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Diachronic Analysis of the Impact of Arbitration on Transaction Costs: The Case of the Detachment of Dividends in France in the Period from 1990 to 2000

Assoumou Menye Oscar

Department "Finance and Accounting", ESSEC of the Douala University, Douala, Cameroon

Email address:
oscar_assoumou@yahoo.fr, oscar.assoumou@gmail.com

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Abstract: There are often two competing assumptions as to the interpretation to be given to price adjustments on dividend detachment dates. The tax assumption that the adjustment reflects the tax differential between capital gains and dividends and the tax heterogeneity assumption that favors the creation of clients and the holding of high-yield securities by categories of investors with little income tax. The alternative hypothesis emphasizes arbitrages and dividend capture strategies and concludes that in equilibrium the adjustments reflect the transaction costs of arbitragists. The difference between these two hypotheses is hardly palpable. This work proposes a double contribution. Theoretically, it integrates transaction fees into a model of arbitrage between capital gains and dividends. It is therefore shown, by finding the results of customer effects and by generating new relationships between the fall in the price and transaction costs, that the two hypotheses do not generate contradictory results and respond to the existence of two different tax systems on the Monthly Settlement (RM) and on the Cash. Empirically, it proposes, on the one hand, a measure of implicit transaction costs using the range, based on daily data observed around dividend detachment dates and, on the other hand, it highlights a statistic that reflects the tax differential in the markets. Finally, a study of the volumes offered and requested reinforces the idea that the existence of transaction costs is not incompatible with the customer effect.

Keywords: Arbitration, Transaction Costs, Capital Gain, Dividend, Customer Effect

1. Introduction

In classical financial theory, there are two competing assumptions as to the interpretation to be given to price adjustments on dividend detachment dates. In accordance with the tax assumption, the adjustment reflects the tax differential between capital gains and dividends. In other words, investors are demanding greater profitability of dividend-distributing securities, since dividends are generally taxed more than capital gains. As for the heterogeneity of taxation, it favors the creation of clienteles and the holding of securities with a high rate of return by categories of investors with little taxation on [10]. The alternative hypothesis emphasizes arbitrages and dividend capture strategies and concludes that in equilibrium the adjustments reflect the transaction costs of the arbitragists [14, 16].

The difference between these two hypotheses is difficult to show empirically and many antithetical results have been published. Thus, on the French market for [10] show that the conditions of taxation are linked to the method of trading the shares. Therefore, on the basis of the tax hypothesis, two different types of adjustments arise. On the monthly settlement (RM), a situation of non-taxation of dividends and abandonment of the tax credit creates an identical implicit taxation for all investors cashing the dividend. On the spot, investors benefit from the tax credit, and are not all taxed isochronously on the dividend.

However, the work of [10] leads to results that contradict the fiscal hypothesis. They show that the price adjustment recorded on the monthly settlement is not significantly different from that recorded in cash. They show that there is a customer effect on the monthly payment, where taxation is supposed not to intervene.

The contribution of this article is both theoretical and empirical. Theoretically, it is a question of integrating transaction costs into a model of arbitrage between capital gains and dividends. It will therefore be shown, by finding the results of customer effects and by generating new relationships between the fall in the price and transaction costs, that the two hypotheses do not generate contradictory results and respond to the existence of two different tax systems on the RM and on the cash. Empirically, the contribution of this work consists, on the one hand, in proposing a measure of implicit transaction costs using the range, based on daily data observed around dividend detachment dates [6], and on the other hand, in highlighting a statistic that reflects the tax differential on the markets. In addition, a study of the volumes offered and requested reinforces the idea that the existence of transaction costs is not incompatible with the customer effect.

To highlight the scope of our proposals, in section 1, we will present the modeling of the rational behavior of an investor, which arbitrates between different strategies, allows to highlight the impact of transaction cost and taxation on the investment decision and on the adjustment of prices around the payment of the dividend [4]. In Section 2, the analysis of the dividend capture strategy allows the expression of the tax differential to measure the effect of taxation and transaction fees on price adjustment and to infer investor behavior. Section 3 shows how the two assumptions of the existence of taxation and transaction fees can be combined. Finally, in section 4, we will test the predictions of the global arbitration model.

2. Arbitration Between Capital Gains and Dividends in the Presence of Transaction Costs

2.1. Assumptions and Conceptual Framework of the Model

In the context of this work, we have voluntarily adopted the hypothesis of homogeneous tax conditions. Indeed, investors are characterized by a couple of tax rates (T_d, T_p), where T_d denotes the marginal tax rate on income and T_p that on capital gains. An investor who acquires securities on the monthly settlement market has his liquidation account credited with an amount equal to that of the dividend. This operation amounts to receiving an untaxed dividend, without the benefit of the tax credit [8]. On the other hand, a buyer of securities traded in cash receives the dividend, on which it is taxed, and benefits from the tax credit. The investors considered in this model are long-term shareholders, who seek to maximize their after-tax profitability. All individuals are risk neutral.[1]

They incur transaction costs, which correspond to the fees paid to intermediaries and the difference between the sale price and the purchase price of a security at a given time. Whether the transaction is contemplated before or after the dividend is detached, the explicit component of the cost (brokerage fees) is constant in percentage terms. On the contrary, the implicit factor, generated by the difference between the selling price and the purchase price, is not always constant. It is estimated by the band, and depends on three variables: the spacing of the band, the level of the band and the position of the equilibrium price in relation to the band.[2]

2.2. Model of Arbitrage Between Capital Gains and Dividends

We will incorporate the following ratings: P_0 is the initial purchase price of the share, P_b and P_{has} the respective share prices before and after the dividend is detached, D is the amount of the dividend distributed, and A is the tax credit rate. C_b and C_a represent transaction costs: different levels of transaction costs before and after secondment are possible insofar as the essential component of the costs is implicit and corresponds to the range whose temporal constancy cannot be assumed.

The investor's objective is to maximize the expectation of gain at the time of dividend detachment. Relationship (1) records the financial flows related to the resale of the share before and after the posting. The resale date of the share is irrelevant in the event of an equality between the two series of flows:[3]

$$P_b - (P_b - P_a) \times T_p - C_b \times (1 - T_d) = \quad (1)$$

$$P_a - [(P_a - P_0) \times T_p] + D - [(1 + A) \times D \times T_d - A \times D] - C_a \times (1 - T_d)$$

The model of [5] can be found, assuming that the transaction costs and the tax credit rate are zero.

The equality (1) implies a lack of opportunity for arbitration. The rate of return, required before taxes at the coupon posting session,

$R_{ex} = (P_a - P_b + D)/P_b$, can be deduced from equality (1):

$$R_{ex} = \frac{D}{P_b} \times \left[1 - \frac{(1+A)(1-T_d)}{1-T_p}\right] + \frac{C_a - C_b}{P_b} \times \frac{1-T_d}{1-T_p}$$

This equilibrium rate reflects the pre-tax profitability that the investor requires, so as not to be encouraged to arbitrate between the capital gain and the dividend. It depends on two components: dividend yield and transaction costs. These two components are multiplied by a factor that reflects the tax differential.

The investor with a low marginal income tax rate demands

1 The DRS replaced the RM on September 25, 2000. It is a segment of the Parisian market that brings together the securities for which the settlement of transactions can be postponed at the end of the month.

2 The ranges, observed on shares listed on the CAC system of the Paris Stock Exchange, are described in Hamon and Jacquillat (1992)

3 Transaction costs are assumed to be deductible from taxable income. If, conversely, the costs are deduced of added value, equality (1) allows to obtain the market value of the dividend according to the fall in the price and the difference in transaction costs before and after the posting, taking into account the taxation: $\frac{(P_b - P_a) + (C_a - C_b)}{D} = \frac{(1 - T_d)(1 + A)}{1 - T_p}$

a higher return on securities for which there is a greater increase in transaction costs between the day before and the day of posting. The weight given to transaction fees is higher. The high-dividend tax investor demands higher profitability from securities that have a high dividend yield. The weight given to the dividend yield is higher.

The ratio of [5], which can allow us to express the fall in the price per euro of dividend distributed, becomes:

$$\frac{P_b - P_a}{D} = \frac{1-T_d}{1-T_p} \times \left[1 + A - \frac{C_a - C_b}{D}\right] \quad (2)$$

The fall in the price per franc of dividend distributed reflects not only the tax differential, but also the difference in transaction costs before and after the dividend is detached. In the event that the payment of the dividend results in an increase in the implicit cost (widening of the band), the fall in the price, around the payment, will be less than the tax differential. This explains the difference, which exists between the fall in the price and the dividend. It is due to the tax differential and the increase in transaction costs that absorbs a portion of the dividend payment.

The decrease in the price does not accurately reflect the amount of the dividend due to taxation and the existence of transaction fees.

2.3. Impact on Courses

In the monthly settlement market, the tax credit and the tax rate on dividends are zero. Assuming that the capital gains tax rate is equal to 18. 1%, the relationship (2) can be rewritten as:[4]

$$\frac{P_b - P_a}{D} = 1{,}22 \times \left[1 - \frac{C_a - C_b}{D}\right]$$

Based on the assumptions of taxation and no transaction costs, the adjustment should be constant and above the unit. This is questionable and cannot be reflected in reality. [10] Observe for example an average value of 73% on the RM. This leads us to believe that the price adjustment is not exclusively due to the tax assumption but also to the existence of transaction costs.

In cash trading, dividends are subject to income tax. Since investors do not have the same marginal tax rate, there is therefore a customer effect [11]. The consideration of personal taxation is at the origin of the customer effect. This effect states that low-tax investors prefer high-dividend stocks and vice versa. In the event of a penalty for dividends, the price drop per dividend franc is less than one unit.

3. Dividend Capture and Transaction Costs

3.1. Model Assumptions

The model is based on assumptions that all individuals have the same tax characteristics, are risk neutral, and seek to maximize after-tax profitability. However, there is a tax-induced investor to receive the dividend. The latter plans to buy the security one day before the payment, to receive the dividend and to resell the security one day after the payment. It incurs transaction costs, associated with the purchase and resale of a security around the detachment, rated C.

3.2. Transaction Cost Approach

The dividend capture model highlighted by [14] can be deduced from the pattern of arbitrage between capital gains and dividends with transaction costs, assuming that the investor has an interest in receiving the dividend. He buys the security just before the detachment of the dividend at price P_b, cashes the dividend and resells the security after the payment of the dividend at price P_a. The arbitration is carried out if the sum of the capital gain and the dividend is greater than the cost incurred. This is summarized by inequity (3):

$$(P_a - P_b)(1-T_p) + D(1-T_d)(1+A) \geq C(1-T_d) \quad (3)$$

At equilibrium, the profits of arbitrage disappear. Constraint (3) is saturated, which makes it possible to express the dropout of courses according to the tax differential and the transaction cost according to the formula:

$$\frac{(P_{b-P_a})}{D} = \frac{1-T_d}{1-T_p} \times \left[1 + A - \frac{C}{D}\right]$$

The drop in dividend prices partly reflects the tax differential and transaction costs. It is close to the tax differential for high dividend yield and low transaction cost securities.

When the monthly settlement market existed, T_d and A were equal to 0, and T_p to 18.1%. Therefore, the price drop as a percentage of the dividend distributed was expressed by the relationship (4):

$$\frac{p_b - p_a}{D} = 1{,}22 \times \left[1 - \frac{C}{D}\right] \quad (4)$$

From equality (4), it is possible to deduce a relationship between the dropout of courses and transaction costs. It makes it possible to establish a negative correlation between the dropout of courses and the transaction fees. This forecast can only be assessed and verified around the date of secondment.

Due to the specificity of the French market, the tax differential cannot be represented only by the fall in the price per dividend franc but must also include tax assets and transaction costs:

$$\frac{P_b - P_a}{D(1+A) - C} = \frac{1 - T_d}{1 - T_p}$$

This equality no longer expresses the drop in prices per franc of dividend distributed, but the drop in prices per franc of overall dividend, less transaction costs. This assertion makes it possible to infer tax rates from price drops per dividend franc net of transaction fees.

Among investors, who have a low tax rate, those who wish to collect the dividend, hold securities with low transaction

4 Rate used in France in the 1990s.

costs and high rates of return.[5]

On the RM, the tax differential, expressed as a function of dividend and transaction cost, took the following form:

$$\frac{P_b - P_a}{D - C} = \frac{1}{1 - T_p}$$

The ratio is not significantly different from 1.22, and in theory, it is constant regardless of the dividend yield class and range class.$(P_b - P_a)/(D - C)$

In spot trading (assuming a tax credit of 50%), the tax differential is written:

$$\frac{P_b - P_a}{1{,}5D - C} = \frac{1 - T_d}{1 - T_p}$$

Individuals, the lowest income taxed, hold high-yielding securities. Thus, the model makes it possible to establish a positive correlation between $(P_b - P_a)/(1{,}5D - C)\ et\ D/P_b$.

Individuals who wish to collect the dividend, in application of a dividend capture strategy, have a low marginal tax rate. In order to maximize their profitability, they have an interest in holding securities with low transaction costs. Since explicit costs are irreducible, and constant in percentage, they choose securities that have very low implicit costs. Therefore, the model is used to establish a negative correlation between $(P_b - P_a)/(1{,}5D - C)\ et\ C/P_b$.

Equation (5) relates the pre-tax rate of return, dividend yield and transaction costs, and reflects the profitability required before taxes by the investor:

$$R_{ex} = \frac{D}{P_b} \times \left[1 - \frac{(1+A)(1-T_d)}{1-T_p}\right] + \frac{C}{P_b} \times \frac{1-T_d}{1-T_p} \quad (5)$$

By positing $X = \frac{C}{P_b}\ et\ Y = \frac{D}{P_b}$, R_{ex} is written in the form of a linear model in X and Y, according to the relation (6) which follows:

$$R_{ex} = X \times \frac{1-T_d}{1-T_p} + Y \times \left[1 - \frac{(1+A)(1-T_d)}{1-T_p}\right] \quad (6)$$

Unlike the analysis of [12], this model takes into account transaction costs, without necessarily calling into question the positive relationship between the price drop and the dividend yield.

The model of arbitrage between capital gains and dividends, proposed by [12], is the first to incorporate transaction costs. It reflects the absence of profit opportunity at the time of payment of the dividend provided that the double inequality of the relationship (7) is verified:

$$1 - \propto \frac{P_{moy}}{D} \leq \frac{P_b - P_a}{D} \leq 1 + \propto \frac{P_{moy}}{D} \quad (7)$$

Under these conditions, the growing relationship between the price drop and the dividend yield exists only for securities, whose fall in the price per dividend franc is situated between the two limits of inequality (7). In other words, the customer effect appears only for securities, which do not give investors the opportunity to speculate at the time of the detachment of the dividend.

However, according to the basic assumptions of this model, transaction costs are proportional to the price level ($\propto P_{moy}$). The higher the dividend yield, the greater the probability that the fall in αP_{moy} the price per dividend franc will exceed the non-profit limits. This is the reason why [12] questions the customer effect.

By assuming that costs are composed of explicit costs, constant in percentage, and implicit, variable costs, the limits of no profit opportunity are no longer so restrictive and the customer effect becomes compatible with the existence of transaction fees.

From equation (1.5), a positive correlation can be deduced between the ex-dividend rate of return and transaction costs:

$$\frac{\partial R_{ex}}{\partial (C/P_b)} = \frac{1 - T_d}{1 - T_p} \geq 0$$

In other words, the required pre-tax rate of return increases with transaction costs. This naturally leads to a positive correlation between the ex-dividend rate of return and the absolute range, in relation to the cum-dividend price. This correlation exists only around the detachment of the dividend and depends on the marginal tax rate of the shareholder. More concretely, the slope of the derivative increases all the more as the marginal tax rate decreases. This is consistent with the dividend capture assumption. If transaction costs increase, the surplus profitability, demanded by the shareholder, grows much faster for securities held by individuals with low tax rates.

The derivative of the rate of return in relation to the dividend yield can then be written:

$$\frac{\partial R_{ex}}{\partial (D/P_b)} = 1 - \frac{(1 - T_d)(1 + A)}{1 - T_p}$$

Two cases are to be distinguished according to the value of the tax rate:

Case 1: $T_d \leq 1 - \frac{1-T_p}{1+A}$

Under these conditions, the higher the dividend yield, the lower the rate of return. A decrease in the rate of return combined with an increase in the rate of return encourages arbitragists to capture the dividend since the share of the capital gain in the rate of return decreases. Therefore, the dividend capture assumption is more easily verified for high dividend yield securities. The positive correlation between the rate of return and transaction fees is expected to be greater for high dividend yield securities.

Case 2: $T_d > 1 - \frac{1-T_p}{1+A}$

The derivative is positive. The rate of return, required before taxes, increases with the dividend yield. This case corresponds to the model of [2]. The income tax rate is higher than the capital gains tax rate. The investor has no tax incentive to receive the dividend. It requires a surplus of profitability that is all the stronger the higher the dividend yield.

5 This assertion Corroborate the liquidity customer effect, highlighted by Amihud and Mendelson [1986], according to which securities, which have high ranges, are held by long-term investors.

3.3. Impact on Volumes

The capture of the dividend results in an increase in the demand for securities, before the dividend is detached, and an increase in the supply of securities on the date of payment of the dividend. At the date of posting, it is difficult to differentiate the influence on transaction volumes of investors with tax motives, and arbitragists who receive the dividend. On the other hand, one day before the payment date, an increase in demand for securities could be a sign of arbitrage on the dividend.

4. Interaction of Dividend Appreciation and Dividend Capture Arbitrage Models

The table below summarizes the assumptions and predictions of the models.

Table 1. *Taxation, transaction cost and dividend detachment.*

	Taxation without transaction costs		Taxation with transaction costs	
	Rm	**Cash**	**Rm**	**cash**
Price fall	$\frac{P_b - P_a}{D} = \frac{1}{1-T_p}$	$\frac{P_b - P_a}{D} = \frac{(1-T_d)(1+A)}{1-T_p}$	$\frac{P_b - P_a}{D-C} = \frac{1}{1-T_p}$	$\frac{P_b - P_a}{D\,(1+A)-C} = \frac{1-T_d}{1-T_p}$
Ex-dividend rate of return	$R_{ex} = \frac{D}{P_b} \times \left[1 - \frac{1}{1-T_p}\right]$	$R_{ex} = \frac{D}{P_b} \times \left[1 - \frac{(1-T_d)(1+A)}{1-T_p}\right]$	$R_{ex} = \frac{C}{P_b} \times \frac{1}{1-T_p} + \frac{D}{P_b} \times \left[1 - \frac{1}{1-T_p}\right]$	$R_{ex} = \frac{C}{P_b} \times \frac{1-T_d}{1-T_p} + \frac{D}{P_b} \times \left[1 - \frac{(1-T_d)(1+A)}{1-T_p}\right]$
Impact on courses	$\frac{P_b - P_a}{D} = 1.22$	Positive correlation between$\frac{P_b - P_a}{D}$ and $\frac{D}{P_b}$	$\frac{P_b - P_a}{D-C} = 1.22$	Positive correlation between$\frac{P_b - P_a}{D-C}$ and $\frac{D}{P_b}$ et negative between $\frac{P_b - P_a}{D-C}$ and$\frac{C}{P_b}$
Impact on volumes	Increase in supply one day before payment and on the day of secondment		Increased demand for securities before dividend payments. Increase in supply on the day of payment	
Investor behavior	Low marginal tax rate shareholders holding high-yielding securities		Low marginal tax investment holding high-yielding, low-transaction-cost securities.	

NB. The tax conditions used here are those effective in 1990-1991, the period of the study, particularly as regards the taxation of capital gains (18.1%).

The assumptions of taxation and dividend capture are not incompatible. We can compare the equilibrium rates of return, R_1 and R_2, under the tax assumption and under the dividend capture assumption. R_1 and R_2 will determine the thresholds for the collection of the dividend. Initially, if the rate of return around the detachment is higher than R_1, the assumption of taxation without transaction costs is verified: the shareholders, whose rate pair corresponds to the dividend yield class to which the security belongs, will cash the dividend. In a second step, the dividend capture assumption is verified if the rate of return is greater than R_2. Therefore, if R_2 is less than R_1, two types of investors acquire the security: long-term shareholders, whom the tax differential encourages to receive the dividend, and arbitragists whose purpose is to receive the dividend by buying and selling the security around the date of detachment. But if R_1 is less than R_2, the arbitragists disappear, and only shareholders who have a tax differential in favor of the dividend receive the dividend.

5. Results

The empirical tests on which we relied were carried out over the period from March 1990 to April 1991, due to the availability of data with better limits. All companies, which pay a dividend and which are listed in the database time-stamped shares AFFI-SBF have been selected. Over this period, 474 dividends were paid, of which 153 were paid on the monthly settlement market and 321 on the spot market. Enterprises, for which the value of the statistic (P[67]$_b$ P_a)/ [D (1+A) C] is not included in the interval [, where the mean of the statistic and the standard deviation is denoted, were eliminated from the sample.$\mu - \sigma;\ \mu + \sigma]\mu\sigma$[8]

5.1. Tax Customer Effect Test

Over the years 1990 and 1991, the average headings of the report (P_b P_a) / Dis 61%, all securities combined, it is 75% for securities traded in monthly settlement and 55% for those traded on the spot. The ratio (P_b - P_a) / D is significantly different from 0, regardless of the market. In addition, there is a customer effect in both markets. People, the most income-taxed, seem to hold low-dividend-yield securities.

However, two points can be made to these results. First, on the RM, the ratio (P[9]$_b$ P_a)/D is significantly different from 1.22, which contradicts the hypothesis of a single consideration of taxation, concerning capital gains. Secondly, a Fisher test makes it possible to reject the hypothesis of a significant difference between the adjustments found in the two markets, which is not compatible with the existence of two different tax systems. These remarks call into question the classic customer effect models [5, 10] and lead to the taking into account of transaction costs in the model.[10]

6 Association Française de Finance, Société des Bourses Françaises.

7 It has been verified that the day of payment of the dividend and the day before the payment do not correspond particularly to a period of increase or decrease in the index: out of 474 observations, 262 increases in the index were noted on the day of payment and 281 increases the day before payment

8 The values of μ and σ are calculated in Table 2.

9 The exceedance threshold is 0.0001.

10 The value of the statistic is 2.026, which gives a probability of exceeding this

5.2. Correlation Between Price Drop-out Per Franc of Total Dividend Net of Transaction Costs and Rate of Return

In addition to the explicit costs paid to the intermediaries executing the transmitted order, there is an implicit component related to the conditions of execution of the order on the market. The range or difference between the two best limits of the carnet is used in this study to approximate the cost of a purchase and sale. The transaction costs expressed in proportion to the price are written:

$$C = (k + S)\,P$$

Where k is the explicit percentage cost of buying and selling a share and S is the relative range. Since k is constant over time, only ranges are taken into account in the study. The range is measured from the first best limits of the session. The relative ranges (differences between the offered price and the asking price related to the middle of this difference) observed at the opening of the detachment session have an average value of 2.61% and a standard deviation of 3.62%, all securities combined. The respective averages on RM and cash are 1.35% and 3.31%. The standard deviations are 1.31% and 4.25%. These observations were made over the period from March 1990 to April 1991.

The assimilation of the implicit transaction cost to the value of an observed range poses a double problem, due to a possible difference between the range displayed and that actually achieved and the position of the equilibrium price in relation to the range. On the second point, the probability that a given equilibrium price will be caused by buyers is assumed to be equal to that of sellers. It is not rejected by the data because the percentage of prices caused by non-book buyers on a window around the dividend detachment [-10; 10] is 42%[13]

The characteristic values of the price drop per franc of dividend net of transaction costs are given in Table 2.

Table 2. *Reporting* $\frac{P_b - P_a}{D(1,5) - C}$.

Market	All titles combined A=0	All titles combined A=0.5	RM (A=0)	Spot market A=0.5
Number of observations	454	469	146	316
$P_b - P_a$	12,48	12,75	14,37	11,42
D (1+A)	19,21	28,67	20,67	27,29
C	30,93	30,33	13,54	38,22
$\frac{P_b - P_a}{D(1+A) - C}$	0,59 (3,16) [4,00]	0,32 (3,4) [2,07]	0,90 (2,02) [5,22]	0,19 (2,91) [1,15]

Note: The standard deviations are in parentheses and the Student tests are in square brackets. Under the null hypothesis, the mean is not significantly different from 0.

According to the tests, the ratio $(P_b - P_a)/[D(1+A)-C]$ is significantly different from 0 on the RM. Another student test makes it possible to affirm that the price drop per franc of dividend net of fees $(P^{11}{}_b - P_a)/(D - C)$ is not significantly different from 1.22 on the RM. Therefore, it reflects the tax differential which is theoretically 1.22. On the other hand, on the spot, the course dropout is no different from 0 (the value of student's statistic is 1.15, the threshold is equal to 0.25 19). In addition, the price drop per franc of global dividend, net of transaction fees, is significantly different between the RM and the cash as the price drop reflects the tax differential, it can be said that the calculations confirm the existence of different tax systems on the RM and on the cash.[12]

It is likely that the price drop per franc of dividend net of fees $(P_b - P_a / [D(1+A) - C]$ is a statistic that more accurately reflects the tax differential than the classical statistic $(P_b - P_a)/D$. However, it is necessary to prove that the tax customer effect is preserved, by considering the price drop per franc of overall dividend net of transaction costs.

Price falls were grouped by quintile of rates of return. The dividend capture model predicts a positive correlation between price drop-out and dividend yield.

Table 3. $\frac{P_b - P_a}{D(1+A) - C}$ *by dividend yield quintile.*

RM: A=0		Cash: A=0.5	
$\frac{P_b - P_a}{D - C}$	$\frac{D}{P_b}$	$\frac{P_b - P_a}{D(1,5) - C}$	$\frac{D}{P_b}$
0,151	1,02%	0,038	0,79%
0,593	1,57%	0,052	1,61%
0,672	2,03%	0,125	2,17%
0,691	2,85%	0,339	3,16%
1,150	5,23%	0,502	5,62%

Note: The number of observations per class is 29 in the RM and 63 in the spot.

In cash as in RM, the price drop increases with the dividend yield. These results are consistent with the tax customer effect assumption. The introduction of transaction costs makes it possible to preserve the customer effect, highlighted by [5] and later popularized by [13]. It appears that the most income taxed persons hold securities with a low dividend yield.[13]

Two statistics, Friedman's and Page's, make it possible to test ordered alternative hypotheses [15]. The hypothesis tested is as follows: $\chi_R^2 \chi_L^2$

H_0: aug 1 = augly$_2$ = aug 3 = aug 4 = aug 5

against

H_1: aug$_1$ < aug$_2$ < aug$_3$ < aug$_4$ < aug 5

where aug$_i$ is the average of the price drop, calculated on the i[th] quintile of dividend yield.

Friedman's statistic is written:

$$\chi_R^2 = \frac{12}{IJ(J+1)} \sum\left(\sum R_{i,j}\right)^2 - 3I\,(J+1)$$

Where I denotes the sample size, J the number of classes and $R_{i,j}$ the rank of the i[th] term of the series j. This statistic follows a law of $^2\,\chi$ to D-1 degrees of freedom. In this case, there are 5 classes. Friedman's statistic follows a law of four degrees of freedom, and Page's statistic follows a law of at one degree of freedom. The results are presented in Table 4.

value, equal to 15.53%.

11 The exceedance threshold is 0.2783.

12 Fisher's statistic takes the value of 4.761, the probability of exceeding this value is 0.02.

13 KHALED ZOUARI, Effet-clientèle et politique financière de l'entreprise: étude théorique et empirique, Thèse de doctorat en sciences de gestion, Université de Rennes 1, 1989.

Table 4. *Client Impact Testing.*

Market	actual by class	Statistics of Friedman	Page Statistic
Monthly payment	23	16,83	15,68
Cash	56	14	12,64

NB: The values in the table χ_R^2 are: at the 1% threshold, at the 5% threshold.$\chi_R^2(1) = 6.63\ et\ \chi_R^2(4) = 13.3 \chi_R^2(1) = 3.84\ et\ \chi_R^2(4) = 9.49$

At the 1% threshold, the assumption according to which the dropouts of courses are on average equal between the different quintiles is rejected, regardless of the mode of negotiation. There is likely a growing relationship between the overall price drop, net of transaction fees, and the dividend yield.

5.3. Testing the Effect of Transaction Costs

The ratio (P_b - P_a)/ [D (1+A) - C] represents the fall in price at the detachment per franc of global dividend net of transaction costs. Table 5 reports the values for five classes of shares formed according to the observed values of relative range over the period.

On both the RM and the cash, a negative correlation between the price drop and the range is observed. Thus, investors with low marginal tax rates hold the most liquid securities. This reflects the capture effect of the dividend.[14]

Table 5. $\frac{P_b - P_a}{D(1,5)-C}$ *by relative range quintile.*

RM: A=0		Cash: A=0.5	
$\frac{P_b - P_a}{D-C}$	$\frac{C}{P_b}$	$\frac{P_b - P_a}{D(1,5)-C}$	$\frac{C}{P_b}$
0,756	0,13%	0,437	0,44%
0,657	0,39%	0,340	1,25%
0,423	0,72%	0,207	2,12%
0,391	1,41%	0,111	3,44%
-0,339	3,37%	-0,256	8,99%

Note: The table displays the averages calculated by quintile.

The tests of ordered alternative hypotheses are presented in Table 6. The hypothesis tested is as follows:

H_0: aug 1 = $augly_2$ = aug 3 = aug 4 = aug 5

against

H_1: $aug_1 < aug_2 < aug_3 < aug_4 <$ aug 5

where aug_i is the average of the course dropout, calculated on the i^{th} quintile of range.

Table 6. *Ordered alternative Hypothesis Tests.*

Market	actual by class	Statistics of Friedman	Page Statistic
Monthly payment	23	4,77	1,09
Cash	56	16,57	8,48

NB: This table presents the results of the tests of ordered alternative hypotheses concerning the differences in shareholders' reaction to the detachment by classes of implicit transaction fees.

Different results are observed depending on the quotation market. On the spot, the dropout of prices is a decreasing function of the range. On the RM, the hypothesis of an order of course dropouts according to the range is rejected. As a result, it appears that course dropouts do not differ significantly from one class to another. This is due to the fact that on the RM, the securities have a very homogeneous and high degree of liquidity. In other words, the relative range is lower on average on the RM than on the spot and the standard deviation is lower. Therefore, the range classes cannot be clearly distinguished. This leads to homogeneous course dropouts according to the range classes. These calculations confirm the assumption that the dropout rate on the RM is constant regardless of the range class.

5.4. Impact of Dividend Payment on Volumes in Quantity

The impact of a dividend detachment can first be measured on transaction volumes. The daily activity level is obtained by aggregating the number of securities traded during the session.

For each security, the excess volume is defined by the ratio of the volume of the day to the average of the volume observed over a reference period corresponding to the 40 days of the estimation period. The ratio is normalized to 0 by subtracting one from the value thus obtained. A negative value indicates a deficit in activity compared to the reference period. Only securities, for which data are available on the day of payment, 50 days before payment, and 10 days after payment, have been taken into account. The event window is located between the 10th day before the payment and the 10th day after the payment.[15]

The results of Table 7 show that excess volumes accompany the detachment, the most significant values being observed in sessions -2 to 0 (date of detachment of the dividend coupon): with 31.4% excess volume at the session -2, 40.3 in excess at the session -1 and 24.7 in excess at the detachment session. These initial results, consistent with those set out in [10], do not contradict the dividend capture hypothesis.

However, the number of securities traded is an aggregate data that does not provide information on the long or short meaning of the imbalance at the origin of the excess volume. The examination of the orders in the book makes it possible to refine these first results. The number of titles offered and requested at the best limits is used as a variable approximating the quantities in booklet. For each session, a cumulation of the quantities offered on the one hand, on the other hand of the quantities requested at the best limit is carried out.[16]

Table 8 shows that there is significant excess demand on the window [-2; +2] and excess [17]supply on the window [-2;

14 Liquidity is one of the components of the range. It is assumed here that the liquidity of a security is all the stronger the lower the range.

15 The definition of excess volume, in instantaneous section and over a narrow window, makes the estimates of activity in volumes and activity in francs equivalent.

16 The securities offered or requested at the best limits correspond to orders, present in the book for a certain time. Even if these volumes are stocks and not flows, aggregation has a meaning in this case. All orders in the carnet are taken into account in achieving successive balances until they disappear. To this extent, they can be counted more than once. This is tantamount to considering that, when they are repeated, they come from another principal.

17 if $\bar{X} = \frac{1}{N} \sum X_i$ denotes the average of the observations for a fixed day, according to the theorem central-limit, $\sqrt{N}\,(\bar{X} - \mu)$ follows a normal distribution of parameters 0 and σ, for N greater than 20 observations.

0]. Excess volumes requested on dates -2 and -1 and volumes offered in excess on the ex-dividend date signal the presence of investors, strongly interested in paying the dividend. This is confirmed by the finding of an excess offer, immediately on the ex-dividend date. Conversely, Table 8 shows that the excess volumes claimed on the ex-dividend date and one day after are less important than those on dates -2, -1 and 2. This means that investors, heavily taxed on income, have no interest in buying the cum-dividend security. Therefore, they wait until the dividend is actually detached and the price stabilizes before buying the ex-dividend security. It is as if two types of investors were present in the market. The first group, composed of investors characterized by a couple of tax rates (T_d, T_p) in favor of the dividend: they buy the cum-dividend security to resell it detached dividend. The second group is composed of highly income-taxed investors, who have no interest in receiving the dividend, and resell the cum-dividend security to buy it back ex-dividend.

To highlight the presence of investors with a strong interest in the dividend, the impact of dividend payments on demand volumes can be studied by yield class.

Table 9 shows that excess demand increases with the dividend yield on the date immediately preceding the dividend payment.

Table 7. *Behavior of average abnormal transaction volumes over the event period.*

Date	Excess volume	Sample size	Test de Student
-10	-1,2%	327	-0,23
-9	19,5%	326	3,76
-8	12,4%	327	2,39
-7	12,4%	327	2,39
-6	14,5%	321	2,79
-5	3,2%	327	0,61
-4	12,1%	325	2,33
-3	6,9%	320	1,33
-2	31,4%	325	6,04
-1	40,3%	328	7,76
0	24,7%	329	4,76
1	6,0%	320	1,15
2	15,6%	319	3
3	4,3%	320	0,83
4	-1,3%	319	-0,26
5	-8,6%	319	-1,65
6	5,7%	316	1,10
7	-0,3%	317	-0,65
8	-0,8%	316	-1,48
9	8,6%	316	1,65
10	-11,3%	315	-2,18

NB: A zero excess volume indicates activity identical to that of the reference period. A negative excess volume identifies a deficit in activity compared to the reference period.

Table 8. *Behavior of the supply and demand of securities over the event period.*

Excess demand				Excess supply		
Date	**Excess volume**	**Nb Obs.**	**Test de Student**	**Excess volume**	**Nb Obs.**	**Test de Student**
-10	-5,6%	294	-0,94	2,1%	277	0,34
-9	22,9%	294	3,85	14,6%	274	2,35
-8	13,4%	292	2,26	13,0%	276	2,09
-7	9,2%	289	1,55	21,3%	276	3,42
-6	1,4%	287	0,24	17,6%	274	2,83
-5	2,3%	289	0,39	-4,0%	278	-0,63
-4	6,7%	288	1,12	2,5%	275	0,40
-3	11,4%	287	1,93	2,3%	272	0,37
-2	24,2%	291	4,08	38,2%	276	6,12
-1	26,0%	292	4,39	37,7%	276	6,05
0	20,7%	295	3,48	49,6%	280	7,95
1	14,5%	287	2,45	-0,4%	271	-0,07
2	27,6%	286	4,65	5,1%	269	0,81
3	8,3%	290	1,39	4,4%	269	0,71
4	10,5%	285	1,78	-1,0%	271	-1,60
5	-3,0%	284	-0,51	-12,2%	267	-1,96
6	8,3%	285	1,39	-0,8%	263	-0,13
7	2,1%	284	0,36	-18,7%	267	-2,99
8	-5,0%	280	-0,83	-12,8%	264	-2,05
9	-8,9%	279	-1,51	-14,9%	263	-2,40
10	-6,4%	278	-1,08	-15,6%	264	-2,50

Note: The volume requested in excess corresponds to that associated with the low limit of the carnet and the volume offered in excess at the upper limit.

Table 9. *Excess claim volumes by D/F quintile around dividend detachment date.*

D/P	-2	-1	0	1	2
weak	-7,5%	-4,0%	-4,0%	14,4%	29,8%
2	26,7%	1,5%	21,7%	-1,7%	15,7%
3	2,4%	16,8%	19,4%	13,5%	18,7%
4	-10,5%	30,9%	9,6%	15,1%	48,9%
strong	108,6%	80,6%	60,4%	19,5%	23,0%

Note: Date 0 is the date of detachment of the dividend.

However, the positive abnormal volumes observed around the dividend detachment are not observed on all securities. Indeed, only 254 titles for a total of 474, characterized by a small relative range generate positive abnormal volumes around the detachment. The securities, the most traded around the detachment, appear to be those characterized by the lowest implicit transaction costs.[18]

6. Conclusion

The study provides three results. First, it validates the range, as a measure of implicit transaction fees. Secondly, it highlights a statistic, which makes it possible to represent the tax differential according to the value of the price drop per franc of dividend net of transaction costs. This ratio $(P_b - P_a)/[D(1+A) - C]$ gives an account of the tax differences between the RM and the cash, which does not allow to be done $(P_b - P_a)/D$, since the previous studies [10] generate similar results on the RM and on the cash. In addition, on the RM, the price drop per franc of dividend net of transaction costs is not significantly different from 1.22. Finally, the falling ratio of the net dividend price to transaction costs is an increasing function of the dividend yield. Third, the volume study reinforces the idea that the customer effect is not incompatible with the existence of transaction fees.

In addition, it highlights the effect of taxation and transaction costs on ex-dividend profitability. For shares traded in cash, the price drop per franc of dividend net of transaction costs is an increasing function of dividend yield and decreasing the range. Investors, the least taxed on income, therefore invest in high-dividend-yielding and low-band securities. On the RM, there is also an increasing relationship between price drop and dividend yield, and a decreasing relationship between price dropout and range. However, the tests reject the hypothesis that the dropout rate is not constant between the different quintiles of range. This is due to the fact that many stocks traded in monthly settlement are characterized by a small range.

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18 The average of the relative range over the 254 securities is 0.0189 while the average of the relative range over the overall sample is 0.0261.