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Ex-Dividend Day Pricing in Portugal

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Dissertação
Mestrado em Finanças

Orientado por
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2022

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Abstract

Our study evaluates the ex-dividend stock price behavior in the Portuguese Stock exchange, during the period between 2004 and 2017. The standout characteristic of this period is the fact that, from 2012 onwards, dividends and capital gains taxes were the same for private investors. This allowed us to conduct an analysis of the impact of these tax changes on ex-dividend price formation. Using panel data regression methods, we analyzed a sample of 262 observations from 23 listed firms. For our full sample period we find, as expected, a positive relationship between the dividend yield and ex-dividend price change, i.e., the ex-day price fall is related to the gross dividend amount. At first, when testing for a tax explanation in the formation of ex-dividend prices, our results were not robust enough to support the hypothesis. Nonetheless, after splitting the sample into the period before and after the 2012 tax change and comparing both subsamples, we find evidence that points towards the presence of a tax effect. We find no evidence supporting market microstructure arguments in ex-dividend price behavior. We tested our first subsample (before the tax changes) for clientele effects, and the observed results were insignificant.

Resumo

O nosso estudo avalia o comportamento do preço das acções na data ex-dividendo na bolsa portuguesa, ao longo do período entre 2004 e 2017. A característica mais marcante deste período é o facto de, a partir de 2012, as taxas de imposto sobre os dividendos e sobre as mais-valias mobilárias serem os mesmos para os investidores privados. Isto permitiu-nos realizar uma análise do impacto destas alterações fiscais na formação do preço ex-dividendo. Utilizando métodos de regressão de dados de painel, analisámos uma amostra de 262 observações de 23 empresas cotadas. Para todo o nosso período de amostragem encontramos, como esperado, uma relação positiva entre a *dividend yield* e a variação do preço ex-dividendo, ou seja, a queda do preço ex-dividendo está relacionada com o montante bruto de dividendos. Inicialmente, ao testarmos a existência uma explicação fiscal na formação dos preços ex-dividendos, os nossos resultados não foram suficientemente robustos para suportar a hipótese. No entanto, após dividirmos a amostra, considerando então o período antes e o período depois da alteração fiscal de 2012 e comparar ambas as subamostras, encontramos provas que apontam para a presença de um efeito fiscal. Não encontramos indícios que apoiem argumentos de microestrutura de mercado no comportamento do preço ex-dividendo. Testamos a nossa primeira subamostra (antes das alterações fiscais) para efeitos de clientela, e os resultados observados foram insignificantes.

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1. Introduction

In a perfect market, where taxes do not exist and all market participants are rational, the stock price should fall by the full amount of the gross dividend on the ex-dividend day[1]. However, a number of empirical studies spanning across the past several decades have shown that, generally, stock prices do fall on the ex-day, but by less than the full dividend amount.

The debate around ex-dividend stock price formation started with Campbell and Beranek's (1955) contribution, where the authors found that prices fell on the ex-day by around 90% of the dividend amount. They justified this phenomenon with the existence of different dividend and capital gains taxations, that impact investors' decisions. But it was Elton and Gruber's (1970) study, aiming to evaluate Modigliani and Miller's (1961) clientele effect hypothesis, that truly launched the discussion around ex-day price changes and, in particular, how they relate to taxation. Since then, several contributions to the debate have come forward, attempting to make sense of ex-dividend price behavior. Some, such as Elton *et al* (1984), Barclay (1987), Bell and Jenkinson (2002) and Elton *et al* (2003) find evidence supportive of Elton and Gruber's (1970) tax explanation. Others argue for other explanations. Kalay (1982) proposes that short-term arbitrageurs are the driving force behind the ex-dividend price fall. Bali and Hite (1998) and Frank and Jaganathan (1994) explain the ex-dividend price changes with market microstructure arguments. In any case, the explanation of ex-dividend prices is far from being unanimous.

Our contribution to the discussion follows that of Farinha and Soro (2005) and Borges (2008), who looked at the ex-dividend price behavior in the Portuguese stock market. Interestingly, they came to opposite conclusions, with Farinha and Soro (2005) finding evidence supporting Elton and Gruber's (1970) tax explanation, while Borges (2008) argues against the validity of that reasoning. We seek to add to the ex-dividend pricing debate in general, but also to extend the work done about the Portuguese stock market in general. In addition, our sample period is unique when it comes to studies of ex-dividend price behavior in Portugal. In 2012, Portugal moved from taxation scenario favoring capital gains over dividends, as is more common in the

[1] The first day that a given stock trades without the right to receive a dividend associated to it.

literature, to one of equal taxation, i.e., tax indifference. We believe that it is this opportunity to study the same market in periods of different taxation that distinguishes the value of our study. With these tax changes as the pillar of our research, we follow Elton and Gruber's (1970) methodology and seek to evaluate the presence of tax effect in the formation of ex-dividend prices in Portugal.

Like most studies, we find evidence of a positive relationship between the price change and the dividend yield. Moreover, we do not find strong enough evidence to support the existence of a clientele effect. Our results also do not corroborate the influence of microstructure effects on the formation of ex-dividend prices, as suggested by Bali and Hite (1998) and Boyd and Jagannathan (1994). Our most striking results concern the tax explanation. We first test the sample as a whole and find that our results are not strong enough to support the presence of a tax effect. However, after splitting the sample in two, considering the periods before and after the 2012 tax changes, we see that the difference and the results obtained for each subsample do point towards a tax explanation.

Our study is organized in the following way: the next section is a brief review of the existing empirical work on this topic. Section 3 provides an overview of the Portuguese tax system and, critically, the changes that occurred in 2012. In section 4, we state our research hypotheses and describe our methodological approach as well as our sample. We present our results in section 5, and section 6 concludes our work.

2. Literature Review

It was Farrar and Selwyn (1967) who first looked at the differential tax treatment between dividends and capital gains and how it relates to dividend payments. Using a partial equilibrium model, they find that, in the more common scenario of dividends being more heavily taxed than capital gains, firms should not distribute dividends, as investors would prefer the better after-tax income offered by capital gains. With this study as a basis, Brennan (1970) develops a market equilibrium model and concludes that, in order to compensate for the tax disadvantage, investors will demand a higher before-tax dividend return.

While studying Miller and Modigliani's (1961) clientele effect hypothesis, Elton and Gruber (1970) established a relationship between the stock price behavior on the ex-dividend day and the taxation faced by the marginal investor. They developed a model that relates the dividend and capital gains tax rates to the ex-dividend price change ratio, i.e., the price change divided by the gross dividend amount. With this model they showed that, the ex-dividend price change should mirror the after-tax value of the dividend relative to the after-tax value of capital gains. Consequently, if the dividend tax is higher than the capital gains tax, the stock price should fall by less than the dividend. The authors find evidence of a tax effect in ex-dividend price formation and obtain results supportive of the clientele hypothesis.

Since then, Elton and Gruber's (1970) arguments have been extensively evaluated in the literature.

A contribution worth mentioning that supports Elton and Gruber (1970) is the study by Barclay (1987). This study examines the ex-dividend day behavior of common stock prices before the enactment of the federal income tax. On ex-dividend days during the pre-tax period, stock prices fell, on average, by the full amount of the dividend. Barclay's (1987) findings support the hypothesis that investors in the pre-tax period see capital gains and dividends as perfect substitutes and the theory that the differential taxation of dividends and capital gains has led to investors discounting the value of cash dividends relative to capital gains.

Kalay (1982) challenges Elton and Gruber's (1970) findings, and argues in favor of short-term arbitrage as the main driver behind ex-dividend prices. While acknowledging that taxes influence investor decisions, the author shows that the marginal tax rate cannot be inferred from the relationship between ex-dividend price behavior and the dividend yield without any additional information. Kalay (1982) states that the ex-dividend price fall cannot be explained by a tax effect, but rather by the transaction costs faced by arbitrageurs.

A different challenge to Elton and Gruber's (1970) work is that of market microstructure arguments. Frank and Jagannathan (1998) find that, in Hong Kong, where there are no dividends or capital gains taxes prices fall by less than the dividend on the ex-day. They also state that handling dividends, i.e., collecting dividend payments and possibly reinvesting them, is troublesome for private investors but not for large, market-making investors. They argue that market makers buy at the ask price before the stock goes ex-dividend and sell it at the bid price after it goes ex-dividend. Frank and Jagannathan (1998) say that even in the absence of taxes this would mean that prices would fall on the ex-day. Another study within the scope of microstructure arguments is the one by Bali and Hite (1998), where the authors profess that the price drop around the ex-dividend day is less than the full amount of the dividend but will stay within one tick of the dividend. An important finding of theirs is that stock dividends, which aren't taxable, show similar behavior in terms of price drop to cash dividends, which are taxable.

A number of authors also applied Elton and Gruber's (1970) ideas to periods where changes in taxation took place. One of those papers is the one by Michaely (1991). The author looks at the behavior of ex-dividend stock prices around the time of the 1986 tax reform in the United States. At the time, this reform started by reducing and later ultimately eliminated the differential treatment in terms of taxation between dividends and realized capital gains. Michaely (1991) finds that these tax changes did not have an impact on the ex-dividend price behavior, which leads him to the argument that individual investors oriented towards the long-term have no effect on ex-dividend prices. In addition, the author finds that these prices are mostly influenced by short-term traders and corporate traders. Zhang, Farrell and Brown (2008) look at the topic of ex-dividend pricing from a similar perspective. In 2003, the American taxation regime changed so that dividends and capital gains were henceforth taxed in

the same way. The authors look at how this affected Ex-Dividend Pricing, and find that the price is affected by risk, transaction costs and taxes. In addition, they find that dividend clienteles weaken decreased with the tax change, and the price drop ratio decreased with the tax change too. The abnormal trading volume of high dividend yield stocks around the ex-dividend day decreases with the tax cut, which would suggest that the tax cut reduced the motivation for tax-induced trading.

There is also a number of studies that were conducted outside of the US market. Booth and Johnston (1984) use the ex-dividend day price drop and the associated dividend to try to measure the market's marginal tax rate, i.e., an implied tax rate, which Elton and Gruber (1970) first suggested. The sample used is of 1970-80 of the Canadian stock market, an interesting period due to four different tax changes having happened. The authors find little evidence of clientele effect and conclude as well that arbitrage fails to explain the ex-dividend price behavior. Kato and Loewenstein (1995) take a look at stock price behavior around the ex-dividend day in the Japanese stock exchange. They find that prices rise on the ex-day and that tax effects appear to be secondary. The authors also conclude that intercorporate manipulative trading might be what's behind ex-day price movement and not the actual dividends. Both Lasfer (1995) and Bell and Jenkinson (2002) look at tax changes in the UK and found evidence supporting the existence of a tax effect in ex-dividend price behavior, while Michaely and Murgia (1995) also obtain results in favor of the tax explanation for the Milan stock exchange. Daunfeldt (2002) looks at the impact of tax changes in Sweden on ex-dividend prices and finds that his results are not robust enough to support a tax effect.

In the specific case of the Portuguese stock market, there are 2 papers that stand out. These are the contribution by Farinha and Soro (2005) as well as the one by Borges (2008).

Farinha and Soro (2005) look at the ex-dividend stock price behavior in the Portuguese stock exchange between 1993-2002 and try to dissect the influence of taxation on prices. Farinha and Soro (2005) classify investors according to their tax profile and find that the observed ex-dividend price reduction is in line with a fiscal explanation. In addition, they find that arbitrage strategies around the ex-dividend day do not bring forth significant returns. Furthermore, the

authors argue that the observed price drop is consistent with the theory and also find few evidence of the existence of a clientele effect.

The work by Borges looks at an earlier time period, from 1990-1998. Contrary to Farinha and Soro (2005), Borges' (2008) results are not consistent with a tax-related explanation for the ex-dividend day price drop. Similarly to Farinha and Soro (2005) however, Borges (2005) finds no evidence of clientele effects and argues that perhaps the price movements around the ex-dividend day are nothing more than an anomaly, a possible sign that markets aren't always efficient.

These two papers are particularly relevant for our research because they have a lot in common with what we have set out to do, which is providing a more recent contribution to the analysis of ex-dividend pricing in the Portuguese stock exchange.

In summary, we can see that the decades-old debate on the influence of taxes on ex-dividend stock prices shows mixed conclusions, which opens the door for our study to be a worthy contribution to the discussion.

3. Theoretical Framing and The Portuguese Tax System

The Portuguese Tax System

The taxation of dividends and capital gains holds special importance in our research. As such, it is important to clarify how the Portuguese Tax System works and, in particular, how it evolved throughout our sample period.

The tax system currently in place in Portugal is the result of a significant tax reform that took place in 1988. The IRS (Personal Income Tax) and IRC (Corporate Income Tax) tax codes were introduced, and several partial income taxes were replaced by global income taxation, both for individuals and firms. Although the bulk of the tax codes haven't suffered many significant changes, the way dividends and capital gains are taxed has changed a few times over the years.

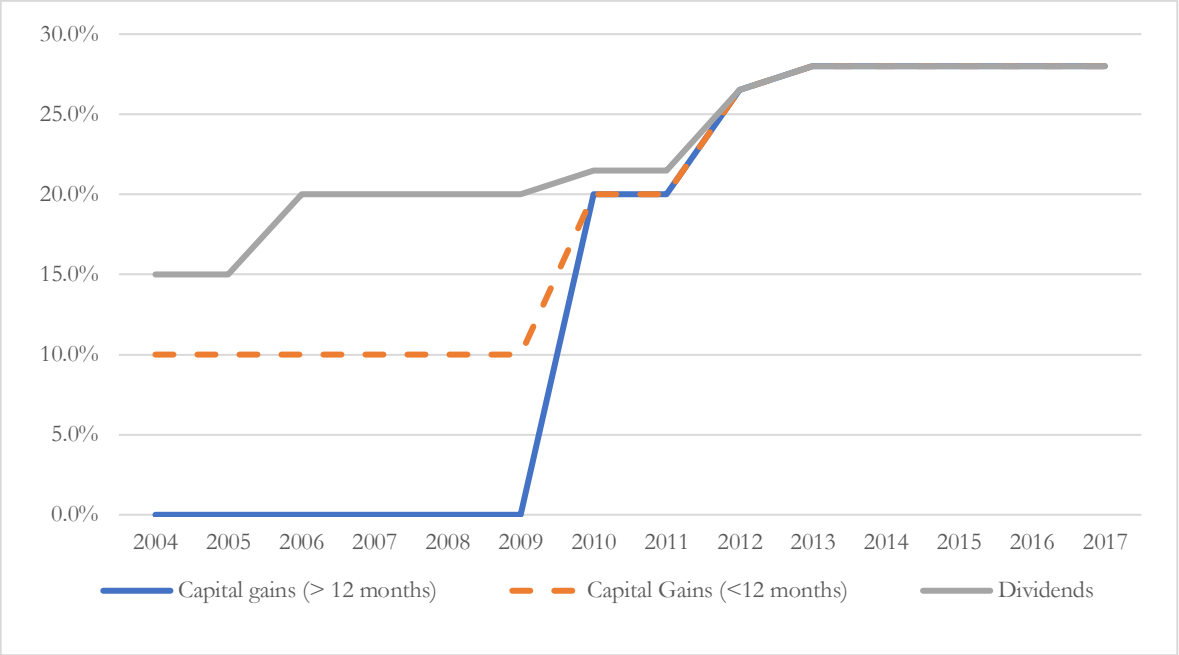
When it pertains to dividends, they are taxed first and foremost through a withholding tax, which is applied when the dividend is paid. This means that investors already receive the dividend net of the aforementioned withholding tax. Nevertheless, one can choose to include them as global income to be taxed by the standard personal income tax. In that case, only 50% of the gross dividend will be included in the global income, with the amount that was withheld upon the payment of the dividend being deducted from the final tax collection. If one chooses not to include the dividends in the global personal income, the effective tax rate will be the withholding tax. As for corporations, they are obliged to include dividend income in the global income, with 50% being deducted from the total taxable amount. Capital gains taxation occurs whenever the net amount between gains and losses in buying and selling shares throughout a fiscal year is positive. Individual investors are subject to a capital gains tax rate, while capital gains made by corporations are taxed at the regular corporate tax rate (IRC).

Throughout our sample period, which goes from January 2004 to December 2017, there have been some changes in the way dividends and capital gains are taxed. For example, for shares of firms acquired under a privatization programme (until the end of 2002), only 50% of both dividends and capital gains were taxable for the first five fiscal years. Furthermore, in the first

two years of our sample, investors were obliged to include dividend income in their personal income for taxation purposes. This obligation stopped in 2006, when investors were now able to choose whether to include dividends in global personal income or not. It is important to point out that, while our sample does include observations that were possibly affected by these caveats, we did not consider neither of them in our analysis, for simplification purposes. One issue that concerns the taxation of capital gains is the fact that, until 2010, a differentiation was made in the taxation. If an investor held the shares for more than 12 months, he was considered exempt from capital gains taxation. When they were held for less than 12 months there were subject to a 10% autonomous tax rate. From 2010 onwards, this distinction ceased to exist and all capital gains resulting from stock market transactions were eligible to be taxed.

Figure 1 shows the evolution of the taxation of dividends and capital gains throughout our sample period (2004-2017).

Fig. 1 – Capital Gains and Dividend Taxation in Portugal throughout our Sample Period



As we can see, throughout most of our sample, dividends were subject to a much higher tax burden than capital gains. The difference was particularly stark between 2006 and 2009. It was then reduced to a small difference of 1.5% (in favor of Capital Gains) in 2010 and 2011, and

ultimately the two tax rates were brought level in 2012 and remained on par until the end of the sample. Table 1 illustrates the evolution of the tax rates between 2004 and 2017 in numerical terms, as well as how the tax rates translate to the tax discrimination factor (TD) throughout the sample[2]. We calculate the tax discrimination factor through the following formula:

$$TD = \frac{(1-t_d)}{(1-t_{cg})} \tag{3.1}$$

Table 1 – Tax rate and tax discrimination factor evolution in the sample period

	Capital Gains[3]	Capital Gains	Dividends	TD (t_{cg} = 0)	TD (t_{cg} =0,1)
2004	0,0%	10,0%	15,0%	0,85	0,94
2005	0,0%	10,0%	15,0%	0,85	0,94
2006	0,0%	10,0%	20,0%	0,80	0,89
2007	0,0%	10,0%	20,0%	0,80	0,89
2008	0,0%	10,0%	20,0%	0,80	0,89
2009	0,0%	10,0%	20,0%	0,80	0,89
2010	20,0%	20,0%	21,5%	0,98	0,98
2011	20,0%	20,0%	21,5%	0,98	0,98
2012	26,5%	26,5%	26,5%	1,00	1,00
2013	28,0%	28,0%	28,0%	1,00	1,00
2014	28,0%	28,0%	28,0%	1,00	1,00
2015	28,0%	28,0%	28,0%	1,00	1,00
2016	28,0%	28,0%	28,0%	1,00	1,00
2017	28,0%	28,0%	28,0%	1,00	1,00
Mean				**0,92**	**0,96**

[2] With regards to the tax discrimination, the following should be noted. Within the scope of our research, we decided to use only the individual dividend withholding tax and the individual capital gains tax, for simplification purposes. As such, the aforementioned caveats in dividend taxation (benefits in privatized firms, obligation to include in taxable income until 2006) were not considered in the computation of the tax discrimination factor. As for the capital gains tax, Farinha and Soro (2005) suggest that the most important investor class in the Portuguese stock exchange is the long-term individual investor. Such an individual would very likely be in a high IRS tax bracket and, consequently, it would be more beneficial for the investor to have capital gains taxed at their tax rate and not to include them in their global personal income.

[3] Assuming shares were held for over twelve months. The same applies to the first column of the TD factor.

As the table shows, tax discrimination against dividends was strong in the first part of the sample, before reducing in the middle years and ultimately arriving at a situation of tax indifference between dividends and capital gains, from 2012 until 2017, the last year of our sample. The average tax discrimination factor of during our sample period was 0,92 if we assume shares were held for over twelve months and 0,96 if we assume otherwise. This means that during the sample period, if an individual investor were to receive 100€ from investments (pre-tax), he would receive 8€[4] less (after-tax) if these 100€ came in the form of dividends, as opposed to capital gains.

Theoretical Framing

Having discussed the taxation framework that was in place during our sample period, we will now seek to understand how it could impact our research. As mentioned before, Elton and Gruber (1970) connected dividend and capital gains taxation do stock price behavior on the ex-dividend day. They postulate that, in an efficient market, the ex-dividend price drop should reflect the tax discrimination effect of dividends vis-á-vis capital gains. The marginal investor would then be indifferent as to whether the income comes from dividends or capital gains, and the observed price fall would allow for inferring the income tax rate of the investor.

Considering no transaction costs, the equilibrium is then given by:

$$P_c - t_{cg}\,(P_c - P_o) = P_e - t_{cg}\,(P_e - P_o) + D(1-t_d) \qquad (3.2)$$

where:

P_c: Price on the day before the stock goes ex-dividend (Henceforth, cum-dividend price)

P_e: Ex-dividend price

P_o: Price at which the stock was purchased

t_d: Dividend tax rate

t_{cg}: Capital gains tax rate

D: Gross dividend

[4] Or 4€ if, before 2010, they always held their shares for less than 12 months.

The left side of equation (3.2) represents the return an investor receives by selling on the cum-day, while the right side is the return of selling on the ex-day.

Rearranging, we get:

$$\frac{P_c - P_e}{D} = \frac{(1-t_d)}{(1-t_{cg})} \tag{3.3}$$

This equation will be the basis of our study. Considering the evolution in the Portuguese taxation environment that occurred throughout our sample period, we take Elton and Gruber's (1970) work as the foundation for our research. In an equilibrium such as that which Elton and Gruber (1970) suggested, that takes equation (3.3) as a basis, the share price should fall by less than the dividend if dividends are more heavily taxed than capital gains. Additionally, and, given the characteristics of our sample, perhaps most importantly for our study, when one moves from a situation of a tax differential (favorable to capital gains) to tax indifference, the price fall should move from less than the dividend to the full amount of the dividend. Our research hypotheses, which we will formulate in the next section, stem from this theoretical reasoning.

4. Research Hypotheses, Methodology and Sample Description

Research Hypotheses

The general subject of our analysis will be to assess the impact of a potential tax effect on ex-dividend day stock price formation. As we saw in section 2., our literature review, this has been the focal point of many studies, most of which conclude that, at least in part, ex-dividend price changes can be explained due to fiscal discrimination effects. The literature also tells us that, historically, most countries tax dividends more heavily than capital gains. This was also the case for most of our sample period. Under such circumstances and excluding other potential factors such as microstructure arguments or arbitrage costs, the expectation would be for the price to fall on the ex-day, namely by less than the full dividend amount. This brings us to our first hypothesis:

H1: *In the presence of a tax effect, one would expect a positive relation between the price change and the dividend yield.*

Furthermore, according to Elton and Gruber (1970) and equation (3.3), if prices do indeed reflect the presence of a fiscal effect, the price variation should be equal to the marginal investor's *TD*. In other words, we should be able to observe the equality of equation (3.3). This reasoning leads us to our second hypothesis:

H2: *The average price variation, controlled by the dividend, should not differ significantly from the average tax discrimination factor (TD).*

As mentioned before, what makes our sample period a particularly compelling research object for the study of ex-dividend prices, is the shift from a situation of tax discrimination to one of tax indifference. We built our final hypothesis around this idea. In our sample, in the period of 2004-11 there is a tax differential unfavorable to dividends and from 2012 onwards we have a scenario of tax indifference. As such, and going back to Elton and Gruber (1970), if we look at equation (3.3), the stock price should fall by the full amount of the dividend. With that in mind, we formulate our third hypothesis:

H3: *If one follows Elton and Gruber's (1970) reasoning, in a scenario of tax indifference (or TD = 1), the average price variation divided by the dividend should be bigger than in a scenario that observes a higher tax burden on dividends vis-á-vis capital gains. As such, we expect an increment in the average price variation divided by the dividend when there is a shift from a tax discrimination[5] situation to one of tax indifference.*

In a scenario where clientele effects exist in the market, as suggested by Elton and Gruber (1970) in their analysis of Miller and Modigliani (1961), the expectation would be for lower taxed individuals to prefer higher dividend stocks, and vice-versa. For this effect, we elected to test only our first subsample, i.e., the period where dividends were still more heavily taxed than capital gains.

H4: *Considering Elton and Gruber's framework, in the presence of a clientele effect, the expectation would be for the price change ratio (the left side of equation (3.3)) to increase as the dividend yield increases. In other words, individuals with a lower tax discrimination factor (right side of equation (3.3), would prefer higher dividend stocks.*

Methodology

Having formulated our research hypotheses, we will now expose the methodology we chose to follow. To this end, we follow the methodology used by Farinha and Soro (2005), who also chose Elton and Gruber's (1970) work as the foundation for their research. In order to measure the existence of a tax effect, it is important to relate the tax rates on dividends and capital gains with the dividend yield around the ex-day. Assuming no transaction costs and risk-neutral investors, this reasoning will lead us back to equations (3.2) and (3.3). For simplification purposes, we will henceforth refer to the left side of equation (3.3) as QVP. In Elton and Gruber's (1970) model, QVP represents the ex-dividend price behavior that, given a certain set

[5] In favour of dividends.

of dividend and capital gains tax rates, would lead to an investor being indifferent to the timing of purchasing and sale of a stock. The mean of all observations would then be:

$$\overline{QVP} = \frac{1}{N}\sum_{n=1}^{N}\left(\frac{P_c - P_e}{D}\right) \quad (4.1)$$

where:

N: number of observations

P_c: cum-dividend day closing price

Pe: ex-dividend day price (closing, opening, or adjusted close)

D: gross dividend

Following Elton and Gruber's (1970) reasoning, this statistic will allow us to estimate the marginal tax rates of the marginal investor[6].

Alternatively, one could compute the statistic through the following regression:

$$QVP_i = \overline{QVP} + \varepsilon_i \text{ , where } E(\varepsilon_i) = 0 \text{ and } Var(\varepsilon_i) = \sigma^2 \quad (4.2)$$

Nevertheless, Farinha and Soro (2005) point out that several issues can be attributed to equation (4.2) in its capacity to properly estimate QVP. These issues had been previously mentioned by other authors that worked with the regression model in (4.2), such as Eades *et al* (1984), Barclay (1987) or Bell and Jeckinson (2002). For example, it is not expected that QVP will follow a normal distribution. In addition, the residual term in (4.2) will most likely be heteroskedastic, since QVP is scaled by the value of the dividend, meaning that the weight given to observations with a lower dividend will be excessive. To solve this problem, Farinha and Soro (2005) follow a methodology suggested by Boyd and Jagannathan (1994) and Bell and Jeckinson (2002), which we will also follow here. This methodology gives a reduced weight to observations where the dividend yield is lower, and the ex-dividend change is larger. The regression model is derived from the ex-dividend return of a stock $R_{e,i}$, which is given by:

[6] In our case, a long-term individual investor in the highest personal income tax bracket.

$$R_{e,i} = \left(\frac{P_e - P_c + D}{P_c}\right)_i = (1 - \overline{QVP})\left(\frac{D}{P_c}\right)_i + \varepsilon_i \quad (4.3)$$

From here, a new regression can be derived:

$$\left(\frac{P_c - P_e}{P_c}\right)_i = \alpha_2 \left(\frac{D}{P_c}\right)_i + \mu_i \quad (4.4)$$

Equation (4.4) shows the relationship between the change in price on the ex-day and the dividend yield. The QVP is now given by the slope of the equation. With this equation, the heteroskedasticity problems of regression (4.2) can be overcome. Furthermore, there is the possibility of adding an independent term to the regression in order to evaluate market microstructure effects. This is suggested by several authors such as Farinha and Soro (2005), Boyd and Jagannathan (1994) as well as Frank and Jagannathan (1998). It should be noted that, in the presence of microstructure effects, the expected sign for the independent term is negative, as these would impact ex-dividend prices negatively. The inclusion of the independent term yields the following regression:

$$\left(\frac{P_c - P_e}{P_c}\right)_i = \alpha_1 + \alpha_2 \left(\frac{D}{P_c}\right)_i + \mu_i \quad (4.5)$$

Regressions (4.4) and (4.5) will be what we will use to empirically test our hypotheses. It is important to point out that, in terms of actual data that is necessary to conduct our study, the variables we need are the following: the cum-dividend price, the ex-dividend price and the gross dividend per share. Nonetheless, while we use closing prices for the cum-dividend price, there is some debate around whether to use closing, opening, or even adjusted prices for the ex-dividend price. The case against closing prices, suggested by Elton and Gruber (1970), relates to the fact that, if one considers closing prices, i.e. including a full day of transactions, other factors that influence prices could also be at play, possibly diluting the actual impact of a fiscal effect. Other authors, such as Kalay (1982) argue against the use of opening prices, due to the possibility that the first transaction orders given by investors on the ex-day are likely to reflect a discount of the full amount of the dividend. A third possibility is that of using adjusted prices, either opening or closing. In our research, since there was no consensus among the literature, and in

order to be as thorough as possible, we opted to conduct our analysis in three ways. Using unadjusted closing prices, unadjusted opening prices, and adjusted closing prices. We compute our adjusted closing prices using a methodology followed by Borges (2008), which adjusts by the rate of return of the relevant stock market index[7] on the ex-day:

$$P_e' = \frac{P_e}{1+R_m} \tag{4.6}$$

where:

P_e: Ex-day closing price

P_e': Adjusted ex-day closing price

R_m: Return of the relevant stock market index on the ex-day

At this stage, we should clarify that we opted to work with panel data in our econometric analysis. Since our sample had both time-series[8] and cross-section[9] elements, we decided this was the best approach. According to authors such as Gujarati (2003) and Verbeek (2004), panel data analysis can yield more efficient and realistic models than traditional cross-section or time-series models. Gujarati (2003) also argues that panel data models can be particularly helpful in analyzing the dynamics of change, which could be adequate for our study, due to the changes in taxation that occurred over the course of our sample period.

There are three possible regression techniques in panel data analysis. Pooled Least Squares (PLS), the Fixed Effects Model (FEM) and the Random Effects Model (REM). PLS, also known as Common Effects Model, essentially disregards the panel characteristics of the data, by *pooling* the data together and then running the traditional least squares model. Both of the FEM and REM are more adequate to study the intricacies of individual characteristics in a panel data set. In order to determine which of the three models is most adequate, one should first test FEM against PLS, through a likelihood ratio F-statistic, that tests if the FEM is redundant. The null hypothesis

[7] In our case, the Portuguese PSI-20 index.
[8] Observations, i.e., dividend payment occurrences, throughout time.
[9] Observations, i.e., dividend payment occurrences, for a given company. Each company serves as a cross-section identifier in our data sample.

here is that PLS is the adequate model. If we cannot reject the null, PLS is the most adequate model. If we reject the null, we need to move to another test, in order to assess whether to use FEM or REM. This test, named after Hausman (1978), puts the adequacy of the REM up against the FEM. Here, the null hypothesis is that REM is the most adequate model. If we cannot reject the null, we use REM. Otherwise, FEM is the most adequate model. In section 5, where we will present our results, further details on this model selection process will be provided.

Sample description

The main driver of our sample selection was to have the 2012 tax changes be the focal point, in the sense that the sample should be significant and informationally complete both before and after the tax changes. Taking into account that the Portuguese stock market, which is the object of our research, is not as liquid as some of the other markets that have been used in ex-dividend day studies, we decided only to include observations from companies that were, at some point, constituents of the PSI-20 index. After that, we filtered the sample to remove companies that did not pay a dividend or did only have limited trading volume around the ex-day.

We ultimately arrived at a sample of 262 observations from 23 firms, from 04/06/2004 until 12/12/2017. These included 129 observations in our dividend-capital gains fiscal discrimination period (2004-2011) and 133 observations in our fiscal indifference period (2012-2017).

All data was collected from Thomson Reuters' *Refinitiv Eikon* software[10]. The data we collected consisted of all relevant information on dividend payments[11], historical stock prices on the cum-dividend and ex-dividend days for the firms in our sample during the sample period, and the historical returns of the PSI-20 index on all the ex-dividend days in our sample[12]. Additionally, we also obtained the information on the leavers and joiners of the PSI-20 index during our sample period from *Refinitiv Eikon*.

[10] We then used *Yahoo Finance* and the websites of the dividend paying companies to cross-check if all information was accurate and if any relevant information was missing (for example stock splits that could potentially affect how the price was reported).
[11] This includes: Gross and Net dividend per share, announcement date, ex-dividend date and payment date
[12] In order to compute the adjusted closing prices. See equation (4.6).

Table 2 presents the descriptive statistics of the main variables featured in our sample, both for every sample year separately and for the entire sample period.

Table 2 – Sample Descriptive Statistics

		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	**Total**
N. Obs		12	14	15	18	16	14	25	15	19	23	21	26	22	22	**262**
N. Firms		-	-	-	-	-	-	-	-	-	-	-	-	-	-	**23**
Pcum (€)	Max.	9,48	18,50	14,68	20,85	17,21	12,32	12,12	15,27	15,09	17,97	13,49	13,41	13,93	16,86	**20,85**
	Min.	0,55	0,76	0,72	1,79	1,11	0,63	0,81	0,51	0,37	0,50	0,59	0,55	0,15	0,39	**0,15**
	Mean	3,94	4,48	4,78	6,58	5,28	4,44	4,88	3,51	4,21	4,08	5,12	5,65	5,30	6,89	**5,03**
	Std. Dev.	3,11	4,97	3,86	5,18	4,15	3,50	3,92	3,85	4,92	4,44	4,00	4,20	4,09	5,08	**4,30**
Div (€)	Max.	0,24	0,50	0,48	0,48	0,58	0,58	1,00	1,30	0,44	0,50	0,40	0,75	0,47	0,61	**1,30**
	Min.	0,02	0,02	0,03	0,03	0,03	0,03	0,81	0,01	0,01	0,01	0,01	0,01	0,00	0,00	**0,00**
	Mean	0,10	0,15	0,16	0,17	0,16	0,15	4,88	0,18	0,15	0,14	0,15	0,19	0,15	0,22	**0,16**
	Std. Dev.	0,07	0,15	0,15	0,13	0,16	0,16	3,92	0,32	0,11	0,12	0,11	0,17	0,11	0,16	**0,16**
D. yield (%)	Max.	5,16	6,76	7,22	5,45	6,96	12,08	12,85	15,00	11,76	16,08	7,44	9,91	20,27	14,63	**20,27**
	Min.	0,84	1,48	1,24	1,01	0,98	0,49	0,36	0,92	0,95	0,95	0,81	0,64	0,75	0,51	**0,36**
	Mean	2,85	3,53	3,57	2,66	3,15	4,54	4,43	5,12	5,67	4,58	3,17	3,48	4,21	3,96	**3,96**
	Std. Dev.	1,12	1,58	1,95	1,17	1,71	3,13	3,16	3,62	3,55	3,48	1,89	1,99	4,05	3,16	**0,03**

Legend:
N. obs – Number of observations in the sample each year
N. Firms – Number of Firms in the sample
Pcum – Cum-dividend day price, presented in euros
Div – Gross dividend per share, presented in euros
D. yield – Dividend Yield, the ratio between the gross dividend and the cum price, presented as a percentage

Looking at the sample, it is noteworthy that our average cum dividend price is 5,03€. This is more than four times less than that observed by Farinha and Soro (2005) from 1993 to 2001 in the Portuguese Stock Exchange (20,92€). With a maximum of 1,30€ in 2011 and a minimum of 0,002€ in 2016 and 2017, we arrive at an average dividend per share of 0,16€. Comparing this with Farinha and Soro (2005), we see that, like the average cum price, ours is substantially lower than what the authors found for the same stock exchange in their sample period (0,51€). Nevertheless, our sample shows an average dividend yield of 3,96%, which is higher than the 3,01% demonstrated by Farinha and Soro (2005) for 1993-2001.

Table 3 presents descriptive statistics for the QVP throughout our sample period. We should recall that, as we saw in equation (4.1), the QVP for an observation[13] is calculated by scaling

[13] i.e., a dividend payment event.

the ex-dividend price fall (P_c - P_e) by the gross dividend per share (D). We compute QVP according to closing, opening and adjusted closing ex-day prices.

Table 3 – QVP throughout our sample period

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	**Total**
Closing Prices (P_c) used to compute QVP = (P_c - P_e)/D															
Mean	0,567	0,412	0,725	0,443	1,182	0,168	0,178	0,583	0,570	0,827	0,360	0,749	0,386	0,579	**0,550**
Std. Dev.	0,497	0,412	0,522	0,662	0,794	1,437	1,729	0,944	0,652	0,484	0,861	0,696	0,717	0,677	**0,900**
Opening Prices (P_e) used to compute QVP = (P_c - P_e)/D															
Mean	0,403	0,762	0,637	0,630	0,658	0,395	0,576	0,715	0,476	0,763	0,515	0,478	0,196	0,380	**0,535**
Std. Dev.	0,361	1,138	0,724	0,506	0,782	0,824	0,777	1,134	0,492	0,578	0,554	0,461	0,784	1,470	**0,804**
Adjusted Closing Prices (P_e) used to compute QVP = (P_c - P_e)/D															
Mean	0,450	0,273	0,551	0,440	1,055	0,335	0,154	0,404	0,542	0,609	0,174	0,703	0,416	0,740	**0,491**
Std. Dev.	0,482	0,462	0,437	0,573	0,794	0,893	1,761	0,673	0,801	0,679	0,870	0,599	0,686	0,543	**0,854**

Looking at the table above, we can see that using closing prices yields the highest average QVP (0,550), as well as the highest standard deviation (0,900). The lowest standard deviation happens when we use opening prices to compute QVP (0,804) and the use of adjusted closing prices leads us to the lowest QVP mean in all three approaches (0,491). In all three computing methods, the sample standard deviation is higher than the mean, which is consistent with what Farinha and Soro (2005) had obtained for their sample.

As we can recall from equation (3.3), Elton and Gruber (1970) equate the QVP to the tax discrimination factor (TD) between dividends and capital gains. While the observed average QVP isn't particularly close to the TD of our sample period[14], there are some years of approximation. In addition, one should note that closing prices provide the observed QVP that is closest to the mean TD, although the difference for the other QVPs isn't significant.

As we had mentioned before, an important part of our research was assessing the difference between the 2004-11 and the 2012-17 periods. We applied the same methodology for these sub-samples as we did for the main sample. A more detailed look on the subsamples is provided in section 5.

[14] See Table 1.

5. Empirical Results

In this section we will present our empirical results. The econometric analysis we conducted to test our hypotheses was done using *EViews*, a statistical software package geared towards econometric analysis. We used the software to apply the PLS, FEM and REM models on our panel data. As explained in section 4, the model selection process is done through two[15] statistical tests that assess which model is most adequate for the data in question. These tests were also conducted in *EViews*.

In the first stage of our analysis, we looked at the full sample in order to evaluate H1, that is, the hypothesis of a positive relationship between the dividend yield and the price variation. In equations (4.4) and (4.5), the dependent variable is the ex-day price change, as a percentage of the cum-dividend price, and the independent variable is the dividend yield. As such, the results of the regression model will explain the relationship between the price variation and the dividend yield, which we expect to be positive. In order to test our research hypotheses, we considered equations (4.4) and (4.5) to estimate our regression models. Like Farinha and Soro (2005) we choose to also include an independent term in order to test for market microstructure effects. As such, these are the regressions we computed at this stage:

- Regression 5.1, using ex-dividend closing prices and no independent term
- Regression 5.2, using ex-dividend closing prices and including an independent term
- Regression 5.3, using ex-dividend opening prices and no independent term
- Regression 5.4, using ex-dividend opening prices and including an independent term
- Regression 5.5, using ex-dividend adjusted closing prices and no independent term
- Regression 5.6, using ex-dividend adjusted closing prices and including an independent term

[15] As explained in section 4, the process is the following: A first test that assesses whether fixed/random effects are redundant and if they are not considered redundant, a second test, the Hausman (1978) test which will decide whether to use fixed effects or random effects in the model.

Once we established our regressions, we had to estimate each regression and assess which was the most adequate panel data model to use. Table 4 illustrates how we conducted that process.

Table 4 – Panel Data Model Selection

Regression	Fixed Effects Test	Hausman Test	Model Decision
5.1	Cannot reject H_0	/	PLS
5.2	Cannot reject H_0	/	PLS
5.3	H_0 is rejected	Cannot reject H_0	REM
5.4	H_0 is rejected	Cannot reject H_0	REM
5.5	H_0 is rejected	Cannot reject H_0	REM
5.6	H_0 is rejected	Cannot reject H_0	REM

As we can see from the table above, our testing determined that, for the regressions estimated using closing ex-dividend prices, using the Pooled Least Squares model is the best approach. Both for opening prices and for adjusted closing prices, we determined that the Random Effects Model is the most efficient model. It is important to point out that it is not possible to estimate a regression using random effects without an independent term. As such, regressions (5.3) and (5.4) are identical, and the same applies for regressions (5.5) and (5.6). For the sake of avoiding redundancy, we will present them together in our results. Our heteroskedasticity tests showed that the residuals in regression models (5.1) and (5.2) were indeed heteroskedastic. We corrected the heteroskedasticity problem by resorting to the Generalized/Weighted Least Squares method (GLS), as suggested by Gujarati (2003). Table 5 shows the results of our estimations for regressions (5.1) - (5.6).

Table 5 – Full Sample Regression Model Results

Regression	Method	N. obs	α_1	α_2 (Div. Yield)	p-value (α_2)	R^2	Adjusted R^2
Closing Prices (P_e) used to compute $(P_c - P_e)/P_c$							
5.1	GLS	262	-	0,630304	0,0000	0,35405	0,35405
5.2	GLS	262	0,00505	0,757938	0,0000	0,37123	0,36881
Opening Prices (P_e) used to compute $(P_c - P_e)/P_c$							
5.3 & 5.4	REM	262	0,00451	0,695759	0,0000	0,34816	0,34565
Adjusted Prices (P_e) used to compute $(P_c - P_e)/P_c$							
5.5 & 5.6	REM	262	0,00459	0,711792	0,0000	0,45946	0,45738

Primarily, it is interesting to compare the explanatory power of the models. We can observe that the use of adjusted closing prices yields the model with the most explanatory power. In that model, the the independent variables explain around 46% of the model, compared to around 35% both when using closing prices and when using opening prices. When comparing it to the models estimated by Farinha and Soro (2005) using an approach similar to ours[16], we see that the explanatory power of the models is similar[17]. As we had mentioned before, authors such as Frank and Jagannathan (1998) and Boyd and Jagannathan (1994) suggest the inclusion of an independent term, which in case of a negative sign, could mean microstructure effects in the market. In all the models we estimated, the independent term is negative but of no statistical significance, meaning that if there where microstructure effects during our sample, they were mostly insignificant. This result contradicts the findings of Frank and Jagannathan (1998) and Boyd and Jagannathan (1994) but is in line with Farinha and Soro (2005), who did not find a strong enough case for microstructure effects in their own study of the Portuguese

[16] Farinha and Soro (2005) do not present their results for adjusted closing prices. The authors did compute adjusted prices, using an adjustment process different to ours, but did not present the results due to them being very similar to the unadjusted results.

[17] Farinha and Soro (2005) present an R^2 of 0,4522 for opening prices and 0,2793 for closing prices.

stock market. As for the other independent variable, the dividend yield, we find that it is statistically significant for all three ex-dividend prices, meaning we can consider the dividend yield as relevant and impactful in the formation of ex-dividend price changes. In all regressions, the sign of the dividend yield is positive, pointing towards a positive relationship between the dividend yield and the ex-day price change. Looking at the differences in the models estimated, we can see that the α_2 coefficient is quite similar in all of them, meaning that, irrespective of the ex-day prices we chose to estimate the model, they all predict a similar impact of the dividend yield on the ex-day price variation.

At this point we should look back to the explanation we made in section 4 of equations (4.4) and (4.5). As we mentioned, the QVP is given by the slope of the equation, meaning that, in regressions (5.1-5.6), α_2 is our estimated QVP. To the effect of comparing the estimated QVP to the tax discrimination factor of our marginal investor, we look back at Table 1. We can see that all of our estimated QVPs are lower than the TD for the marginal investor[18]. For the sake of completeness, we ran a *Wald* test equating QVP to the tax discrimination factor of 0,92, for all our regressions. The null hypothesis was rejected in every test.

In regard to our first research hypothesis, we believe our results are robust enough to support it. We find evidence that confirms the existence of a positive relationship between the dividend yield and and the ex-dividend price changes, in all three of our scenarios[19]. As for the second hypothesis, which seeks to test Elton and Gruber's (1970) argument that QVP should be equal to the tax discrimination factor, we believe our results are not enough to support it. By looking at our estimated QVPs we can see that they are indeed lower than the tax discrimination factor for the sample and the *Wald* tests we ran confirm that initial suspicion. As such, we cannot accept our hypothesis that the QVP does not differ significantly from the tax discrimination factor. This means that we cannot confirm the presence of a tax effect in our sample, or that we, at least, need to acknowledge that there must be other factors influencing the ex-dividend price. This is consistent with the results of Borges (2008) but contradicts the findings of

[18] The TD for the marginal investor for our sample period was 0,92 in the scenario considering the capital gains tax of 0% until 2009 and 0,96 considering a capital gains tax of 10% until 2009

[19] Using ex-dividend closing prices, ex-dividend opening prices and ex-dividend adjusted closing prices

authors such as Farinha and Soro (2005), Elton and Gruber (1970), Barclay (1987) and Elton *et al* (2003).

Results for the subperiods of 2004-2011 and 2012-2017

In this subsection we will analyze the most important of our three research hypotheses. As we have mentioned before, the added value of our work comes from the fact that we can observe, during our sample period, two different taxation scenarios. The remainder of our analysis is crucially tied with the shift from a situation where, in Portugal, dividends faced a heavier tax burden than capital gains (2004-2011) to a situation of tax indifference (2012-2017). In order to proceed with our study, it was necessary to split the initial sample in accordance to this. After splitting the sample, we had a subsample of 129 observations from 21 firms for the period of 2004-2011 and a subsample of 133 observations from 20 firms for the period of 2012-2017. Since we have already shown the yearly descriptive statistics in table 2 it would be redundant to do so again. Table 6 presents the descriptive statistics for the relevant variables of both subsamples, but only the respective sample means.

Table 6 – Descriptive Statistics for 2004-2011 and 2012-2017

		2004-2011	2012-2017	**Total**
N. Obs		129	133	**262**
N. Firms		21	20	**23**
Pcum (€)	Max.	20,85	17,97	**20,85**
	Min.	0,51	0,15	**0,15**
	Mean	4,82	5,24	**5,03**
	Std. Dev.	4,13	4,47	**4,30**
Div (€)	Max.	1,30	0,75	**1,30**
	Min.	0,01	0,00	**0,00**
	Mean	0,16	0,17	**0,16**
	Std. Dev.	0,18	0,14	**0,16**
D. yield (%)	Max.	15,00	20,27	**20,27**
	Min.	0,36	0,51	**0,36**
	Mean	3,77	4,14	**3,96**
	Std. Dev.	2,50	3,14	**0,03**

Legend:
N. obs – Number of observations in the sample each year
N. Firms – Number of Firms in the sample
Pcum – Cum-dividend day price, presented in euros
Div – Gross dividend per share, presented in euros
D. yield – Dividend Yield, the ratio between the gross dividend and the cum price, presented as a percentage

From the table we can see that, relative to the main sample, the subsample for 2004-2011 has a lower average cum-dividend price and a lower mean dividend yield. In the second subsample (2012-2017), we can verify the opposite, a higher average cum-dividend price and higher dividend yield. In addition to the descriptive statistics of the subsamples, it is worth looking at the average observed QVPs of both samples. Again, since we have already presented the yearly averages, only the averages for both samples are presented.

Table 7 – QVP for 2004-2011 and 2012-2017

	2004-2011	2012-2017	**Total**
Closing Prices (P_e) used to compute QVP = (P_c - P_e)/D			
Mean	0,511	0,587	**0,550**
Std. Dev.	1,071	0,697	**0,900**
Opening Prices (P_e) used to compute QVP = (P_c - P_e)/D			
Mean	0,601	0,470	**0,535**
Std. Dev.	0,801	0,804	**0,804**
Adjusted Closing Prices (P_e) used to compute QVP = (P_c - Pe)/D			
Mean	0,441	0,539	**0,491**
Std. Dev.	0,980	0,711	**0,854**

When looking at the observed QVPs for both subsamples, a few things are of note. As was the case with the main sample, the standard deviation is always greater than the mean, irrespective of which type of ex-dividend prices are used to compute QVP. In terms of how the subsamples relate to the main sample, there is contrast between opening ex-dividend prices and closing prices, both adjusted and unadjusted. When using opening prices, the 2004-2011 subsample presents a QVP mean higher than the total sample mean and a 2012-2017 mean that is lower than the total. The opposite happens when considering closing prices or adjusted closing prices. Putting the two subsamples against each other, the most striking difference is in

the standard deviation. The standard deviation of the QVP is considerably smaller for the 2012-2017 subsample, namely when using ex-dividend closing prices (adjusted or not). When using opening prices, the standard deviation is practically identical for both subsamples.

In order to test H3, we need to estimate and compare the QVPs for both subsamples. For that purpose, we will have to use regressions (5.1)-(5.6) once again, only this time we will estimate the models using the two subsamples. It is important to understand that, even if the regressions used to estimate the model are the same, it is no guarantee that the same panel data model as used for the full sample will be identified as the most efficient for the sub sample. For example, with the full sample, we identified the Random Effects Model as the most efficient one when considering opening ex-dividend prices, but it is possible that, with the subsamples being different sets of data than the main samples, that a different model is identified for opening prices. For that reason, we conducted the model identification tests for all 12 relevant regressions, 6 for each subsample. Once again, when necessary, we corrected for heteroskedasticity by using GLS. Table 8 presents the estimation results for the 2004-2011 subsample and Table 9 for the 2012-2017 subsample.

Table 8 – Regression Model Results for the Period of 2004-2011

Regression	Method	N. obs	α_1	α_2 (Div. Yield)	p-value (α_2)	R^2	Adjusted R^2
Closing Prices (P_e) used to compute (P_c - P_e)/P_c							
5.1	GLS	129	-	0,602037	0,0000	0,28624	0,28624
Opening Prices (P_e) used to compute (P_c - P_e)/P_c							
5.4	GLS	129	0,001483	0,539862	0,0000	0,17196	0,16544
Adjusted Closing Prices (P_e) used to compute (P_c - P_e)/P_c							
5.5 & 5.6	REM	129	-0,002608	0,632274	0,0000	0,55982	0,47343

Table 9 – Regression Model Results for the Period of 2012-2017

Regression	Method	N. obs	α_1	α_2 (Div. Yield)	p-value (α_2)	R^2	Adjusted R^2
Closing Prices (P_e) used to compute (P_c - P_e)/P_c							
5.1	GLS	133	-	0,655307	0,0000	0,43284	0,43284
Opening Prices (P_e) used to compute (P_c - P_e)/P_c							
5.3 & 5.4	REM	133	-0,007743	0,792282	0,0000	0,63481	0,632021
Adjusted Closing Prices (P_e) used to compute (P_c - P_e)/P_c							
5.6	PLS[20]	133	-0,005198	0,765300	0,0000	0,59320	0,59009

Before assessing the results for the two subsamples, a few things are of note. For comparison purposes and to facilitate the understanding our what we are arguing, we only present three regressions[21] per table, one for each type of ex-dividend prices used in the estimation of the model. This is due to the intricacies of each model. For example, as we mentioned before, it is not possible to exclude the independent term when using the Random Effects Model. With that in mind, when comparing REM with GLS or PLS, we choose to present the regression that includes the independent term, for comparability purposes. Otherwise, when comparing two regressions that were estimated using least squares, we present the regressions that were estimated without the independent term[22].

When comparing the results in Table 8 and Table 9 to the results from the main sample (Table 5), certain observations are worth mentioning. In terms of the explanatory power of the model, the first subsample (2004-2011) maintains the same trend we saw in the main sample, with the use of adjusted closing prices seemingly yielding a better goodness of fit than opening

[20] Since no heteroskedasticity was found, the estimator we obtained using the Pooled Least Squares model is efficient and is the one we present.
[21] And, consequently, one QVP.
[22] This choice is based on the fact that the independent terms were statistically insignificant. As such, we believe that the regressions without independent terms provide more accurate estimations of QVP, thus making them more pertinent for our testing of H3.

or closing prices. In addition, the α_2 coefficient, which is the estimated QVP, is lower for the period of 2004-2011 than in the main sample, for every type of ex-dividend prices. Moreover, it is noteworthy that the second subsample (2012-2017) shows a perceptibly higher explanatory power than both the first subsample and the main sample, across all types of ex-dividend prices. The estimated QVP for the second subsample is higher than in the main sample, for every type of ex-dividend prices.

When comparing both subsamples to each other, we observed that the estimated QVP was considerably higher in the period from 2012 to 2017. Table 10 provides an overview of that comparison.

Table 10 – Comparison of estimated QVP in the two subsamples[23]

Ex-Day Prices	α_2 (2004-11)	α_2 (2012-17)	Change	Change (%)
Closing Prices	0,602037	0,655307	+0,05327	**+8,8%**
Opening Prices	0,539862	0,792282	+0,25242	**+46,8%**
Adjusted Closing Prices	0,632274	0,765300	+0,13303	**+21,0%**

The increase in the estimated QVP is quite significant, particularly when using opening prices. Due to the aforementioned characteristics that distinguish the two subsamples, namely the shift from a scenario of tax discrimination in disfavor of dividends to a scenario of tax indifference, we believe these results are consistent with Elton and Gruber's (1970) reasoning that a higher tax discrimination factor would bring a higher QVP (see equation 3.3) and signal the existence of a tax effect in the formation of ex-dividend prices. With that in mind, we are convinced that these results are sufficient to support and confirm H3. Crucially, it should be noted that, while we did not find evidence strong enough to support the existence of a fiscal effect on ex-dividend prices when we analyzed the full sample earlier in this section, when we split the sample and compare the two periods where taxation was different, our results are consistent with the presence of a tax effect.

[23] As mentioned in section 4, the estimated QVP is given by the slope of the regression, i.e., the coefficient α_2.

Clientele Effects

With the aim of evaluating our sample for tax clientele effects, we decided that it was more logical to use the subsample comprising the period between 2004-2011 instead of the full sample, as it could perhaps be futile to search for clientele effects in a period that contains a scenario of tax indifference. Miller and Modigliani's (1961) argument acknowledging the clientele effect was that one can expect high-dividend stocks will be more attractive to investors less punished by taxation on dividends, i.e., with a a higher TD, computed as in (3.1). If one relates this with the relationship that Elton and Gruber (1970) established between the tax discrimination factor (TD) and the ex-dividend price change divided by the dividend (QVP), it is expectable that, in the presence of clientele effects, the QVP would rise as the dividend yield rises.

In order to assess this, we follow a methodology similar to the one used by Farinha and Soro (2005), splitting the sample into quintiles, ordered by dividend yield. We estimated the respective QVPs according to equation (4.4), using ex-dividend closing prices[24]. Table 11 shows the estimation results.

Table 11 – Clientele effects estimations

Quintile	N. obs.	D. Yield	α_{1Q}	α_{2Q}	α_{3Q}	α_{4Q}	α_{5Q}
1	26	1,26%	0,45889				
2	26	2,3%		0,48785			
3	25	3,1%			0,86995		
4	26	4,5%				0,54183	
5	26	7,7%					0,60748

Legend:
D. Yield – Mean dividend yield in that quintile

[24] We did the same exercise using opening prices and adjusted closing prices, but the results were less precise.

As we can infer from the table, our results are not sufficient to support the existence of clientele effects. In addition to the trend in the QVP estimates not being in line with what would be expected, the estimate for the first quintile is statistically insignificant, which further compromises the hypothesis. These results are in line with the findings of Borges (2008) and Farinha and Soro (2005) for the Portuguese stock market and, in broader terms, also aligned with authors like Booth and Johnston (1984) and Menyah (1993).

6. Conclusion

The backbone of our study is the unique characteristics of the sample period we chose. By choosing a larger sample that included periods of both tax discrimination and tax indifference, we were able to test our research hypothesis more thoroughly. It is not the first time that a study looking at the impact of taxation changes in ex-dividend prices has been carried out. The likes of Booth and Johnston (1984), Michaely (1991), Zhang, Farrell and Brown (2008) for example, all carried out studies that included, to some extent, an analysis on the impact of changing tax regimes. Nevertheless, our study was, to the best of our knowledge, the first do so in the Portuguese stock market. While Farinha and Soro (2005) did look at a change in dividend taxation, it was only for the year 2002 and it was still not a shift to a situation where dividends and capital gains are taxed identically.

Following Elton and Gruber's (1970) methodology, we first tested our full sample for the existence of tax effects in the formation of ex-dividend prices. The results we found were not robust enough to support this hypothesis, which is in line with Borges' (2008), who also rejects the tax explanation in the Portuguese stock market. However, the characteristics of our sample enabled us to split the sample and do separate testing for the period before the 2012 tax changes and the period after them. When comparing the results of both subsamples, the differences we find point towards the existence of a tax effect. The introduction of a tax indifference scenario yields a notable increase in the estimated price change relative to the dividend, which is accordance with Elton and Gruber's (1970) reasoning, as well as the findings of Farinha and Soro (2005) for the Portuguese stock market. As such, we believe that our results show that the tax explanation for the formation of ex-dividend prices is credible.

Moreover, we tested our full sample, as well as our subsamples, for microstructure effects and did not find evidence supportive of those arguments, suggested by Boyd and Jagannathan (1998) and Bali and Hite (1998). We also evaluated our first subsample, i.e., the period before the tax changes, searching for clientele effects. Our results were not consistent with the validity of the clientele hypothesis.

In our eyes, our decision to use three different types of ex-dividend prices[25] adds to the significance of our results. We believe that the fact that for every hypothesis we tested, all three methods point in the same direction, albeit to varying degrees, is a testament to the empirical relevance of the study we conducted.

[25] Closing prices, Opening prices and Adjusted closing prices.

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