all common stocks listed on KOSPI and KOSDAQ minus one-month MSB rate.

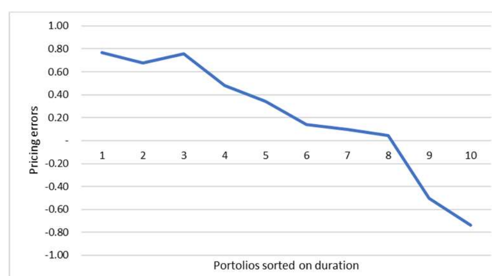
Book values of equity, earnings, sales growths and ROEs come from TS2000. Market capitalization data are from KISVALUE. Stock return data are obtained from Data Guide. For long-term average sales growth used to estimate equity book value growth, I obtain Korea GDP growth rates from World Bank for the past 33 years from 1987 through 2019. For long-term average cost of capital, I use KOSPIs for the past 33 years from 1987 through 2019 which come from TS2000. Stocks below the 20th quantile of market capitalization are excluded to avoid possible small firm anomaly.

	D1	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**D1-D10**
$\boldsymbol{\alpha_{FF3}}$	0.77	0.67	0.76	0.47	0.35	0.16	0.12	0.09	-0.51	-0.82	1.58
t stat	*6.41*	*6.14*	*6.96*	*4.19*	*2.90*	*1.33*	*0.92*	*0.55*	*-2.82*	*-3.74*	*8.56*
$\boldsymbol{\alpha_{FF4}}$	0.77	0.68	0.76	0.48	0.34	0.14	0.10	0.05	-0.50	-0.74	1.51
t stat	*6.34*	*6.16*	*6.92*	*4.27*	*2.86*	*1.17*	*0.74*	*0.30*	*-2.65*	*-3.32*	*8.48*

Alphas under 3 factor model



Alphas under 4 factor model



3.3 Duration factor loading and price of risk

In addition to analyzing alphas, I test whether duration factor loading on monthly excess returns is not nil with statistical support. By sorting firm month stock returns into deciles based on duration, market capitalization, book to market ratio, ROE and sales growth, I obtain a total of 50 portfolios, or ten portfolios for each sorting variable. Sorting variables at year end of *t* are linked to subsequent 12-month excess returns for year *t+1*. For each portfolio, I conduct panel regressions of monthly excess returns on factors: RMmRF, SMB, HML, WML, LDmHD for a proxy for market portfolio, size, book to market ratio, momentum and duration respectively.

I quantify duration factor(LDmHD) using independent sorts. Stocks are assigned to 2 x 3 groups, or above-the-median market capitalization(Big) and below-the-median market capitalization(Small) groups for size and the 30th percentile(High), the 30th percentile to the 70th percentile(Middle) and the 70th percentile(Low) based on duration. LDmHD is a long-short portfolio return with long position on Low duration sort and short position on High duration sort. Denoting Big and Small as B and S, High, Middle and Low as H, M and L respectively, I obtain LDmHD = (SL + BL)/2 – (SH +BH)/2.

Table 4 reports duration factor loadings for ten portfolios sorted on duration, market capitalization, book to market ratio, ROE and sales growth respectively. Duration factor loading monotonically decreases over durations from 0.47 to -0.73, which is a natural outcome by definition of duration factor, LDmHD. On the other hand, duration factor loading monotonically increases from -0.81 to 0.37 as book to market ratio increases. This is reasonable as duration is negatively corelated with book to market ratio as presented in the Table 1. The negative relationship suggests that high book to market stocks(value stocks) have shorter durations than low book to market stocks(growth stocks). If prices properly reflect risks, shorter duration stocks might carry higher distress risk or higher reinvestment risk than its counterpart according to risk-based explanations on value- or duration premium. Notalby there is no correlaton between market capitalization and LDmHD which is in line with Table 1. ROE and Sales growth seem to account for LDmHD to some extent, but it does not seem to be significant in statistic term. In summary, duration factor is not dominated by market capitalization, ROE and Sales growth while close relationship with Book to market is observed in the sample. Duration is negatively correlated with excess returns which is consistent with the downward sloping term structure of equity returns as analyzed in 3.1 and 3.2.

Table 4**:** Loading of return on duration factor
This table presents duration factor loadings for decile portfolios sorted on duration, market capitalization, book to market ratio, ROE and sales growth. T statistics are based on the standard errors corrected following Newey and West(1987,1994) and provided in each t stat row. Panel regressions of monthly excess returns on factors(RMmRF, SMB, HML, WML, LDmHD for a proxy for market, size, book to market, momentum and duration respectively) yield loadings on each factor on a portfolio basis. Only duration factor loading is provided in the table. In the regression, explanatory variables at end of year *t-1* are linked to excess returns of subsequent 12 months of year *t*. Portfolio sorting variables are given in the first column. The sample covers 33-year period from 1987 through 2019.

	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**	**[8]**	**[9]**	**[10]**
Duration	0.47	0.41	0.31	0.23	0.18	0.03	-0.17	-0.56	-0.59	-0.73
t stat	*14.05*	*13.20*	*7.00*	*4.12*	*4.13*	*0.43*	*-1.88*	*-3.59*	*-5.55*	*-4.45*
Book to market	-0.81	-0.51	-0.23	-0.20	0.04	0.08	0.22	0.29	0.33	0.37
t stat	*-4.29*	*-4.81*	*-2.90*	*-1.92*	*0.54*	*0.99*	*3.85*	*7.66*	*10.46*	*13.11*
Market capitalization	-0.02	-0.09	0.07	-0.06	-0.01	-0.18	-0.06	-0.07	0.02	-0.02
t stat	*-0.23*	*-0.73*	*0.80*	*-0.60*	*-0.17*	*-1.05*	*-0.82*	*-0.75*	*0.31*	*-0.35*
ROE	-0.53	-0.21	0.01	0.07	0.10	0.12	0.11	-0.06	0.07	-0.11
t stat	*-3.32*	*-1.85*	*0.18*	*0.93*	*1.53*	*1.61*	*2.14*	*-0.42*	*0.66*	*-0.61*
Sales growth	-0.19	-0.06	-0.05	0.16	0.15	0.09	0.14	0.07	-0.22	-0.50
t stat	*-1.77*	*-0.61*	*-0.37*	*2.41*	*2.91*	*1.83*	*2.10*	*1.23*	*-1.96*	*-3.15*

Following Mohrschladt and Nolte(2018), I perform factor spanning tests to assess whether LDmHD, or duration factor, has a marginal explanatory power. LDmHD is regressed on common risk factors(market, size, value and momentum). Table 5 shows the common risk factors do not lead the intercepts left by the regressions to be insignificant. This implies the common risk factors do not necessarily completely explain the duration factor.

Table 5**:** Relation between duration and common risk factors.
The table shows factor spanning test results. LDmHD stands for return of long-short portfolio formed of low duration stocks minus high duration stocks. Low duration stocks represent stocks below the 30th duration percentile and high duration stocks above the 70th duration percentile at a specific month in the 2 x 3 sorts based on market capitalization and duration. Dependent variables are time series of LDmHD. In the first column, explanatory

variables are provided: MKT is return on KOSPI for the period from 1987 through 2019 as s proxy for market portfolio, SMB is small minus big portfolio in terms of market capitalization, HML is high book to market minus low book to market portfolio and WML is a momentum portfolio formed of winner minus loser portfolio. The sample covers 33-year period from 1987 through 2019. T statistics are based on the standard errors corrected following Newey and West(1987,1994) and provided in the t stat rows.

	LDmHD	LDmHD	LDmHD	LDmHD
Intercept	1.65	1.70	1.06	1.04
t stat	*6.11*	*6.30*	*3.93*	*3.85*
MKT	-0.13	-0.15	-0.12	-0.11
t stat	*-2.60*	*-3.00*	*-2.40*	*-2.20*
SMB		-0.44	-0.34	-0.33
t stat		*-2.44*	*-1.89*	*-1.83*
HML			0.65	0.65
t stat			*5.00*	*5.00*
WML				0.05
t stat				*0.33*

Further to analysis of beta, or exposure of duration factor, I measure price of risk of duration factor using Fama Macbeth regression following Mohrschladt and Nolte(2018) to evaluate whether duration factor risk has a price independent of prices on standard factors(Fama French three factors augmented with momentum). To test whether LDmHD serves as a risk factor, I build 25 testing assets based on market capitalization and book to market ratio, or 5 x 5 sorts composed of five from market capitalization and the other five from book to market ratio.

Table 6 reports LDmHD remains statistically and economically significant after controlling for the Fama and French three factors augmented with momentum. Model [1] presents LDmHD dominates market portfolio as price of LDmHD is 0.82% with t statistic of 2.41 while market has 1.79. Models [2], [4] and [6] show market factor remains significant in absence of duration or momentum factor or when excess return is regressed only with market . Furthermore models [2] and [4] demonstrate that addition of LDmHD to the standard three factors reduces intercepts, or residual returns, from 2.70% to 2.11% which is statistically supported. Model [3] shows the least residual of 1.27% with the intercept's t-statistic below 2. Column [5] presents residual return goes down when LDmHD is added to the Fama French three factors augmented with WML. Model [2] shows changes in residual returns when LDmHD factor is replaced with HML, and SMB is added. The replacement drives up residual return to a significant level from 1.51% to 2.70%. Models [2], [3] and [4] shows conflicting interaction between LDmHD and HML. As LDmHD becomes endogenous in models [2] and [4], the price of HML goes down from 1.65% to 1.08%. Similarly, the price of LDmHD goes down from 1.53% to 1.39% when HML is added as a risk factor. Addition of WML brings down the price of LDmHD but does not induce LDmHD to be insignificant with the adjusted *t* statistic of 2.29. In model [5], I identify that duration may serve as an additional independent risk factor to explain equity return as LDmHD survives standard risk factors. Models [6] and [7] report LDmHD constitutes more proportion in equity return than market factor as its unaccounted part, or 1.02%, is far less than its counterpart(6.38%). In short, duration has an incremental explanatory power as duration remains significant in both statistical and economical terms after controlling for the standard pricing factors.

Table 6**:** Price of duration factor
The table below reports prices of risk in percent for the standard risk factors and duration, which are outcome of Fama Macbeth regressions. I use 25 equally weighted market capitalization and book to market portfolios as testing assets. MKT is return on KOSPI for the period from 1987 through 2019 as a proxy for market portfolio. LDmHD stands for low duration stock return minus high duration stock return. Low duration stocks represent stocks below the 30th duration percentile and high duration stocks above the 70th duration percentile at a specific month in the 2 x 3 sorts based on market capitalization and duration. SMB is small minus big portfolio in terms of market capitalization, HML is high book to market minus low book to market portfolio and WML is a momentum portfolio

formed of winner minus loser portfolio. The sample covers 33-year period from 1987 through 2019. T statistics are based on the standard errors adjusted following Shanken(1992) and are given in the t stat rows for each estimate.

	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Intercept	1.51	2.70	1.27	2.11	1.51	6.38	1.02
t stat	*2.56*	*3.86*	*1.74*	*2.81*	*1.96*	*11.00*	*25.50*
MKT	-1.27	-2.59	-1.21	-2.04	-1.27	-5.93	
t stat	*-1.79*	*-3.36*	*-1.55*	*-2.52*	*-1.55*	*-8.35*	
LDmHD	0.82		1.53	1.39	0.82		1.17
t stat	*2.41*		*4.50*	*4.09*	*2.29*		*3.55*
SMB		0.24	0.83	0.47	0.26		
t stat		*0.71*	*2.37*	*1.31*	*0.73*		
HML		1.65		1.08	0.82		
t stat		*5.89*		*3.27*	*2.50*		
WML					-2.75		
t stat					*-3.81*		

3.4 Sensitivity and robustness

Durations are dependent on various assumptions: future dividend cash flows and discount rate. Future cash flows vary with sales growth and ROE: long term average rates and coefficients. To see how sensitively changes in each variable affects equity return term structure, I move discount rates from 2% to 22% with base case rate of 12%, AR coefficient of ROE from 0.23 to 1.23 with base case coefficient of 0.73, long run ROE from 2% to 22% with base case rate of 12%, AR coefficient of sales growth from -0.04 to 0.96 with base case coefficient of 0.46, and long run sales growth average from -4% to 16% with base case rate of 6%.

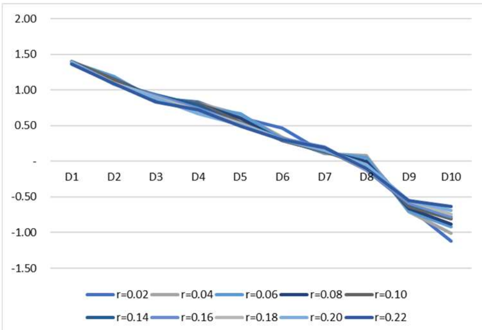
Figure 4 present how equity return term structure responds to changes in each variable. Overall the downward-sloping term structure remains unchanged. We see changes in discount rates barely affect the term structure. Contrarily changes in ROE coefficient, long run ROE, sales growth coefficient and long run sales growth lead to more fluctuations in return curves but do not fundamentally change the term structure from downward sloping to upward sloping structure. Notably greater ROE and lower sales growth tend to lead the return curves to slope more downwards. The downward term structure becomes the most pronounced when long run ROE and its AR coefficient are the highest and the long run sales growth and its AR coefficient are the lowest as colored in red in the figure. Higher ROE and lower sales growth are characteristic of value stocks relative to growth stocks. This implies value premium could be a proxy for duration premium and vice versa.

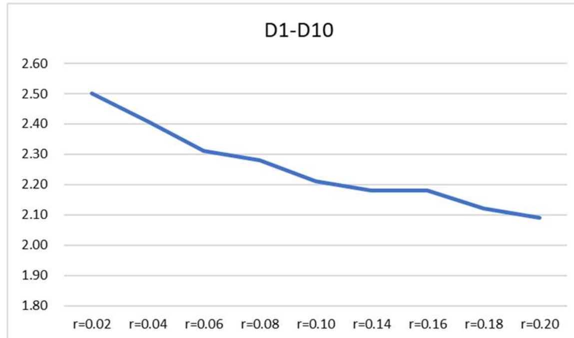
It is remarkable that discount rate changes least impact term structure among the variables. But changes in assumptions associated with cash flows significantly affect the term structure in a relative term. From the investors' behavior perspective, this could imply investors would not care about possible changes in discount rate; rather they would fear risk of changes in cash flows. Consistent with Lettau and Washter(2007), investors' differential responses to cashflow shocks and discount rate shocks could explain the downward sloping term structure in which low duration premium is justified. Dechow, Erhard, Sloan and Soliman(2021) reports Covid19 pandemic risk has a disproportional impact on short duration stocks which have more of value in cash flows in nearer future and demonstrates the equity duration is useful for explaining sensitivity of equity prices to a strong but short-term volatility in cash flows in such a situation of unexpected macroeconomic event as Covid19 pandemic where it involves an explosive impact on world economy but the recovery is expected to happen within 12 to 24 months of the peak time of pandemic due to expectation of vaccination available in the time frame.

Figure 4: Impact of changes in assumptions on term structure
This figure reports how sensitively excess returns of duration sorted portfolios respond to changes in the assumptions used to estimate durations. Monthly excess returns are equally weighted. I observe all common stocks listed on KOSPI and KOSDAQ for the 33-year period from 1987 through 2019. Delisted firms are not excluded

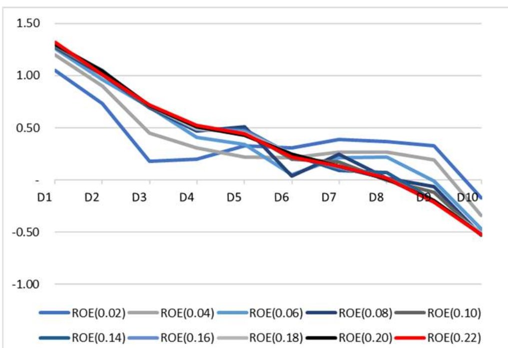
while financial institutions are excluded.

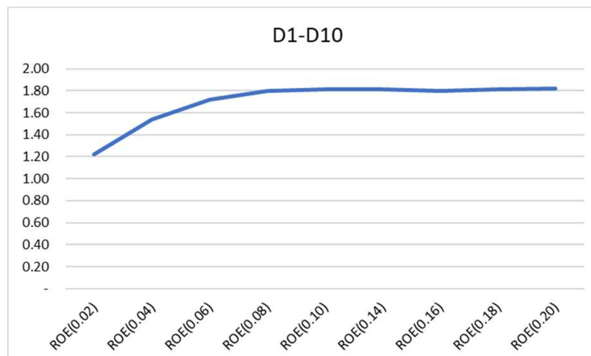
Discount rate



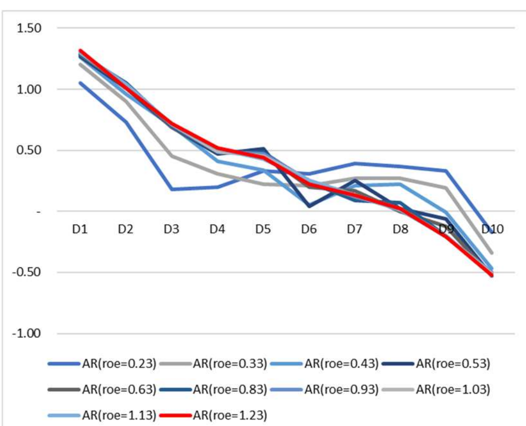


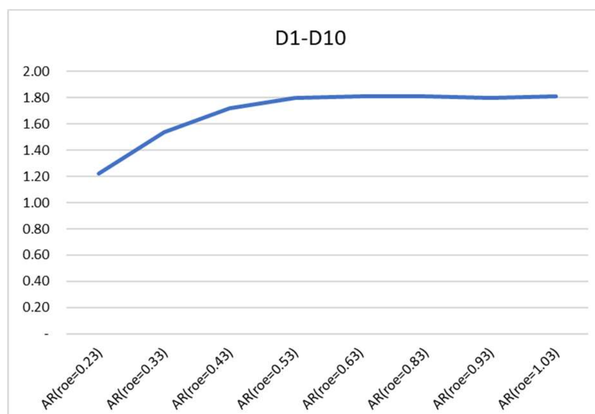
Long run ROE



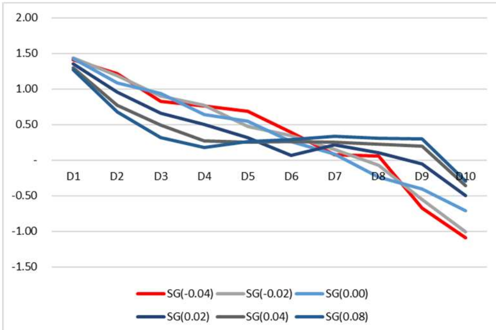


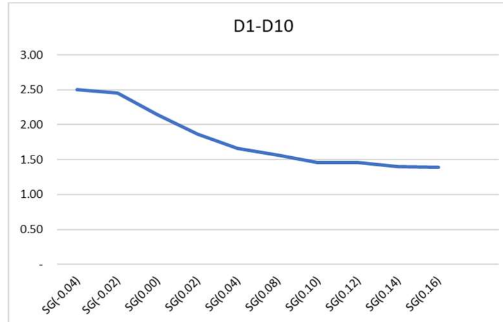
AR coefficient of ROE



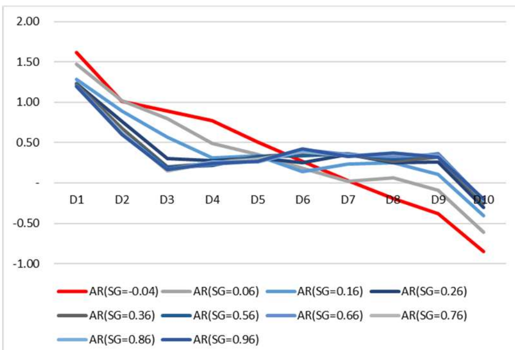


Long run sales growth





AR coefficient of sales growth



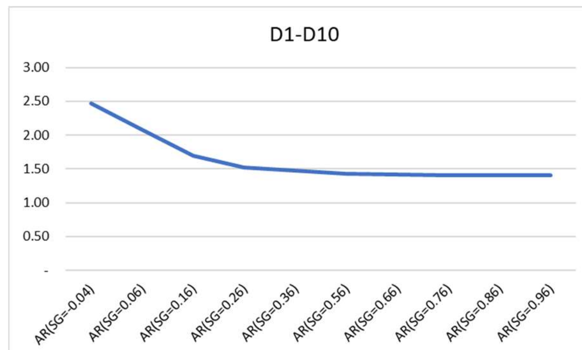


Table 7 presents variations in excess returns at a level of portfolio in response to variations in parameters. Overall I observe a downward sloping term structure hold and the results are statistically significant across the variables. This indicates duration premium is persistent regardless of changes in values of variables. The sensitivity test result alleviates possibility of cross-sectional measurement errors arising from using a sample.

Table 7**:** Mean excess returns sensitivity of ten portfolios sorted on duration
The table documents how monthly excess returns respond to changes in the variables with OLS t statistics given in each t stat row for the ten portfolios grouped on durations and an arbitrage portfolio composed of going long with the portfolio with the lowest duration(D1) and short selling the portfolio with the highest duration(D10).

Returns are equally weighted. Durations are reestimated at each year end and therefore portfolios are annually rebalanced. As a result, durations at the end of year *t* correspond to the subsequent monthly returns for the year *t+1*. Each firm month is sorted into deciles based on the estimated durations. I include all common stocks listed on KOSPI and KOSDAQ for the 33-year period from 1987 through 2019. Delisted firms are not excluded while financial institutions are excluded. Stocks below the 20th market capitalization are excluded to avoid possible small firm anomaly.

As a proxy of risk-free rate I use rates of 'Monetary Stabilization Bonds (MSBs)' issued and utilized by Bank of Korea as means of the Bank's open market operations. As there is no MSBs whose maturity is one month, one month rate is calculated by monthly compounding using yearly rates. Market excess return is value weighted return of all common stocks listed on KOSPI and KOSDAQ minus one-month MSB rate.

	D1	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**D1-D10**
r=0.10	1.40	1.15	0.88	0.81	0.55	0.29	0.14	-0.06	-0.63	-0.81	2.21
t stat	*17.50*	*14.38*	*11.00*	*10.13*	*6.11*	*3.22*	*1.56*	*-0.60*	*-5.73*	*-6.23*	*27.63*
r=0.14	1.39	1.10	0.93	0.79	0.51	0.32	0.17	-0.12	-0.60	-0.78	2.18
t stat	*17.38*	*13.75*	*11.63*	*9.88*	*5.67*	*3.56*	*1.89*	*-1.20*	*-5.00*	*-6.00*	*27.25*
AR(roe=0.63)	1.28	1.03	0.69	0.49	0.47	0.20	0.17	-0.00	-0.12	-0.53	1.81
t stat	*16.00*	*12.88*	*8.63*	*6.13*	*5.22*	*2.22*	*1.70*	*0.00*	*-1.09*	*-4.08*	*22.63*

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D1-D10
AR(roe=0.83)	1.29	1.05	0.70	0.48	0.48	0.24	0.09	0.07	-0.20	-0.52	1.81
t stat	*16.13*	*13.13*	*8.75*	*6.00*	*5.33*	*2.67*	*0.90*	*0.70*	*-1.82*	*-4.00*	*22.63*
ROE(0.10)	1.28	1.03	0.69	0.49	0.47	0.20	0.17	0.00	-0.12	-0.53	1.81
t stat	*16.00*	*12.88*	*8.63*	*6.13*	*5.22*	*2.22*	*1.70*	*0.00*	*-1.09*	*-4.08*	*22.63*
ROE(0.14)	1.29	1.05	0.70	0.48	0.48	0.24	0.09	0.07	-0.20	-0.52	1.81
t stat	*16.13*	*13.13*	*8.75*	*6.00*	*5.33*	*2.67*	*0.90*	*0.70*	*-1.82*	*-4.00*	*22.63*
AR(SG=0.36)	1.22	0.68	0.20	0.24	0.33	0.36	0.35	0.27	0.32	-0.25	1.47
t stat	*13.56*	*8.50*	*2.22*	*2.67*	*3.67*	*4.00*	*3.89*	*3.00*	*2.91*	*-2.27*	*21.00*
AR(SG=0.56)	1.21	0.63	0.19	0.22	0.33	0.34	0.36	0.29	0.36	-0.22	1.43
t stat	*13.44*	*7.88*	*2.11*	*2.20*	*3.67*	*3.78*	*4.00*	*3.22*	*3.27*	*-2.00*	*20.43*
SG(0.04)	1.30	0.77	0.49	0.27	0.25	0.26	0.25	0.23	0.20	-0.36	1.66
t stat	*16.25*	*9.63*	*5.44*	*3.00*	*2.78*	*2.89*	*2.78*	*2.30*	*1.82*	*-3.00*	*23.71*
SG(0.08)	1.27	0.68	0.32	0.18	0.26	0.29	0.34	0.31	0.30	-0.29	1.56
t stat	*15.88*	*8.50*	*3.56*	*2.00*	*2.60*	*3.22*	*3.78*	*3.10*	*2.73*	*-2.64*	*22.29*

3.5 Vintage analysis and robustness

Characteristics that existed in specific periods could disappear over time. To test whether the downward term structure remains across years, I intersect the 33-year observation period into the three sub-periods each of which has 11-year period. Table 8 presents excess returns at a portfolio level with OLS t statistics given in each t stat row below. Overall I find statistically significant downward term patterns of equity return hold across the sub-sample periods as seen in the Figure 5. The long-short portfolio(D1-D10) shows more than 1.5% of duration premium per month across the sub-periods.

Table 8**:** Monthly excess returns for ten portfolios sorted on durations for the varied periods
The table reports monthly mean excess returns of the ten portfolios sorted on duration with OLS t statistics in each t stat row for subsamples. The long short portfolio is formed in the way the shortest duration portfolio(D1) is held for long position and the longest duration portfolio(D10) is sold short. Monthly excess returns are equally weighted. Portfolios are annually reformed with durations reestimated at each year end. As a result, durations at the end of year *t* are matched to the subsequent 12 monthly returns for the year *t+1.* Each firm month is sorted into deciles based on the estimated durations. I include all common stocks listed on KOSPI and KOSDAQ for the 33-year period from 1987 through 2019. Delisted firms are not excluded while financial institutions are excluded.

Book values of equity, earnings, sales growth and ROEs come from TS2000. Market capitalization data are from KISVALUE. Stock return data are obtained from Data Guide. For long-term average sales growth used to estimate equity book value growth, I obtain Korea GDP growth rates from World Bank for the past 33 years from 1987 through 2019. For long-term average cost of capital, I use KOSPIs for the past 33 years from 1987 through 2019 which come from TS2000. Stocks below the 20th quantile of market capitalization are excluded to avoid small firm anomaly.

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D1-D10
					Panel A: 1987 to 1997						
Mean	-0.15	-0.51	-0.77	-0.94	-0.89	-1.33	-0.97	-1.40	-1.86	-1.66	1.51
t stat	*-0.58*	*-2.13*	*-3.21*	*-3.76*	*-3.56*	*-5.32*	*-3.88*	*-5.60*	*-7.44*	*-5.72*	*7.95*
					Panel B: 1998 to 2008						
Mean	1.77	1.30	1.42	0.85	0.57	-0.14	-0.27	-0.89	-1.74	-1.24	3.00
t stat	*9.32*	*7.65*	*7.89*	*4.72*	*3.00*	*-0.74*	*-1.29*	*-3.71*	*-6.96*	*-3.76*	*15.79*
					Panel C: 2009 to 2019						
Mean	1.67	1.51	1.50	1.19	1.04	0.95	0.68	0.70	0.21	-0.16	1.84
t stat	*18.56*	*16.78*	*15.00*	*11.90*	*10.40*	*9.50*	*6.80*	*6.36*	*1.62*	*-1.07*	*20.44*

Figure 5 Equity term structures in varying periods

These figures exhibit duration premiums in varying periods. I intersect 33-year period from 1987 through 2019 into three sub-sample periods. Each sub period has 11-year observation. Delisted firms are not excluded while financial institutions are excluded. Stocks below the 20th quantile of market capitalization are excluded to avoid possible small firm anomaly.

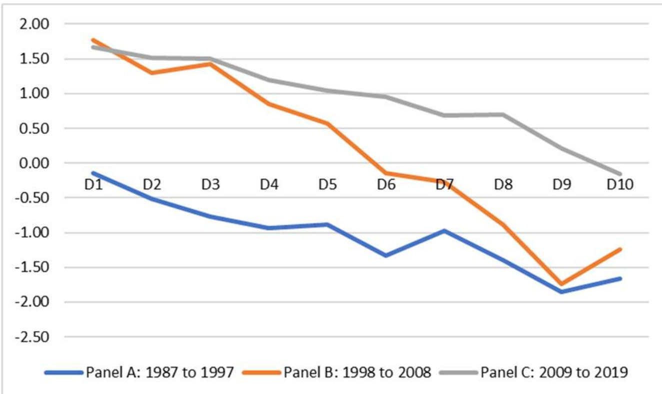
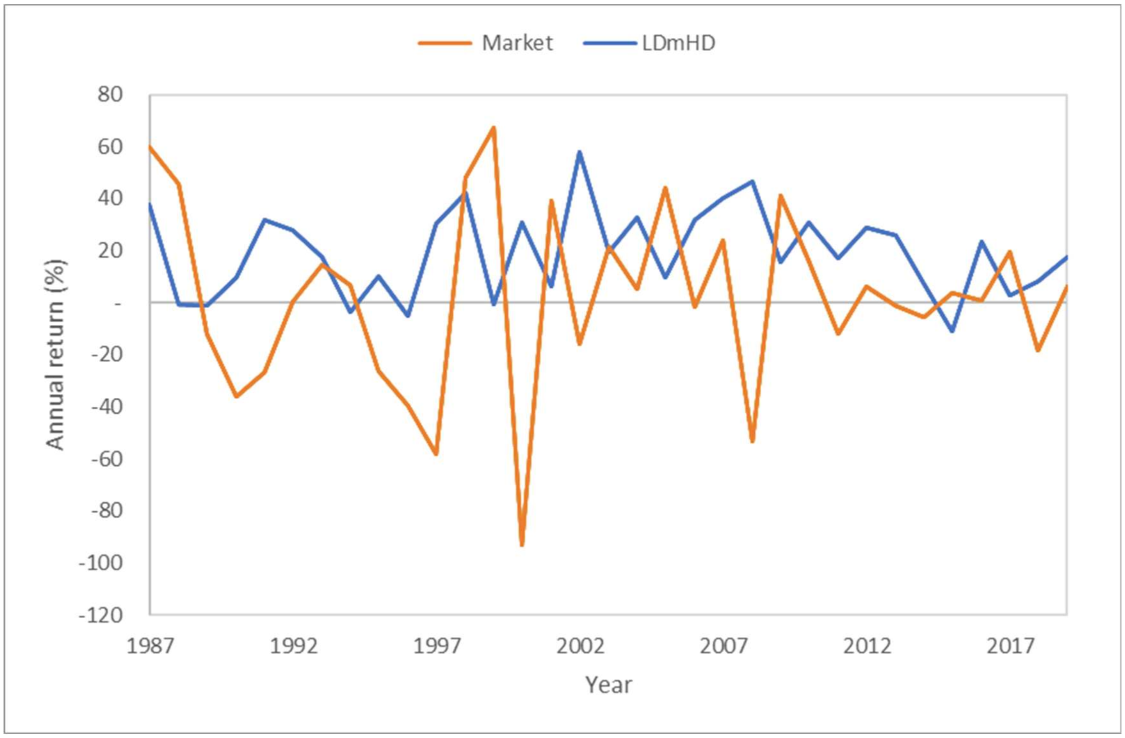


Figure 6 presents time series of excess returns of long-short portfolios(low duration stocks minus high duration stocks) and market excess returns. There seems to be duration premium(LDmHD) across the sample years. Both market excess returns and LDmHD vary over time showing negative covariance. There are ups and downs in LDmHD with average of 19% and standard deviation of 17%. Notably, LDmHD becomes pronounced in market downturns: the spread between low duration stocks and high duration stocks turns smaller during the up market while the spread becomes larger during the market downturns. Based on the risk-based explanations on the duration premium(Mohrschladt and Nolte(2018) and Gonçalves(2021)), this could imply that investors may request more compensation for bearing increasing reinvestment risk in bad times because the opportunity cost of investors who invest in short duration stocks will increase during the market downturns as compared to when the investors invest in long duration stocks which will provide a hedge against the reinvestment risk. On the contrary, investors would not require the reinvestment premium or request less compensation for the reinvestment risk in good times because the opportunity cost will reduce.

Figure 6 Time series of long-short portfolio returns
This figure plots annualized long-short portfolio excess returns and market excess returns. Long-short portfolio is formed of low duration stocks minus high duration stocks(LDmHD). High duration stocks are stocks with above-the-70th-percentile at a prior year end and low duration stocks are stocks with below-the-30th-percentile duration. Durations are renewed on an annual basis as at year end and LDmHD are updated accordingly.



4 Short sale constraints and the term structure

The previous chapter demonstrates equity return's downward sloping term structure which holds across the variables and the time variations. In this chapter, I explore why short duration premium survive that would have disappeared in an effective market. Following Weber (2018), I test whether short sale constraints in Korea market would restrict arbitrage transactions and therefore lead to the long-short portfolio earning an excess return.

Hypothesis 1: An arbitrage portfolio yields a higher positive excess return in a portfolio with lower foreign investment ratios.

Hypothesis 2: If Hypothesis 1 is the case, the excess returns from the long short portfolio should be driven by high duration stocks, not short duration stocks.

4.1 Foreign investments' ownership and short sale constraints

Foreign investors are the largest trader in both borrowing and lending of stocks in Korea stock market. Foreign investors accounted for 64% as stock borrower and 49% as stock lender while local broker-dealers explains 25% and 30% as lender and borrower respectively for the period from 1996 through 2019 according to Korea Financial Investment Association (KOFIA). Given the materiality of foreign investors ownership in the short sale market, I determine to use foreign investment ratios (FIR) as a short selling constraint proxy.

Table 1 illustrates a strong positive correlation between foreign investment ratios and market capitalization. To eliminate a size effect from my proxy, I count on Nagel (2005) and derives residual foreign investment ratios (RFIR) from the following regression equation:

$$log\,\frac{FIR_{it}}{1-FIR_{it}} = \alpha + \beta_1 \log(Market\ cap) + \beta_2 (\log(Market\ cap))^2 + RFIR_{it}$$

4.2 Short sale restrictions and term structure of equity returns

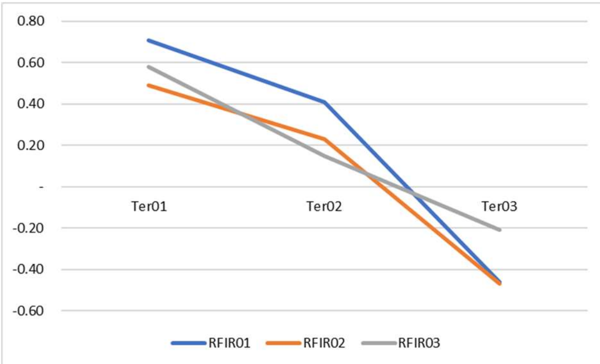
Table 9 reports monthly excess returns for the nine portfolios sorted on duration and foreign investment ratios. The return monotonically decreases as duration increases across tertile portfolios. Figure 7 shows return curves slope downward across the portfolios from low RFIR to high RFIR, but the downward sloping pattern is the most pronounced for the portfolio with the lowest RFIR(RFIR01) which is deemed to be the most short sale constraint. In the lowest RFIR portfolio, low duration stocks generate excess return of 0.71% per month while high duration stocks earn an excess return -0.46% per month. As a result, the arbitrage portfolio(T1-T3) will earn 1.18% of excess return which is statistically significant and economically large.

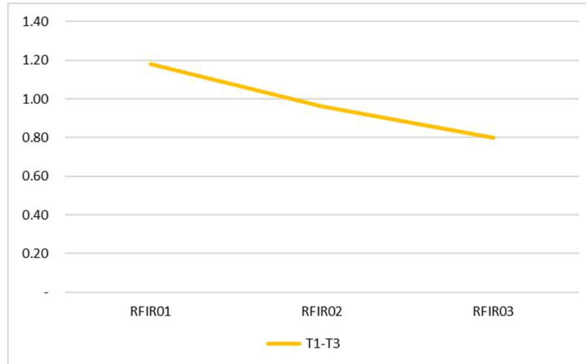
Looking at the last column, excess returns monotonically decrease over RFIR portfolios from the most short sale constraint to the least short sale constraint portfolio. The most short sale constraint stocks produce a statistically significant excess return of 1.18% per month while the least short sale constraint portfolio yields a lower excess return of 0.80% , which is almost half of the most short sale constraint stocks. Higher excess return in the most short sale constraint portfolio confirms Hypothesis 1 is correct. Looking at varying excess returns across RFIRs, we find the excess returns originate significantly from high duration stocks: out of the total excess return of 0.38% from the long short portfolio, high duration portfolio (T3) accounts for 0.25%, or a proportion of 66% of the total excess return. On the contrary, an excess return from the shortest duration portfolio is only 0.13% which is statistically insignificant. This supports Hypothesis 2. Short sale constraint proxied by foreign investors' ownership only matters for the highest duration portfolio.

Table 9: Mean excess monthly returns of nine portfolios sorted on durations and foreign investment ownership
This table provides monthly excess returns with OLS t statistics in each t stat row of nine portfolios grouped on durations and residual foreign investment ratios(RFIR) and an arbitrage portfolio composed of long position with the lowest duration portfolio(T1) and short position with the highest duration portfolio(T3). Returns are equally weighted. Durations are reestimated at each year end on an annual basis and portfolios are annually rebalanced. As a result, durations at the end of year *t* correspond to subsequent 12 monthly returns for the year *t+1*. Each firm month is sorted into tertiles based on the estimated durations. These tertiles are further broken down into three portfolios based on RFIRs. RFIRs at the end of year *t* are mapped to monthly returns for the year *t+1*. RIFRs are residuals after a cross-sectional regression of foreign investors' ownership ratios on market capitalization.
I observe all common stocks listed on KOSPI and KOSDAQ for the 23-year period from 1997 through 2019 as foreign investment ratio has been available since 1997. Delisted firms are not excluded while financial institutions are excluded. Stocks below the 20th quantile of market capitalization are excluded to avoid possible small firm anomaly. Foreign investment ratios are obtained from TS2000.

	T1	**T2**	**T3**	**T1-T3**
RFIR01	0.71	0.41	-0.46	1.18
t stat	*7.89*	*4.56*	*-3.83*	*10.73*
RFIR02	0.49	0.23	-0.47	0.96
t stat	*7.00*	*2.88*	*-4.27*	*10.67*
RFIR03	0.58	0.15	-0.21	0.80
t stat	*7.25*	*1.88*	*-1.91*	*8.89*
RFIR01- RFIR03	0.13	0.26	-0.25	0.38
t stat	*1.63*	*2.89*	*-2.08*	*5.43*

Figure 7 Impact of foreign investment on equity return term structure
The figure below visualizes Table 9 presenting patterns of monthly mean excess returns over nine portfolios sorted on durations and residual foreign investment ratios.





5 Conclusion

I observe a downward sloping term structure of equity returns hold in Korea stock market. The shortest duration portfolio has a monthly excess return of 0.77% whereas the highest duration portfolio generates -0.74% of excess return per month after controlling for common risk factors(market, size, value and momentum). As a result, an arbitrage portfolio formed of long position on the shortest duration stocks and short position on the longest duration stocks earn an excess return of 1.51% per month which is statistically and economically significant. Duration has an incremental explanatory power on pricing errors left by CAPM and Fama and French three factor model augmented with momentums.

Short sale constraint drives a larger spread in excess return between high duration stocks and low duration stocks. The return spread is 1.18% per month for the most short sale constraint stocks but the spread reduces to 0.80% per month for the least short sale constraint stocks, which are statistically supported and economically significant. Short sale constraint is binding only for the high duration stocks. Holding low foreign investment stocks and short selling high foreign investment stocks earns a statistically insignificant excess return of 0.13% for the low duration stocks whereas the long short portfolio earns a statistically significant excess return of -0.25% per month for the high duration stocks.

References

A.S. Gonçalves, The short duration premium, Journal of Financial Economics, https://doi.org/10.1016/j.jfineco.2021.04.019

Carhart, 1997, On persistence in mutual fund performance, Journal of Finance, 52 (1997), pp. 57-82

Dechow, Sloan, Soliman, 2004. Implied equity duration: a new measure of equity risk. Rev. Account. Stud., 9 (2004), pp. 197-228

Dechow, Erhard, Sloan, Soliman, 2021. Implied equity duration: a new measure of pandemic shutdown risk. Journal of accounting research, 2021-03, Vol.59 (1), p.243-281

Fama, French, 1993, Common risk factors in the returns on stocks and bonds, Journal of financial economics, 1993-02, Vol.33 (1), p.3-56

Fama, MacBeth, 1973, Risk, Return, and Equilibrium: Empirical Tests, Journal of Political Economy, Vol. 81, No. 3 (May - Jun., 1973), pp. 607-636

Lettau, Washter, 2007, Why is long-horizon equity less risky? A duration-based explanation of the value premium, J. Financ., 62(1), p.55-92

Mohrschladt, Nolte, 2018, A new risk factor based on equity duration, Journal of banking & finance, 2018-11, Vol.96, p.126-135

Nagel, 2005, Short sales, institutional investors, and the cross-section of stock returns, J. Financ. Econ., 78 (2005), pp. 277-309, 10.1016/j.jfineco.2004.08.008

Newey, West, 1987, A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix, Econometrica, Vol. 55, No. 3 (May 1987), pp. 703-708

Newey, West, 1994, Automatic Lag Selection in Covariance Matrix Estimation, The Review of economic studies, 1994-10, Vol.61 (4), p.631-653

Nissim, Penman, 2001, Ratio analysis and equity valuation: from research to practice, Rev. Account. Stud., 6 (2001), pp. 109-154

Shanken, 1992, On the estimation of beta-pricing models, Rev. Financ. Stud. 5 (1), 1-33

Weber 2018, Cash flow duration and the term structure of equity returns, J. Financ. Econ., 128(2018), pp. 486-503

한글 초록

회수시간이 짧은 주식일수록 수익률이 높아지는 현상을 한국주식시장에서도 관찰할 수 있다. 회수기간이 짧은 주식 포트폴리오를 보유하고 긴 주식 포트폴리오를 공매도하는 차익거래 포트폴리오를 구성할 경우 월 2% 이상의 초과수익률을 얻을 수 있음을 과거 수익률 데이터 분석을 통해 관찰할 수 있었다. 기존 자산가격결정모형으로 설명되지 않는 수익률의 상당 부분을 이러한 회수기간 프리미엄을 통해 설명할 수 있다. 회수기간이 짧은 주식이 갖는 수익률 프리미엄은 자기자본수익률이 높고 매출성장률이 낮을 때 더 두드러진다. 공매도 제약이 큰 주식일수록 회수기간 프리미엄은 더 커진다. 공매도가 가장 제한된 주식의 수익률이 가장 덜 제한된 주식의 수익률보다 두 배 가량 높았다. 공매도 제약은 회수기간이 긴 주식에만 유의한 영향을 미친다.

열쇠 말:

회수기간 프리미엄(duration premium), 수익률 기간구조, 공매도 제약, 가치주, 성장주, 위험의 가격