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EQUITY DURATION PUZZLE AND INVESTORS' DEMANDS: EVIDENCE FROM KOREA

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ABSTRACT

We are interested in to find out how prolonged low interest rate condition since GFC (Global Financial Crisis) has changed the investors' appetite for financial assets. Motivated by Jiang and Sun (2017), this study examines equity duration, the sensitivity of the stock prices to interest rate changes in the Korean market using KOSPI data spanning from 1995 to 2015. We find the following results. First, the equity duration tends to be longer as the dividend yield of stocks increases, which is defined as "Equity Duration Puzzle," contradicting the intuition from the Macaulay duration formula (1938). We found this phenomenon also persist for the 30 chaebol companies which are representative of conservative dividend-paying Korean companies. Second, the equity duration of stocks that pay high dividends statistically decreases as interest rate decline slows. Third, the equity duration puzzle exists even after controlling for the distance to default and the cash flow volatility, implying that these factors cannot explain the puzzle. We conjecture that, under the extended low interest rate conditions, investors' demand shift toward the high dividend stocks may explain this puzzle; we found that when the interest rate decreases, both institutional and individual investors increase the demand for high dividend stocks as the safer substitute of bond. This demand shift can explain the equity duration puzzle in Korean market.

Keywords: Equity duration; Interest rate; High dividend stocks; Investor behavior.

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1. INTRODUCTION

Since Macaulay (1938), the notion of duration has drawn a great deal of interest from researchers, which is a dominant measure of the sensitivity of the price of a fixed income assets to a change in interest rates. Intuitively, the longer the duration of asset is, the more sensitive the asset is to fluctuations in interest rates because of the power of compounding. In our study, we examine if stocks with higher dividend payouts have shorter duration, which is consistent with the Macaulay duration formula (1938) drawn by the dividend discount model (DDM). We found that there exists "equity duration puzzle" in Korean market, which is opposite to the intuition from the concept of theoretical duration formula. We also focus on providing the reason of this puzzle. It is important to understand equity duration puzzle since it implies that under the low interest rates environment, the investors choose high dividend yield stocks as the alternative of fixed income investments. This finding casts an interesting insight concerning the investors' behavior across long-term bonds and

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high dividend stocks, which have similar characteristics, and could compete to win investors' asset portfolios in various interest rate regimes.

Major central banks around the world have been deploying the ultra-low interest rate policies responding to the Global financial crisis to avoid a deeper recession. For instance, Bank of Japan and European Central Bank (ECB) have even adopted negative interest rates. In the U.S., the FOMC (Federal Open Market Committee) has maintained the federal funds rate at a record low of 0.01% from 0.38%[1] as of December 2008 to stimulate the U.S. economy. The interest rate in Korea has been decreasing as well. The Bank of Korea has kept the key interest rate steady at an all-time-low of 1.25% since June 2016, which is far below compared to the 5.25% in August, 2008[2]. Under such extended low interest rate conditions, dividend paying stocks attract substantial interests from investors because they can provide competitive yields with less volatility.

Unlike the U.S., the Korean companies are conservative toward dividend payouts. The average dividend yield ratio of Korean firms is estimated at 1.88%[3] reported by Daishin Securities with the companies in MSCI (Morgan Stanley Capital International Index), which is one of the lowest among major capital markets. Korean companies including chaebol group companies have in the past had no need to raise dividend yield for investors since investors focus more on capital gains due to the high growth of the economy and firms. However, as Korean economic growth rate slows down and more foreigners hold Korean stocks, demand for dividend payment has been increasing. Korean government also announced[4] its plan to adopt the new tax incentive policy to encourage higher dividend payments to protect minority shareholder rights, lowering corporate dividend income tax and imposing a tax penalty on excessive retained earnings. Responding to these changes, many Korean companies are increasing dividend payouts and investors show keen interest to high dividend stocks. As a matter of fact, as of May, 2016, the proportion of dividend equity fund in the fund market reached 11%, which is more than four times of a mere 2.7% in 2012. It is expected to further increase as the liquid money in the Korean capital market is estimated to be more than 90 trillion won (as of the end of 2016) in line with the bank's continued easing stance to bolster the economic growth. Therefore, the relationship between the dividend stock and the interest rate changes is an important topic worthy of investigation.

Despite its importance, empirical studies on the equity duration of the dividend stocks have been limited. The past papers mostly focus only on either the equity duration as the element of portfolio management or what factors determine the equity duration. But, no study had examined the equity price sensitivity to interest rates until Jiang and Sun (2017)[5] challenged this issue. Motivated by Jiang and Sun (2017), this paper examines how and why the price of the dividend stocks responds sensitively to the interest rate changes in the Korean market.

The study is conducted with a sample of 738 KOSPI stocks collected from Fn-Guide between May 1995 and December 2015 (248 months). The interest rates of government bonds are collected from

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[1] https://www.bloomberg.com/quote/FDFD:IND
[2] The Bank of Korea, http://www.bok.or.kr/baserate/baserateList.action?menuNaviId=1927
[3] http://www.hani.co.kr/arti/economy/finance/790188.html
[4]http://news.g-enews.com/view.php?ud=201604121135214311896_1&md=20160412153008_F
http://www.yonhapnews.co.kr/bulletin/2016/03/17/0200000000AKR20160317075200008.HTML?input=1195m
[5] Jiang and Sun (2017) found that high dividend stocks tend to have longer duration, more price changes to interest rate changes in the U.S. market, which is contrary to the Macaulay's duration formula.

the Bank of Korea Economic Statistics System. The research methodology follows that of Jiang and Sun (2017). The Macaulay duration formula (1938) suggests that stocks with higher dividend yields have shorter equity duration. If there exists an equity duration puzzle, the equity duration is expected to be longer as the dividend yield increases contrary to the Macaulay duration formula. To find the source of this puzzle in the KOSPI market, this study also tests the effect of the distance to default, the cash flow volatility, and the behavior of stock investors on high dividend stocks. The equity duration puzzle is also tested for thirty chaebol group companies separately as they are known to be reluctant to pay high dividends. If there appears equity duration puzzle even in this market, this analysis could be a robustness check for the validity of equity duration puzzle.

The main findings of the paper are summarized as follows. First, except for the period relating to the financial crisis, the stocks with higher dividend yields have longer equity duration, which is consistent with the findings in Jiang and Sun (2017). This phenomenon presents for the 30 chaebol group companies as well to support the robustness of the result. It is also found that the equity duration of stocks that pay high dividends statistically decreases as interest rate decline slows down. We also found that the distance to default and cash flow volatility cannot explain the equity duration puzzle. We suggest that, under the extended low interest rate conditions, investors' demands toward the high dividend stocks may explain this puzzle.

The remainder of the paper is organized as followings. Section 2 summarizes the literature review. Section 3 describes the methodology and the hypothesis of the study. Section 4 explains the data and shows the empirical test results. Section 5 concludes the paper.

2. LITERATURE REVIEW

The early literature attempted to extend the concept of bond duration to equities. They show that stock duration is equal to the reciprocal of the stock's dividend yield (eg. Lanstein and Sharpe (1978), Leibowitz (1986), Cornell (1999), Kang, Nam and Han (2013), and Elyasiani and Mansur (1998)). They further argue that high yield stocks have a short weighted average maturity of cash flows and hence a shorter duration compared to low yield stocks. But, these papers take note of the equity duration only on the aspect of the portfolio management. Lanstein and Sharpe (1978), and Cornell (1999) suggest the equity duration as one of the ways of assessing its systematic risk (stock market beta). Elyasiani and Mansur (1998) stress the sensitivity of the bank stock returns to changes in volatility of interest rate with GARCH-M model. They find that equity duration directly impacts the first and the second moments of the stock returns as interest rate risk. Also, among several recent studies, Weber (2016) finds that high duration stocks have low future returns because of temporary overpricing.

Other studies examine the potential determinants of the equity price sensitivity to interest rates. Gould and Sorensen (1986) using the dividend discount model argue that high growth stocks are more sensitive to interest rate changes than low growth stocks. Tessaromatis (2003) suggests that government regulation, cyclicality of future cash flows, and equity style (growth versus value characteristics of stocks) can explain the differences in the equity duration. Jiang and Sun (2017) which motivates this study examines the duration of equity stocks on the level of the dividend yield. They suggest that stocks that pay higher dividends tend to have longer duration when interest rates decline. This can be explained by the investors' behavior under the low interest rate regime called "reaching for dividends." They show that when interest rates decline, investors switch their funds to income-oriented equity mutual funds. In particular, households increase stocks in their asset allocations instead of bonds. Also, income fund managers over-weight high dividend stocks in a low interest environment. This increase in the demand for high dividend stocks results in higher stock prices and returns and this phenomenon is suggested as the evidence of higher dividends with longer duration upon the low interest rate condition.

Furthermore, there are some papers about investor's demand and the dividend yields, in particular with the institutional and the individual investors. Cready (1994) suggests that, among individual investors, demand for the stocks of riskier, larger, and low-dividend-yield firms increases with wealth. He further finds that institutional investors prefer the stocks of larger firms, S&P 500firms, and low dividend yield firms compared to individual investors. Inconsistent with Cready (1994), Jain (2007) argues that individual investors prefer to invest in high dividend yield stocks whereas lower-taxed institutional investors are inclined to low dividend yield stocks. He also finds that while individual investors do not prefer share repurchases, institutional investors has a weak preference on larger share repurchases for firms. Although this result is contrary to tax-based and non-tax based dividend clienteles effect, it is consistent with the results of other studies (Peterson, Peterson, and Ang (1985), Kemsley and Nissim (2002)).[6] For recent studies of dividend stocks and investors' behavior, Hartzmark and Solomon (2013) discovered dividend-related anomaly in which there exist abnormal returns in predicted dividend months. They also found that these returns are larger for companies which have higher dividend yields because dividend-seeking investors demand shares that pay larger dividends.

There exist several papers on the high dividend stocks in the Korean market. They show the excess return depending on the level of the dividend yields. Park and Kim (2010) find that stocks with higher dividend yield earn higher risk-adjusted returns for five portfolios ranked by the long-term dividend yield. In a separate paper, Kim (2013) suggests that the investment of the high dividend stocks shows superior achievements in bear markets. He suggests that this result is because of the defensive characteristics of dividend stocks.

3. METHODOLOGY

3.1. Framework of Equity Duration

The equity duration is a measure of equity price sensitivity to changes in interest rates and of the average equity cash flows. The dividend discount model (DDM) is one of the basic methods of valuing a company's stock price based on the net present value of the future dividends. In the dividend discount model (DDM), the definition of stock price is provided below:

[6]Elton and Gruber (1970) find that the ex-dividend day tax effect per dollar of dividends is lower for high dividend stocks than for low dividend stocks, which is consistent with the expected clientele effect because high-dividend stocks attract low-tax investors. Unlike the methodology of most studies, Jain (2007) examines differences in the preferences of higher taxed individual investors and lower taxed institutional investors for dividend paying firms, which is inconsistent with the tax-based dividend clientele hypothesis.

$$P = \sum_{t=1}^{\infty} D_0 \frac{(1+g)^t}{(1+r)^t}$$

Here, P denotes stock price, D_0 denotes the stock's dividend payment at time 0, g denotes the constant growth rate, and r indicates the discount rate for the stock's dividend payment. Assuming the stock's dividend after period t grows at a constant rate of g, the stock price is as follows:

$$P = \frac{D_0(1+g)}{r-g} \tag{1}$$

The traditional measure of duration *(D)* for a stock is the Macaulay duration formula (1938):

$$D = \frac{\sum_i t_i \times \frac{D_0 \times (1+g)^t}{(1+r)^t}}{P} \tag{2}$$

The numerator in the Macaulay duration formula can be written as below:

$$\sum_i t_i \times \frac{D_0 \times (1+g)^t}{(1+r)^t} = (D_0 + P) \times \frac{1+g}{r-g}$$

Combining (1) and (2):

$$D = \frac{\sum_i t_i \times \frac{D_0 \times (1+g)^t}{(1+r)^t}}{P} = \frac{(D_0 + P) \times \frac{1+g}{r-g}}{D_0 \times \frac{(1+g)}{r-g}} = \frac{D_0 + D_0 \times \frac{(1+g)}{r-g}}{D_0} = 1 + \frac{1+g}{r-g} = \frac{1+r}{r-g}$$

Thus, we can express $Duration_t$ as:

$$Duration_t = -\frac{\partial P_t / P_t}{\partial r / r} = \frac{1+r}{r-g} = \frac{1+r}{D_{t+1}/P_t} \tag{3}$$

and $1/(D_{t+1}/P_t)$ is often referred to as the 'modified duration', which is a stock's price at *t* to dividend at *t+1*. This equation (3) shows that stocks of firms with high dividend yields is expected to have low duration, all other things being equal. Intuitively, stocks with high dividend yields have low future dividend growth rates *g,* which result in small amounts of dividend payments farther in the future. It is similar with a concept of bonds' duration that the higher the coupons, the shorter the duration. This implies that bonds with high coupons are less sensitive to changing interest rate and thus are less volatile in a changing interest rate environment.

3.2. Hypothesis of Study

3.2.1. An Empirical Equity Duration

<Hypothesis 1>

- H0: Higher dividend paying stocks exhibit shorter duration (=price sensitivity in interest rate) than low dividend paying stocks.

As mentioned in the previous section in detail, according to the Macaulay duration formula (1938) drawn by the dividend discount model (DDM), stocks with high dividend yields have low duration. If the coefficient of Duration of high dividend stocks significantly increases as the dividend yields increase, the hypothesis that the stocks with higher dividend yields have lower duration can be rejected.

Jiang and Sun (2017) shape the empirical regression model of this study. We estimate empirical equity durations as the negative of the slope coefficients to changes in interest rates from the following market model regression:

$$R_{i,t} - R_{f,t} = \alpha + Duration \times (-\Delta Interest_t) + \beta_1 \times (R_{m,t} - R_{f,t}) + \beta_2 \times SMB + \beta_3 \times HML + \beta_4 \times \mathrm{MOM} + \epsilon_{i,t} \tag{4}$$

Here, $R_{i,t}$ is the return on the asset *i* in month t, $R_{f,t}$ is the interest rate on 1-month Treasury bill in month *t*, $\Delta Interest_t$ is the change in 5-year Treasury bill interest rate in month *t.* The control variables are four significant common factors in stock returns: the market, firm size, book-to-market ratio, and momentum as reported in the Fama and French (1993) and Jegadeesh and Titman (1993). From equation (4), duration is estimated as the negative of the slope coefficients for changes in interest rates to be tested whether it is shorter for low dividend paying stocks. If hypothesis 1 is rejected, one can argue that duration equity puzzle exists.

3.2.2. The Distance to Default and the Equity Duration Puzzle

<Hypothesis 2>

- H0: The probability of default given by the distance to default model can explain the equity duration puzzle.

If the hypothesis 1 that stocks with high dividends have short duration is rejected, there is a possibility that it is due to the probability of default. As said in Jiang and Sun (2017) if companies are under threat of default, they would have a fall in profits and pay lower dividends. Then, their cash flows can have shorter duration, while the result of companies with the high dividends can have the opposite.

According to Merton (1974), the Merton Distance to Default (DD) is calculated as:

$$DD = \frac{ln\left(\frac{V}{D}\right) + (\mu - 0.5\sigma_V^2) \times T}{\sigma_V \times \sqrt{T}} \tag{5}$$

Here, V is the total value of the firm, D is the face value of the firm's debt, μ is an estimate of the expected annual return of the firm's assets, σ_V is the volatility of firm value, and T is a time. However, the problem is that this Merton DD model contains estimates that cannot be calculated exactly. Therefore, we utilize naive DD model constructed by Bharath and Shumway (2008) with naive predictors. First, they approximate the market value of each firm's debt (*naive D*) with the face value of its debt (D). Second, the volatility of each firm's debt is approximated as (6). The five percentage points represent structure volatility and twenty-five percentage points times equity volatility (σ_E) indicate the volatility related to default risk. This is because firms' debt risk is closely correlated to their equity risk when firms are close to default.

$$naive\ \sigma_D = 0.05 + 0.25 \times \sigma_E \quad (6)$$

Therefore, an approximation to the total volatility of the firm (naïve σ_v) can be expressed as:

$$naive\ \sigma_v = \frac{E}{E + naive\ D} \times \sigma_E + \frac{naive\ D}{E + naive\ D} \times (0.05 + 0.25 \times \sigma_E) \quad (7)$$

Here, E is the market value of the firm's equity, and σ_E is the volatility of equity value. Finally, an estimate of the expected annual return of the firm's assets (μ) is approximated as the firm's stock return over the previous time (r_{it-1}). This setting enables us to capture the naive Default to Distance model (DD model) by the iterative procedure per month. Hence, the equation (5) can be expressed as follows.

$$naive\ DD = \frac{ln\left[\frac{(E+naive\ D)}{naive\ D}\right] + (r_{it-1} - 0.5 \times naive\sigma_V^2) \times T}{naive\sigma_V \times \sqrt{T}} \quad (8)$$

Next, we perform double sorts. We employ two sort variables; the means of naive DD and the dividend to price ratios of stocks over the study period to construct the four quartile portfolios respectively. Combining two four quartile sorts, sixteen portfolios are constructed. Then the duration can be examined by running the regression (4) controlling for DD. Then, we check whether hypothesis 1 is still rejected after we sort the portfolio with DD. If there still exists the equity duration puzzle with high dividend stock even after controlling for DD, DD cannot be the cause of the equity duration puzzle.

3.2.3. The Cash Flow Volatility and the equity duration puzzle

<Hypothesis 3>

- H0: The equity duration puzzle is due to stocks' lower cash flow volatility.

Another explanation for the equity duration puzzle with high dividend stocks can be the cash flow volatility. Haugen and Wichern (1974) argued that the securities with relatively high price volatility are less sensitive to interest rate changes, and thus, leads to shorter duration. Also, Hoberg and Prabhala (2009) emphasize that dividends are negatively related to firms' cash flow risk, and duration becomes longer for high dividend stocks with low cash flow risk. Therefore, as in Jiang and Sun (2017)'s study, we examine whether the stocks' potential lower idiosyncratic risk[7] results in the high sensitivity to changes in interest rate for the high dividend stocks. As in the section above, we sort stocks simultaneously based on their dividend to price ratios and idiosyncratic volatilities respectively. We use the sixteen portfolios based on four quartile sort in two variables. Then the duration can be examined by running the regression (4) controlling for the cash flow risk. If there still exists the equity duration puzzle with high dividend stocks, the cash flow volatility cannot be the cause of the puzzle.

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[7]Recent studies show the importance of idiosyncratic risk in driving firms' cash flow risk. As in Jiang and Sun (2017)'s study, our paper uses idiosyncratic volatilities of dividend stocks as the proxy of cash flow volatility.

3.2.4. The Investor Demand and the Level of Interest rate

<Hypothesis 4>

- H0: The level of interest rate affects the investor demand of high dividend stocks.

Jiang and Sun (2017) provide the idea that if lower interest rates lead income-oriented investors to build their portfolios with the larger amount of high dividend-paying stocks, their higher demands cause the longer duration (=stock price sensitivity to interest rate change) for the high dividend stocks. This mechanism is similar to that of the investor's demands in the bond market. Additionally, they propose the hypothesis of "reaching for dividends" in a low interest rate environment. They divert their attention into bond investors' behavior to explain the equity duration puzzle with high dividend stocks. According to Miller and Modigliani (1961), investors can transform income to capital gain without costs, and dividends are not vital factor for investor's demand. However, in real markets, since there exist transaction costs for the transformation, income streams over a long period attract the income-oriented investors. In particular, these investors prefer to choose the long-term bond in their portfolio since the long-term bonds give continuous incomes to long term investors. However, in a situation in which the level of interest rates continuously declines, these long-term bonds may be unattractive to these investors. Thus, these investors would turn their eyes to stock markets, and likely opt for the high dividend stocks that offer steady long-term income streams. Under the environment with the low interest rates and the low economic growth rate, deposit investors also turn to high dividend stocks which can replace bank deposits. From these behaviors of investors, the high demand for high dividend stocks under low interest rate is expected as the plausible explanation for the equity duration puzzle.

$$NP_{i,t} = \alpha + \beta_1 \times DY_{i,t} + \beta_2 \times DY_{i,t} \times Interest_t + \beta_3 \times Size_{i,t} + \beta_4 \times Profit_{i,t} + \beta_5 \times r_{i,t-1} + \beta_6 \times Kospi200_{\ i,t} \tag{9}$$

Here, $NP_{i,t}$ is the logarithm of the net purchase of amounts of stock i in month *t*. $DY_{i,t}$ is the dividend to price ratio of stock i in month *t*. $Interest_t$ is the level of 5 year interest rates. Several firm characteristics including the logarithm of the book value per share ($Size_{i,t}$), the logarithm of the earnings per share ($Profit_{i,t}$), the return of stock i in month *t-1* ($r_{i,t-1}$), and the membership in the KOSPI200 are used as the control variables.

4. DATA AND SUMMARY STATISTICS

This study uses samples from Fn-Guide. The study period spans from May, 1995 to December, 2015. The data sample is constructed with monthly returns, KOSPI index, the monthly net purchase amount of each stock for respective investor groups such as mutual fund companies, insurance companies and others, as well as accounting data such as EPS and BPS. Macroeconomic data such as monthly, 1 year, and 5 year interest rates of Treasury bond from Economic Statistics System (http://ecos.bok.or.kr/) are collected. KOSPI firms with zero dividend or sample below ninety-ninth percentiles are excluded.

Table 1:Descriptive Statistics

	Min.	**Mean**	**Max.**	**Std. dev.**	**Median**	**N**
5-year Interest	1.784	6.202	16.65	3.406	5.01	248
Return	-37.07	0.928	59.57	12.567	0	175526
DY_Chaebol	0.17	1.763	6.64	1.238	1.51	2358
DY	0	1.385	27.55	1.694	0.92	20390
BPS	-83,072.9	49,502.38	2,721,833	15736.349	12,547.19	20390
EPS	-130,966	3,029.139	355,661.7	14,257.56	624.86	20390
NP	2	685337.5	56,222,339	2,401,169	54,751.5	20390

Notes: This table shows descriptive statistics for our study. *5-year interest* is 5-year Treasury Bill interest rate in month *t*, and *Return* is the return on the asset *i* in month t for 737 KOSPI companies. *DY* is the dividend to price ratio of stock *i* in month *t. BPS* is the book value per share of stock *i* in quarter *t*, and *EPS* is the earnings per share of stock *i* in quarter *t*. *NP* is the net purchase of amounts of stock *i* in quarter *t*. The study period for *5-year interest*, and *Return* is from May 1995 to December 2015. In case of the other variables, the study period is September 2008 to December 2015.

5. THE EMPIRICAL RESULTS

5.1. Duration Estimates for Different Periods

Our first test examines whether the stocks with higher dividend yields have a shorter duration. Table 2 provides the duration estimates in each period. As shown in Figure 1, the sample period is divided into the rise (Period A, C) periods and decline (Period B, D) periods of interest rates. The influence of other systematic risk factors such as the market, size, value, and momentum are controlled in the regression model. The statistical significance is calculated with the t-test. Overall, all periods, except period C, show that equity duration in relation to the dividend yield is positive, which is against the hypothesis 1 driven from the dividend discount model. On the other hands, equity durations for low-dividend stocks are not statistically significant in all period and consistent. Thus, equity duration puzzle is not observed in low-dividend yield stocks. Economically, when the long-term bond yields are decreased by 1%, the excess returns on the high dividend stocks increase by 0.0643%. However, the equity duration of high dividends stocks decreases as the level of interest rate declines as shown in the decreasing coefficient values for the period. This indicates that the sensitivity of the price of high dividend stocks to long term interest in the recent period (period D) is lower compared to the past (period A and B).

Meanwhile, in case of period C, the opposite result is shown. The period C had a substantial impact from the financial crisis and therefore excess return of the high dividend stocks decreases even when the interest rate decreases. This is because investors want to select a safer asset during the crisis. This result is consistent with flight-to-quality in Lee and Jang (2015) and the study of Jiang and Sun (2017).

Furthermore, the test is conducted for 30 chaebol companies which are known to have the low dividend payout ratio. Since the list of chaebol companies has been announced by the Fair Trade Commission (http://ftc.go.kr/) from 2008, our study period is from October, 2008 to December, 2015, which is the period of declining interest rates. The list of 30 chaebol groups is shown in

Appendix 1. As Table 2-1 shows, the result is similar to the Table 2. The equity duration is longer as the dividend yield increases, validating that the equity duration puzzle is apparent among chaebol group companies as well during the declining interest rate regime.

Figure1:The Rise(Period A, C) and Decline(Period B, D) of Interest rates

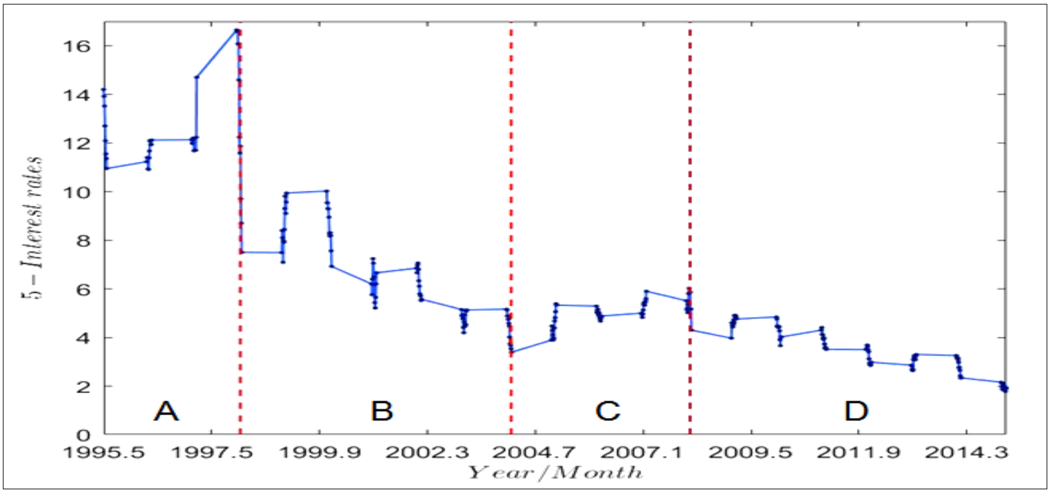

Table 2:Duration Estimates for Different Periods

	Low Dividends	3rd	2nd	High Dividends
Duration (Period A: 199505-199809)				
Model[1]	0.3295***	0.3756***	0.3652***	0.5143***
	(5.92)	(7.54)	(8.76)	(12.2)
Model[2]	0.1804**	0. 2215 ***	0. 1976***	0.2937***
	(2.04)	(3.7)	(3.95)	(4.4)
Duration (Period B: 199810-200411)				
Model[1]	0.1978***	0.2494***	0.2431***	0.2738***
	(5.46)	(8.1)	(8.12)	(9.97)
Model[2]	0.0255	0.0751**	0.0534*	0.1143***
	(0.66)	(2.31)	(1.7)	(3.96)
Duration (Period C: 200412-200809)				
Model[1]	-0.2508***	-0.2874***	-0.3331***	-0.3589***
	(-5.18)	(-7.4)	(-9.19)	(-9.29)
Model[2]	0.0059	0.0646	-0.0807**	-0.0833**
	(-0.11)	(-1.52)	(-2.05)	(-1.99)

	Low Dividends	3rd	2nd	High Dividends
Duration (Period D: 200810-201512)				
Model[1]	0.0226	0.0373*	0.0297	0.0691***
	(0.85)	(1.72)	(1.48)	(3.77)
Model[2]	0.0295	0.0418*	0.0306	0.06463 ***
	(1.11)	(1.95)	(1.54)	(3.59)
Duration (All Period)				
Model[1]	0.0205	0.0387*	0.0353*	0.0643***
	(0.77)	(1.77)	(1.74)	(3.56)
Model[2]	0.0276	0.0441**	0.0352 *	0.0597 ***
	(1.04)	(2.04)	(1.76)	(3.36)

Notes: This table tests for the duration estimates in four different periods comparing four quartile groups from high dividends stocks to low dividends stocks. KOSPI stocks are sorted based on the dividend to price ratio formed and rebalanced every month. The analysis is conducted for the two interest conditions: the rise (Period A, C) and decline (Period B, D) of interest rates. The empirical equity durations are estimated as the negative of the slope coefficients for changes in interest rates from the following market model regression where the excess return of stock *i* in month *t* is the dependent variable as shown in equation: $R_{i,t} - R_{f,t} = \alpha + Duration \times (-\Delta Interest_t) + \beta_1 \times (R_{m,t} - R_{f,t}) + \beta_2 \times SMB + \beta_3 \times HML + \beta_4 \times \mathrm{MOM} + \epsilon_{i,t}$. $R_{i,t}$ is the return on the asset i in month t. $R_{f,t}$ is the interest rate on 1-month Treasury Bill in month t. $\Delta Interest_t$ is the change in 5-year Treasury Bill interest rate in month t, and the negative of the term is used for the convenience of interpretation. In case of Model1, this study includes excess stock market return. In Model2, excess market returns, the Fama and French (1993) size and value factors, and the Jegadeesh and Titman (1993) momentum factor are included. The symbols *, ** and *** indicate the statistical significance at less than the 10%, 5% and 1% levels, respectively.

Table 2.1:Duration Estimates for the 30 Chaebol Companies

	Low Dividends	3rd	2nd	High Dividends
Duration (Period: 200810-201512)				
Model[1]	-0.0267	-0.0398	0.1416**	0.2112***
	(-0.41)	(-0.57)	(2.48)	(3.23)
Model[2]	-0.0346	-0.0427	0.1465**	0.2138***
	(-0.53)	(-0.61)	(2.55)	(3.21)

Notes: This table tests for the duration estimates with 30 chaebol companies. The study period spans from October, 2008 to December, 2015, the period of declining interest rates. Thirty companies are extracted from the Fair Trade Commission. Companies belong to Chaebol group when their total assets are above 5 billion won. The methodology is similar with the Table1. In case of Model1, this study includes excess stock market return. In Model2, excess market returns, the Fama and French (1993) size and value factors, and the Jegadeesh and Titman (1993) momentum factor are included. The symbols *, ** and *** indicate the statistical significance at less than the 10%, 5% and 1% levels, respectively.

5.2. Distance to Default and Cash Flow Volatility

Based on previous results, the equity duration increases in relation to dividend yields. Then, how can we explain the equity duration puzzle of high dividend stocks? In this section, the naive DD (the distance to default) model and the idiosyncratic volatilities are employed to verify whether the distance to default and the cash flow volatility can explain the equity duration puzzle.

Table 3 shows the duration of stocks controlling for the distance to default. The distance to default is estimated with the naive DD model in Bharath and Shumway (2008). Stocks are sorted into four quartile portfolios based on the monthly rebalanced dividend to price ratios and naive DD, and the regression is applied to the four group portfolios. Contrary to what is expected, after controlling the distance to default, the stocks with high dividend yields group continuously shows longer duration in all DD groups. Thus, the equity duration puzzle still exists after controlling for DD which implies that the puzzle cannot be explained by the distance to default of stocks.

Table 3:The Equity Duration Puzzle and The Distance to Default

	Distance to Default (DD)			
	Low DD	**3rd**	**2nd**	**High DD**
Low Dividends	0.15217***	0.15087***	0.12163***	0.16791***
	(5.82)	(6.45)	(5.01)	(6.02)
3	0.08838**	0.05110**	0.11877***	0.10652***
	(2.36)	(1.97)	(4.76)	(3.51)
2	0.21532***	0.16479***	0.13314***	0.09108***
	(9.19)	(6.36)	(4.39)	(2.90)
High Dividends	0.27455***	0.23232***	0.14928***	0.27721***
	(12.73)	(7.88)	(4.30)	(8.18)

Notes: The table examines whether the distance to default has an effect on the high duration of high dividends stocks. The study period is May 1995 to December 2015. Naive DD is calculated using the methodology in Bharath and Shumway (2008). Then, stocks are sorted simultaneously into four quartile portfolios in accordance with two criteria, monthly rebalanced naive DD and their dividend to price ratio. The regression is performed with sixteen portfolios as shown in equation which is same with that in Table 2. $R_{i,t} - R_{f,t} = \alpha + Duration \times (-\Delta Interest_t) + \beta_1 \times (R_{m,t} - R_{f,t}) + \beta_2 \times SMB + \beta_3 \times HML + \beta_4 \times \mathrm{MOM} + \epsilon_{i,t}$. $R_{i,t}$ is the return on the asset i in month t. $R_{f,t}$ is the interest rate on 1-month Treasury Bill in month t. $\Delta Interest_t$ is the change in 5-year Treasury Bill interest rate in month t, and the negative of the term is used for the convenience of interpretation. In case of Model 1, this study includes excess stock market return. In Model 2, excess market returns, the Fama and French (1993) size and value factors, and the Jegadeesh and Titman (1993) momentum factor are included. The symbols *, ** and *** indicate the statistical significance at less than the 10%, 5% and 1% levels, respectively.

The cash flow volatility is also examined whether it is the cause for the equity duration puzzle. The idiosyncratic volatility is calculated as the standard deviation of the residuals from the traditional CAPM regression with daily stock data for every month. Then, stocks are double sorted into sixteen portfolios on the basis of the monthly rebalanced dividend to price ratios and the idiosyncratic volatility (IV), and the regression is conducted. The test results are shown in Table 4. Although the level of the cash flow volatility can account for the equity duration puzzle comparing to the distance to default case, the stocks with high dividends still have higher duration than those with low dividends in the high IV portfolios. Thus, the cash flow volatility also cannot explain the equity duration puzzle of high dividend stocks.

Table 4:The Equity Duration Puzzle and The Cash Flow Volatility

	Idiosyncratic Volatility (IV)			
	Low IV	**3rd**	**2nd**	**High IV**
Low Dividends	0.3330***	0.1962***	0.1847***	0.1091**
	(42.37)	(6.83)	(4.69)	(2.41)
	0.2893***	0.0647***	0.0982***	0.1214***
	(22.22)	(2.62)	(3.64)	(3.47)
	0.1855***	0.0975***	0.0391*	0.1132***
	(8.95)	(5.10)	(1.72)	(2.58)
High Dividends	0.2138***	0.1273***	0.1468***	0.1743***
	(8.45)	(8.19)	(6.44)	(3.32)

Notes: The table tests whether the high duration of high dividends stocks can be explained by the cash flow volatility. The study period is May1995 to December 2015. The idiosyncratic volatility is calculated as the standard deviation of the residuals from the traditional CAPM regression with daily stocks every month. Stocks are double-sorted into four quartile portfolios based on the monthly firm's dividend to price ratios and idiosyncratic volatilities. The explanation for a regression is referred in Table 3. The symbols *,** and *** indicate the statistical significance at less than the 10%, 5% and 1% levels, respectively.

5.3. The Investor Behavior and the Equity Duration Puzzle

5.3.1. Valuation Spread between High and Low Dividen Stocks

The stock investors' investment behavior is examined in this section whether it can explain the equity duration puzzle of the high dividend stocks. In the situation with continuously low or declining interest rates, there are two reasons to believe that there exists a causal relationship between the investors' behavior and the equity duration puzzle. As mentioned in section 3.2.4, the long-term bond becomes less attractive in the low interest condition and investors would select high dividend stocksas a subsitute. Deposit investors can also consider dividend stock as an althernative investment tool when the interest income from bank deposit decline under the low interest rate environment.

To observe this hypothesis, the relative valuation spread between the high and the low dividend stock is examined against the long term interest rate changes. To caluculate valuation spread, four quartile portfolios are formed based on the dividend to price (D/P) ratio at the end of each month. Then, we calculate the spread in market to book (M/B) ratio between the top and bottom quintile portfolio. The regression is performed where the spread between M/B of two portfolios in Month t is the dependent variable and the independent variable is 5 year Treasury bond yield. The coefficient of the $Interest_t$ is negative and statistically significant at 1% level, which indicates that the valuation spread between the high dividend stocks and the low dividend stocks grows as the interest rate decreases. In Model[2], stock volatility and bond volatility are used as the control variables, but the valuation spread still exists. This result implies that investors give more value to high dividend stocks and their stock price rises when interest rate declines.

Table 5:Valuation Spread Between High and Low Dividend Stocks

	Model[1]	**Model[2]**
5 Year Treasury Bond Yield	-0.7885^{***}	-0.5889^{***}
	(-5.80)	(-3.77)
Stock Vol		-224.7851^{***}
		(-4.78)
Bond Vol		1.46232^{*}
		(1.84)
Intercept	10.022^{***}	15.6774^{***}
	(10.42)	(10.57)
Adj R^2	0.117	0.188

Notes: The table examines whether the relative valuation of high and low dividend stocks is related to long-term interest rate. The study period is May 1995 to December 2015. Quartile portfolios are formed in each month on the basis of the dividend to price ratio, which are rebalanced in the next month. The total market capitalization of stocks divided by the total book value of stocks (M/B) for four portfolios is calculated respectively using the methodology in Jiang and sun (2017). Then, we calculate the spread in M/B between the top and the bottom portfolios. The regression is performed where the spread between M/B of two portfolios in Month t is the dependent variable as shown in equation: $VS_{i,t} = \alpha + \beta_1 \times Interest_t + \beta_2 \times SV_t + \beta_3 \times BV_t$. $VS_{i,t}$ is the relative spread of stocks between the 1st and 4th portfolios. $Interest_t$ is the long-term (5 year) interest rate. In Model2, SV_t and BV_t are added as the control variables. SV_t is the monthly volatility of daily stock market's excess return. BV_t is the monthly volatility of daily change of yield on 5-year Treasury bond. The standard errors are corrected for heteroscedasticity and autocorrelation. The symbols *, ** and *** indicate the statistical significance at less than the 10%, 5% and 1% levels, respectively.

5.3.2. The Level of Interest Rate and the Investor Demand

Lastly, we test whether the demand for high dividend stocks increases under the low interest rate environment for various type of investors. If investor demand measured as the net purchase (NP) has positive relation with dividend yield (measured by dividend price ratio) while interest rate is low, we can explain the equity duration puzzle with the demand for high dividend stock under low interest rate regime. In Table 6, the investors' demand for high dividend stocks depending on the change in the interest rate is examined. The net purchase of stocks for 5 types of institutional investors and an individual investor group is regressed on dividend to price ratio (D/P ratio), and the interaction between D/P ratio and the interest rates. The five institutional investor groups are securities companies, insurance companies, mutual funds, banks, and pension funds. The control variables are BPS, EPS, Past-quarter return, and the membership in KOSPI 200.

For all groups, the coefficient of the dividend to price ratio is statistically negative, which means that the institutional and individual investors have negative appetite for high dividend stocks. This finding is consistent with Cready (1994) where the study suggests that institutional investors prefer the firms which pay low dividend yields. The finding is also coinciding with Jain (2007), where the study argues that the institutional investors prefer low dividend yield stocks than high dividend yield stocks.

However, in the second raw of Table 6, the coefficient of the interaction between D/P and the interest rate is statistically negative. This indicates that both institutional investors and individuals transfer their money more into high dividend stocks as the interest rate decreases despite they are not favor of high dividend stocks under high interest rate environment. The difference between the institutional and individual investors has not been found. This result confirms our conjecture that under low interest rate environment, demand (NP) for high dividend stocks increases and this can explain the equity duration puzzle.

Table 6:Different Types of investors' Preference for High Dividend Stocks.

	Security Companies		**Insurance Companies**		**Mutual Funds**	
DY	-0.2082***	-0.1646***	-0.1933***	-0.1589***	-0.1681***	-0.1559***
	(-8.89)	(-6.97)	(-8.04)	(-6.52)	(-6.29)	(-5.73)
*DY*Interest*		-0.6096***		-0.4821***		-0.1704**
		(-9.61)		(-7.38)		(-2.33)
Size(BPS)	0.2919***	0.2701***	0.2327***	0.2155***	0.2175***	0.2115***
	(6.44)	(6.01)	(5.00)	(4.65)	(4.20)	(4.08)
Profit(EPS)	0.0955***	0.1027***	0.2127***	0.2183***	0.223***	0.225***
	(4.17)	(4.52)	(9.03)	(9.32)	(8.51)	(8.59)
P_return	-0.001	-0.0043	-0.0124	-0.0154	0.0029	0.0017
	(-0.02)	(-0.22)	(-0.61)	(-0.76)	(0.13)	(0.08)
Kospi200	5.9516***	5.9634***	5.9200***	5.9294***	6.2889***	6.2922***
	(49.23)	(49.80)	(47.70)	(48.04)	(45.55)	(45.59)
Adj R^2	0.391	0.402	0.3888	0.3956	0.362	0.363
	Banks		**Pension Funds**		**Individuals**	
DY	-0.104***	-0.0807***	-0.2272***	-0.1966***	-0.1058***	-0.0763***
	(-4.35)	(-3.32)	(-8.49)	(-7.23)	(-6.92)	(-4.95)
*DY*Interest*		-0.3265***		-0.429***		-0.4129***
		(-5.01)		(-5.88)		(-9.98)
Size(BPS)	0.312***	0.3004***	0.2651***	0.2498***	-0.294***	-0.3088***
	(6.75)	(6.50)	(5.12)	(4.83)	(-9.94)	(-10.54)
Profit(EPS)	0.0471**	0.0509**	0.2115***	0.2165***	0.1017***	0.1065***
	(2.01)	(2.18)	(8.07)	(8.28)	(6.79)	(7.18)
P_return	-0.0429**	-0.0449**	-0.0025	-0.0051	0.0163	0.0137
	(-2.13)	(-2.23)	(-0.11)	(-0.23)	(1.26)	(1.07)

Kospi200	3.1071***	3.1135***	5.4343***	5.4426***	2.9278***	2.9358***
	(25.17)	(25.28)	(39.32)	(39.52)	(37.11)	(37.59)
Adj R^2	0.1563	0.1605	0.3114	0.3163	0.2527	0.268

Notes: The table examines how different types of investors prefer high dividend stocks according to the level of the interest rates. The types of investors are securities companies, insurance companies, mutual funds, banks, pension funds and individuals. The study period is 3Q, 2008 to 4Q, 2012. The analysis is conducted by the quarterly time-series regression where the net asset purchase of amounts of stock i in Month t is the dependent variable as shown in the equation: $NP_{i,t} = \alpha + \beta_1 \times DY_{i,t} + \beta_2 \times DY_{i,t} \times Interest_t + \beta_3 \times Size_{i,t} + \beta_4 \times Profit_{i,t} + \beta_5 \times r_{i,t-1} + \beta_6 \times Kospi200_{\,i,t}$. $NP_{i,t}$ is the logarithm of the net purchase of amounts of stock i in month t. $DY_{i,t}$ is the dividend to price ratio of stock i in month t. $Interest_t$ is the level of 5 year interest rates. Several firm characteristics including the logarithm of the book value per share ($Size_{i,t}$), the logarithm of the earnings per share ($Profit_{i,t}$), the return of stock i in month t-1 ($r_{i,t-1}$), and the membership in the KOSPI200 are used as the control variables. These regressions include time fixed effects with standard errors clustered by firm. The symbols *, ** and *** indicate the statistical significance at less than the 10%, 5% and 1% levels, respectively

6. CONCLUSION

This paper analyzes the equity duration of the stocks with the level of dividend yields in the Korean market. In line with the Macaulay duration formula (1938) drawn by the dividend discount model, it is intuitively expected that stocks with high dividend yields have shorter duration. However, in a sharp contrast with this expectation, there is an equity duration puzzle where the higher dividend yields stocks have a longer duration. Therefore, the causes of the duration puzzle are examined and the explanation for the phenomenon is provided. Although there were a number of previous studies on equity duration, they examined the equity duration in respect to the portfolio management. On the other hand, this paper focuses on the equity price sensitivity to changes in the interest rate. The main findings of the paper are as follows.

First, the equity duration is longer as the dividend yield of stocks increases except for the period affected by the Global financial crisis. Second, we found the equity duration of high dividends stocks statistically decreases as interest decline slows down. Third, the distance to default or cash flow volatility cannot explain the equity duration puzzle. When the distance to default and cash flow volatility are controlled, higher dividend yields consistently result in the longer duration. Lastly, the investors' demand shift for high dividend stocks is observed when the interest rate decreases. We found that both institutional investors and individual investors put their money into high dividend stocks as interest rate decreases. An interesting implication of this finding is that, under the low interest rates environment, the investors choose high dividend yield stocks as the alternative of fixed income investments. This demand shift toward high dividend stocks by investors can explain the equity duration puzzle.

This paper contributes to the literature by empirically investigating the sensitivity of stock prices to changes in interest rates and provides plausible explanation of the equity duration puzzle, i.e., the longer equity duration with the higher dividend stocks. Also, this paper contributes to reinforce the validity of equity duration puzzle in the global context since Korean market's characteristics and the dividend policy are different from those in the U.S. market. Third, the findings in this study cast an interesting future insight concerning the investors' behavior across long-term bonds and high dividend stocks. They have similar characteristics and could compete to win investors' asset portfolios in various interest rate regimes. Focusing on this perspective, the future study could explore the substitutability of two similar investment classes in more detail.

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