Markov Discrete Choice Process for Dividend Policy

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Abstract

This thesis aims to understand the dynamics underlying payout policies for companies listed on the public stock exchange.

The dividend policy affects the liquid assets of companies both directly, given the size of the dividend paid, and indirectly, affecting the ability of companies to attract sources of financing in the immediate future.

The thesis proposes an optimal dividend payout model that describes managers' behavior. Every year, managers have to choose whether to change their payout policy (by increasing or decreasing dividends) or to maintain the level of dividends paid in the previous period. We assume that the dividend policy is based on *observable state variables* (earnings at the beginning of the period and payout policy during the last period) and *unobservable state variables* (conflicts between managers and shareholders/bondholders, idiosyncratic risks and growth opportunities). We derive the optimal dividend policy from the solution of the stochastic discrete choice dynamic programming problem. The model depends on unknown *primitive parameters* that regulate the expectations of managers on future values of state variables. The maximization of the utility function provides the optimal strategy for the manager.

Using annual balance-sheet data for companies operating in the Euro area, we estimate the structural parameters of the model using a *nested fixed point algorithm*, and we test whether managers choices are consistent concerning the model predictions.

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Introduction

Periodically, the board of directors of listed companies, to finance the businesses, must choose between internal and external sources of financing.

The choice of the source inevitably has an impact on the dividend policy. Indeed, a company that chooses to finance investment only through internal fund would set dividends as a remaining part of the investment policy. On the other hand, a company that decides to finance its investments through external fund alone may freely transfer net profits to the shareholders.

The economic literature on corporate finance has long been questioning the actual costs and benefits of alternative sources of financing and how the management of cash flows affects the firms' value.

Neoclassical economic theory provides valuable insights into this specific aspect of corporate finance. Keynes (1934) assumes that a manager who wants to maximize shareholders' equity retains a level of internal funds such that the marginal benefit equals the marginal cost. Assuming perfect capital markets,[1] Miller and Modigliani (1958) show that financing choices do not influence the companies' value; therefore the different sources of financing are considered perfect substitutes by the manager. Furthermore, Miller and Modigliani (1961) show that the decisions on dividend payments do not affect

[1]The perfect capital market hypothesis consists of a perfectly competitive market, with rational agents, without information asymmetries and frictions generated by transaction costs, taxes and regulatory constraints.

the companies' valuation, because shareholders are indifferent between dividends and the cash held within the company increasing the shares' value.

Their analysis is based on the perfect market hypothesis; however, issues such as uncertainty about future cash flows, taxation, agent's irrationality, market competition, and information asymmetries determine the distance between neoclassical theory predictions and empirical evidence on dividends (Cohen, 2002).

The objective of the thesis is to verify whether the managers' payout decision coincides with an optimal payment rule that determines the dividend policy as a function of observable and unobservable state variables. We assume that managers, *the decision-makers*, employ the dividend policy to control agency conflict and maximize their utility function.[2] As a consequence, managers take sequential decisions regarding the payment of dividends under uncertainty about future cash flows.

By assuming the rationality of the agents, we define the *optimal decision rule* as the solution of the *stochastic dynamic programming discrete choice* model.

The dynamic programming allows determining a procedure able to calculate the optimal decision rule by breaking the problem into a sequence of deterministic optimization problems. The features of this model enable us to measure what we consider the fundamental factors that affect the manager's payout choices: agency conflict and sunk costs of dividend omissions. Arguably, the estimate of the impact of these costs on the manager's utility is necessary to define how the conditional probability of paying dividends varies if the government wants to implement fiscal policy, aimed to reduce the exposure of the economy to excessive corporate leverage, through allowances on corporate debt.

[2] See Jensen and Meckling (1976) and Jensen (1986).

Chapter 1

Literature Review

The managers of companies with liquidity excess have to choose whether to distribute the extra cash among shareholders (as a dividend payment or through share repurchases) or to keep it to finance future projects.[1]

Several studies show that share prices temporarily change as a result of changes in payout policy. Therefore, increasing the dividend level may increase firms' market value. Moreover, several empirical studies show that investors interpret dividend cuts as bad news, causing a reduction in the firms' market value. Hence, the managers may choose to quit or scale down investment projects so as not to be forced to cut dividends. However, both the effects in some cases are stable in others are temporary.

Over the years, different theories and models have been devised to analyze and explain:

1. the degree of substitutability among sources of financing;
2. the changes in the level of dividends in the different periods;
3. the timing of dividends;

[1] Easterbrook (1984) and Jensen (1986).

4. the degree of substitutability among payment methods to shareholders (i.e., the optimal mix between dividends and share repurchases).

In the next sections, we examine the main theories and models proposed in the literature, focusing primarily on Miller and Modigliani (1958, 1961); then we investigate the financial market imperfections that affect the assumption of market perfection and completeness (Acharya, Almeida, and Campello, 2007; Almeida, Campello, and Weisbach, 2004).

1.1 The Irrelevance Proposition Theorems

Miller and Modigliani (1958) seek to establish how variations of the debt to equity ratio affect the value of a company. They used for the first time the political economy analytical tools (specifically, the standard Fisherian framework with an infinite time horizon) in the analysis of corporate finance issues. Miller and Modigliani elaborate a model of equilibrium assuming perfect competition with rational and symmetrically informed agents. Moreover, they assume a world without market frictions such as taxation, transaction costs, and uncertainty about future share prices.

Therefore, assuming a perfect capital market, Miller and Modigliani demonstrate that the capital composition does not alter the value of the company; the *irrelevance proposition theorem*. It implies that the forms of financing (external and internal) are perfect substitutes, thus the companies have no benefit in accumulating financial resources to finance investment opportunities or to deal with future adverse shocks.

Modigliani and Miller (1963) extend the previous model by introducing a tax rate on corporate earnings. They show that the company can benefit from external financing with the so-called tax shield. Moreover, they find that the advantage of external funding depends on the deductibility of interests paid on debt. Thus, the value of a company that has a debt will be higher than that of a company totally equity financed by an amount equal to the present value of the tax advantages. Consequently, one of the predictions of this model is that there should be a substantial prevalence of so-called corner solutions. In other words, we should observe a large number of companies that finance the major part of investments with debt. Therefore, Miller e Modigliani demonstrate how the introduction of a tax system affects the substitutability degree of external and internal sources of financing.

Miller and Modigliani (1961) state the irrelevance of payout policy on the company's value. The authors illustrate the possible consequences of a change in dividend policy through the famous *home-made dividend hypothesis.*

According to this hypothesis, in perfect financial markets, investors are indifferent between the return generated by dividends and the expected return given by the growth of the share price. Indeed, if the manager chooses not to distribute profits, the share price should increase proportionally given the extra-liquidity retained in the company. The shareholders should be able to replicate the same return through the sale of an equal share of stock. Furthermore, the manager could pay a dividend higher than the free-cash flow generated by the company. In this case, the board would be forced to enhance external funds filling the difference between the dividend and the free-cash flow, not increasing the value of the company.

Therefore, Miller and Modigliani show that investors will not be willing to pay a higher price for shares of a firm that regularly pay out dividends than shares of a company that does not. However, it is necessary that agents rationally assume that companies sooner or later distribute the total value generated by their investments.

1.1.1 Market Frictions

Miller and Modigliani's theorems are a cornerstone for the evaluation of choices related to the capital structure and dividend policy of a company. However, the authors themselves are aware of the limitations of their model. In their articles, they stress that the assumptions of the model are so stringent as to make the results of irrelevance a benchmark for further analysis.

We present the main frictions that affect the market perfection assumption:

1. *Taxes.* In the previous section, we have seen how the degree of substitutability of sources of funding varies by introducing taxation that affects the profits of the company. However, Miller (1998) notes that US companies do not make the most of the potential for leverage, burning around 150 billion per year in taxes. Moreover, in the United States, Europe, and many other countries, dividend income is taxed at a higher (personal) rate than the capital gains generated by invested capital. Therefore, rational investors should prefer the capital gains generated by buying and selling shares, particularly those investors who are already subject to high taxation (Foley et al., 2007).

2. *Transaction costs.* They are all costs that a company or investor sustains in making any exchange. Choosing the financial source, a company has to bear costs such as brokerage fees, sales commissions, legal expenses, and incidental expenses. Transaction costs are extremely high when an individual decides to liquidate an investment.[2] Therefore, this kind of cost changes according to the economic sector in which the company operates. The transaction cost can modify the debt and payout policies, as well as the preferences of an investor.

3. *Precautionary motives.* Firms tend to prefer internal sources of finance to cover unforeseen expenses or contingencies whose development is uncertain. In unstable and extremely volatile

[2]The liquidation of a machinery/equipment can be very difficult for a firm because it could be tough to find a buyer and so, the firm could be obliged to depreciate its asset.

economies, the frequency with which negative shocks occur for the company is very high. Therefore, under the same conditions, companies operating in these economies need a greater availability of liquid resources to counter unexpected drops in sales, to take timely advantage of investment opportunities that may arise suddenly, and in some cases to not be forced to change the predetermined payout policy.

4. *Financial constraints.* Firms structurally accumulate liquidity when access to the credit market is limited. Specifically, a company is defined as financially constrained when its access to the capital market is more expensive than other firms with the same growth opportunities. Firms financially constrained are, therefore, forced to manage liquidity in such a way as to maximize the value of the firm and mitigate the higher cost of external financing (Acharya, Almeida, and Campello, 2007; Almeida, Campello, and Weisbach, 2004). Financial constraints limit the ability of companies to both raise new capital to finance new investments and to obtain the liquidity necessary to meet programmed payout policies. In fact, in economies where capital markets are not efficient, companies will need more cash to finance investments and not be forced to give up projects with positive net present value (NPV). Moreover, as mentioned, companies are reluctant to reduce the dividends paid to shareholders. Thus, if they do not have direct access to the capital market would be forced to create reserves ad hoc.

5. *Agency conflicts.* The separation between ownership (shareholders) and management (managers) generates the agency conflict condition due to the asymmetric information. The manager's need to withhold funds by taking advantage of investment opportunities that, in some cases, can be considered too risky by the shareholders, impact the decision to distribute profits (Myers, 1977). Moreover, shareholders are also in conflict with bondholders. The latter are creditors of the com-

pany. Thus, bondholders could require managers to hold liquid assets (reducing dividend payments) to protect themselves against possible financial failure and from the risk of insolvency (Jensen, 1986; Jensen and Meckling, 1976).

1.1.2 Miller and Modigliani's Theory: Criticism

Initially, both academia and the financial world were skeptical about Miller and Modigliani's propositions because the prevailing theory at the time was based on the concept that exists an optimal level of debt per company. According to the static theory of the optimal capital structure, the debt ratio is positively related to the return on assets, given that the most profitable companies have a lower risk of insolvency and are subject to a higher marginal tax rate than companies with lower returns (DeAngelo and Masulis, 1980).

As a result, high-yield companies are stimulated to heavily use the leverage mechanism, having a higher capacity to increase profits. According to this theory, the role of payout policy is fundamental in determining the value of a company. Indeed, the static theory of the optimal capital structure presumes the existence of an optimal dividend level and deviating from it affects the firm's market value. Consequently, a company with an optimal level of debt will see the value of its shares decrease both if the company pays a dividend too low (since investors will adjust their portfolios in search of stocks that generate more returns) and if the company pays a dividend too high (since the company will have insufficient liquidity to finance its investments).

Gordon (1959, 1963) with his *bird in the hand theory* explains the existence of dividends by introducing the possibility that investors prefer a positive return (the dividend) over an uncertain return influenced by market dynamics (increase in share prices). His model provides the option for companies to keep a fraction of the profits to finance new projects. This policy of reinvesting profits within the company's business generates wealth which, possibly, will reflect in a higher value of shares on the market. However, risk-averse investors prefer regular dividend than the possibility of future capital returns. Thus, as a result of an increase in the percentage of retained earnings, risk-averse investors demand a higher dividend yield according to the Gordon model. However, Gordon's theory does not allow companies to invest in projects with zero-net present value (NPV). Rubinstein (1985) shows that retain earnings does not generate any change in the value of the company if the possibility of investing in zero-NPV projects is allowed. Thus, in line with Miller and Modigliani, Bhattacharya (1979) states that a change in cash flows riskiness may influence the dividend distribution policy, but in any way, a dividend policy variation may influence the cash flows riskiness and consequently the riskiness of the company. In the next section, we specifically examine the effects of taxation and transaction costs on a company's payout policy, showing the prominent models in the literature with the primary empirical evidence.

1.2 Dividends and Taxation

As anticipated, in the United States, Europe, and many other industrialized countries, the personal tax rate applied to capital gains generated by the share sales is lower than the rate applied to the dividend yield. The literature on corporate finance has, for a long time, focused on the effects of the disparity in tax treatment between dividends and capital gains. Intuitively, if all investors are subject to the same tax rate, then a rational investor should prefer companies that do not pay dividends or that distribute small dividends. Therefore, at the same conditions, firms that distribute significant dividends should be penalized. However, throughout the 20th century, we observe that most companies regularly paid massive dividends and that the repurchase of shares was considered a marginal payment instrument.

Miller and Modigliani (1961) suggest that different groups of investors (different clientele) are taxed at different rates. As a consequence, there will be investors with higher tax rates which will prefer to invest in companies that do not pay dividends, and investors (whose portfolio is strongly oriented towards pension funds) who are exempt from dividend taxes, therefore indifferent to the dividend policy. In this context, each company should adjust its payout policy to maximize shareholders' wealth by increasing the share price. In equilibrium, companies cannot influence the stock price by changing its dividend policy to attract a specific clientele of investors. Therefore, it is possible to obtain the irrelevance of dividend policies if the supply of dividends can fully satisfy the demand and, at the same time, if investors can adjust their portfolios quickly.

For the first time, Brennan (1971) develops a version of the $CAPM$ (capital asset pricing model) by introducing a personal tax regime. The author shows that investors, with the same risk level, require compensation on returns for firms that choose to distribute a dividend, as a result of the tax regime that penalizes dividend income over capital gains. To reconcile empirical observations with theory, Brennan deduces that a real or perceived constraint must determine the companies' behavior on share repurchases. He then includes in his model a constraint on the share repurchase that constrains companies to distribute the proceeds through dividends. Specifically, the Brennan equation for the capital asset pricing model is as follows:

$$E(R_{it} - R_{ft}) = a_1 + a_2\beta_{it} + a_3(d_{it} - R_{ft}) \tag{1.1}$$

where $E(R_{it})$ represents the expected return for the company i at time t, R_{ft} is the risk-free interest rate for the period t, d_{it} is the dividend announced by the company i and β_{it} represents its systematic risk. The Brennan model suggests that the coefficient a_3 will be positive and statistically significant to compensate for the higher tax burden associated with the dividend.

Black and Scholes (1974) point out that it is complicated, through cross-section analysis, to empirically demonstrate that the expected returns of companies that distribute large dividends are statistically higher than expected returns of firms that don't (both before and after individual taxation). Indeed, it is difficult to control for systematic risk and other factors, so observations cannot be considered independent.

To test the Brennan model, Black and Scholes make some changes to the equation (1.1) to get better estimates. The results obtained do not allow them to determine whether the payout policy affects share prices. Therefore, perplexity is expressed about the hypothesis that the market requires higher returns to compensate for the tax disadvantages of dividends.

Litzenberger and Ramaswamy (1980) extend the Brennan model by including restrictions on shareholder borrowing and restrictions on short selling. According to Brennan (1970, 1973), they find that compensation for a higher dividend is positively correlated to the difference between the dividend rate and the capital gain rate. Moreover, their methodology of analysis differs significantly from that used by Black and Scholes (1974). Indeed, Litzenberger and Ramaswamy (1980) analysis involves three steps to estimate the equation (1.1). The first step consists in the estimation of the beta of each share contained in the sample through the following equation:

$$\begin{aligned} R_{iT} - R_{fT} &= a_{it} + \beta_{it}(R_{mT} - R_{fT}) + \epsilon_{jT} \\ \text{with} \quad T &= t-60, .., t-1 \end{aligned} \tag{1.2}$$

where R_{mj} is the return on a market portfolio proxy at the time j, R_{ij} is the return on the share i, R_{fj} is the risk-free interest rate, and ϵ_{ij} is the error term. Furthermore, the β_{it} coefficient represents the estimated beta for the share i at the time t. The second step consists in estimating for all the months included in the analysis the coefficient that measures the effect of the difference between the expected dividend and the risk-free interest rate on the asset i risk premium. In this regression the beta estimate for the security i during the month t, β_{it}, and the estimated expected dividend, d_{it} is used as control variable. The researchers to estimate the expected dividend used the last dividend paid in the previous 12 months. In the previous 12 months, the firm did not pay any dividend, then

Litzenberger and Ramaswamy assume that the expected dividend is equal to zero. The cross-section regression for the month t is given by:

$$R_{it} - R_{ft} = a_{1t} + a_{2t}\beta_{it} + a_{3t}(d_{it} - R_{ft}) + \epsilon_{it} \tag{1.3}$$

So, thanks to this equation, Litzenberger and Ramaswamy get an estimate of the historical series of a_{3t} for the months from 1936 to 1977. The third and final step computes the a_3 estimation of the (1.1) equation. The coefficient value is calculated as the average of the series of coefficients, a_{3t}, estimated in the previous step.

The standard error in the estimate of a_3 is determined by the formula: $\sigma_{a3t}/\sqrt{t'}$, where σ_{a3t} is the standard deviation of the historical series a_{3t}, and $t^{'}$ represents the number of months in the sample. The results of the Litzenberger and Ramaswamy's tests confirm that dividends have a positive and statistically significant effect on returns and interpret these results as evidence of the influence of taxation on dividend policies.

Miller and Scholes (1982) argue that the relationship between returns and dividends is affected by the various short-term measures of expected return on dividends, which may have undesirable effects due to the possibility that the dividend provides to the market information on future returns. Miller and Scholes criticize the Litzenberger and Ramaswamy's methodology because it produces a distorted estimation of the expected monthly dividends due to the lack of data on dividend announcements. Managers do not always announce the dividend, or sometimes they mislead by promising a dividend that does not take place at the end of the financial year. These announcements are bad news for the market, and they have negative effects on the stock price.

Ultimately, it is complex to empirically demonstrate that the shares expected returns that of firms that distribute high dividends are statistically higher than the expected returns of shares that do not pay dividends, both before and after personal taxation. They do not find any significant relationship between share yields and dividend payments, advancing perplexity over the hypothesis that the market requires higher yields to compensate for the tax disadvantages of dividends.

Subsequently also Chen, Grundy, and Stambaugh (1990), Fama and French (1993), and Kalay and Michaely (2000) underline severe endogeneity problems (due to the strong correlation between dividends and different risk factors) and serial correlation (due to difficulties in estimating the expected dividend).

Fama (1998) seek to measure the effect of dividend taxation on the value of the firm using equations that are not explicitly derived from a theoretical model, but equations that exploit different ways of expressing the firm's market value, dividends and interest on the debt. The objective of this regression strategy is to control for the influence of the company's growth opportunities on payment decisions. Moreover, Fama and French also include in the equation future values to absorb changes in investors' expectations. They deduce, however, that it is very complex to control all the effects of profitability on dividends and interest paid on debt through the variables usually used in the literature. Indeed, the results on the impact of taxation on dividends through a regression of returns are not unique.

An approach that diverges from the theory of static clientele is represented by the hypothesis of investors making dynamic investments.Miller and Scholes (1978) consider the possibility for investors to implement dynamic trading strategies to reduce or eliminate the taxation effect on securities returns. The basic idea is that an investor subject to a high tax rate on dividends will change his investment plans because of the day of the ex-dividend day. Following the announcement of dividend payment, an investor that risks to end up in a different tax bracket, he surely would like to avoid dividend income so as not to be subject to a higher tax rate. Probably he would sell his shares to investors who are exempt from dividend tax. Therefore, it is assumed that investors subject to low rates buy shares in the days before the ex-dividend day and resell them in the following days, to earn on the price difference and on the dividend itself. There is strong indirect evidence to support this theory. Unfortunately, indirect evidence only, since it is tough to establish with certainty the identity of the investors who trade the shares.

Rantapuska (2008) makes an interesting study based on data on the choices of Finnish investors. He analyses the trading data-sets of all investors in the Finnish stock market and demonstrates that low taxed investors tend to buy shares before the coupon detachment, whereas heavily taxed investors tend to sell before the stock pays the dividend.

Poterba and Summers (1984) find that the average drop in share prices between the announcement and the days immediately following the dividend distribution is lower than the dividend amount and also they notice that the average return on shares increases as the dividend increases.

An interesting analysis of the abnormal increase in trading volume around ex-dividend date is provided by Michaely, Vila, and Wang (1996). The increase in trading activity around these days confirms the importance of dividend taxation.

Several studies use an analysis methodology based on the detection of the impact of sudden changes on the dividend income and capital gains taxation to study their influence. This approach focuses on the effects of exogenous events on corporate distribution policy and investor behavior. Typically, these analyses are limited to the time horizon in which a new tax reform becomes effective. The advantage of this strategy consists in the possibility of capturing the impact of taxation by minimizing the influence of variables omitted due to lack of data or the difficulty of isolating payment policy from other unwanted dynamics (such as transaction costs and corporate profitability).

Poterba and Summers (1984) analyze the effects of two major tax reforms on the British market using both daily and monthly data.[3] If taxes affect decisions to buy or sell shares on the ex-dividend day,

[3] They refer to the 1965 reform that introduced a dividend capital gain tax of 30% and the 1973 reform that integrated the corporate income tax. These reforms effectively reduced dividend income tax for private and corporate investors.

then a change in the dividend tax regime should affect share prices. As mentioned above, this approach makes it possible to overlook the criticism of Miller and Scholes (1982) regarding the distortion of the estimation of Litzenberger and Ramaswamy (1979). Indeed, both the “information effects" and the measurement problems will be common to both tax systems. They conclude that, since the increase in dividend taxes in 1913, the investors have been demanding a higher return from companies paying dividends, confirming the hypothesis of Brennan (1971) and Litzenberger's and Ramaswamy's (1979) that taxation represents a significant part of the positive relationship between dividends and stock yields.

Chetty and Saez (2005) take advantage of the reduction in the maximum tax rate on dividends (effectively equating the rate on dividends to the rate on capital gains) that took place in the U.S.A. in 2003. They note that the reform has significantly contributed to the increase in the number of companies distributing profits and changing the dividend trend had in the previous decades.

However, Farre-Mensa, Michaely, and Schmalz (2014) criticize Chetty and Saez's conclusions, and again, they denounce distorted estimations because of the information effect. Specifically, Farre-Mensa, Michaely, and Schmalz emphasize the possibility that managers, anticipating the future tax reform, have decided to postpone dividend payments until the period in which the reform would come into force. The firms have therefore decided to delay the payment of dividends to the period in which the reform would come into force. The companies would, therefore, have chosen to defer payments to take advantage of the reduction in the maximum rate. In this case, the effect of the tax reform obtained by Chetty and Saez would be overestimated. Brav et al. (2008) confirm the hypothesis that companies have only postponed the payment of dividends; as they show that the number of companies paying dividends increases significantly in the quarter following the reform and then returns to pre-reform levels.

Summarizing, the results of cross-section analyses are particularly ambiguous, as they do not definitively confirm the effect of taxation on share yields due to dividend payments. On the other hand, the studies confirm an unusual behavior of the share price and transaction volumes in the days following the announcement. Consequently, it is possible to partially confirm a dynamic clientele effect.[4] (limited to days around the announcement and payment of dividends) but conditioned by transaction costs that block trade between investors subject to different tax rates[5].

Several studies observe that transaction costs inhibits trades, thus placing some limits on the assumptions of the clientele theory. Indeed, by directly analyzing investors' portfolio preferences, several studies suggest that investors subject to high taxation hold a staggering number of shares in companies paying significant dividends, thus weakening the hypothesis of the influence of tax on investors' portfolios.[6]

1.3 Dividends and Asymmetric Information

Several empirical analyses show that announcements of variations in companies' dividend policies determine strong activities in stock markets.[7]

[4] It is a theory that explains how a company's share price moves according to the demands and objectives of investors in response to a tax, dividend or other policy change. It assumes, first of all, that specific investors are attracted to different corporate policies and that when the policy of a company changes, investors adjust their shareholdings accordingly. As a result of this adjustment, the share price moves upwards or downwards

[5] Michaely and Vila (1996) show that the volume of one-day transactions is a decreasing function of transaction costs.

[6] Blume, Crockett, and Friend (1974) survey investors' portfolios. Lewellen, Stanley, Lease, and Schlarbaum (1978) carry out analyses on the clientele of a brokerage firm. Del Guercio (1996) notes that the portfolios are quite similar when analyzing the composition of the portfolios of certain mutual funds (highly taxed) and pension funds (exempt from taxation).

[7] See Michaely, Vila, and Wang (1996), Karpoff (1987), and Pettit (1972).

Typically, the announcement of an increase in dividends is succeeded by an increase in the price of the shares; conversely, the announcement of a cut in dividends is followed by a decrease. It is, therefore, necessary to develop new models capable of explaining the high payout ratio of listed companies and capture the dynamics of the financial markets following the announcement of a change in the payment of dividends.

This is how the theory of signals was born, as opposed to the theory of Miller and Modigliani. This theory states that dividend payments provide positive signals about the company's prospects for stability and growth. Most models in the signaling theory assume that managers have more information (about the profitability of the company) than other market agents.

Bhattacharya (1979) adopts a two-period model where the manager maximizes the value of the company. This model links manager's compensation to the company's profits to recreate a context in which the interests of shareholders and managers are perfectly aligned. However, the manager alone observes the profitability of the investment, and he decides whether to implement a project. Investors do not observe the expected return of the investment. However they observe the dividend that the manager pays and decide whether to invest in the company. Basically, the manager "signals" the profitability of the project through the payout policy promised for the next period. If the profit generated in the first period is insufficient to cover the promised dividend, then the manager will be forced to recourse to external funding and bear the related transaction costs to cover the promised dividend. The dividend is instead directly paid if the profit made at the beginning of period 1 is greater than or equal to the promised dividend. Bhattacharya shows that in equilibrium managers of companies with low expected returns will not find it convenient to promise a high dividend otherwise they would be forced to continuously resort to external financing, and consequently to incur high transaction costs.

Miller and Rock (1985) also develop a two-period model with correlated profits. Through a framework very similar to the one used by Bhattacharya, the researches assume that to give positive signals to the market managers have the possibility of reducing investments and increasing dividends. So they introduce the hypothesis that the distortion occurs in the investment policies of a company, rather than in the choices of financing as previously assumed.

However, both models do not take into account share repurchases and specifically the different tax treatment of repurchases and dividends.

The model of John and Williams (1985), on the other hand, introduces the possibility for firms to repurchase their shares, reproducing a differentiated tax treatment between dividends and repurchases. In particular, repurchases are not taxed, so they are a more advantageous means of repaying shareholders. However, companies that choose to distribute a dividend despite the tax disadvantage signal that the price of their shares is undervalued, causing an increase.

John and Williams assume that the managers are the only who know the real value of the stocks. Moreover, they assume that some shareholder is forced to sell a portion of its shares to satisfy liquidity needs. They show that in equilibrium, only managers of undervalued companies have an incentive to pay dividends. In fact, for these companies, the increase in the share price due to the payment of dividends will be sufficient to offset the cost of taxes. However, this model does not provide shareholders the access to external financing to satisfy their liquidity needs. Indeed, through external funding, shareholders could satisfy their liquidity needs without being constrained to sell shares.

The tendency of companies to gradually adjust their dividend payments is one of the limitations of the signal theory.

The classic signaling models (Bhattacharya, 1979; John and Williams, 1985; Miller and Rock, 1985), are not suitable to explain the gradual adjustment of dividends. This is because only two kinds of equilibrium are assumed:

1. an equilibrium in which dividends completely reveal the private information of the manager (*complete separating equilib-*

ria);

2. an equilibrium in which dividends do not reveal any information (*complete pooling equilibria*).

Kumar (1988) and Guttman, Kadan, and Kandel (2010) instead develop models based on the signal theory that explain the gradual adjustment of dividends.

Assuming that the manager's return is decreasing respect to the shareholders' investment, Kumar shows the existence of a equilibrium of "partial" signaling where the "bad" managers may not have the convenience of paying a dividend equal to that distributed by the "good" managers to not risk over-investment by the shareholders. He shows that the policy of dividend payment in equilibrium is represented by a step function with respect to the productivity of the manager. In practice, all managers on the same partition will pay the same dividend. This element characterizes the gradual adjustment of dividends.

Guttman, Kadan, and Kandel differently elaborate a model where the gradual adjustment of dividends derives from managers' willingness to keep dividends stable until revenues change significantly. An equilibrium is reached in which for intermediate levels of revenues managers pay the same dividend, for levels of revenues outside this range (therefore particularly high or low) there is a complete disclosure of the private information of the manager.

Allen, Bernardo, and Welch (2000) make an interesting contribution to signal theory. In their model, dividends are a useful signal to attract more informed investors. According to their assumptions, companies with good growth prospects for undervalued equity markets try to attract large financial institutions (such as investment funds) that can monitor the potential of a company and the performance of managers. On the contrary, firms that are overvalued with little investment opportunity have no incentive to have institutions among their shareholders that can measure the real value of the firm. Moreover, once institutional investors have been attracted, they can impose a large sanction in response to dividend cuts, so managers are forced to offset dividends. Therefore, distributing dividends allows managers of undervalued companies to report the real value and generate an increase in the shares' price. This hypothesis is in line with the clientele theory described in the previous section and with the widespread practice of gradual adjustment of dividends (in fact, in such a context the reduction of dividends would send the opposite signal).

The examined models assume that the manager considers his own company undervalued and therefore sends positive signals to the markets about the expected return of the company through the payout policy.

1.3.1 Signaling Theory

The assumptions and conclusions described in the previous section can be tested through empirical analyses. The main predictions of the dividend signaling model concern a:

1. positive relationship between changes in dividends and the reaction of prices to changes in dividends;

2. positive relationship between the change in dividends and the future earnings of companies;

3. positive relationship between the changes in dividends and the profit forecasts of the company's analysts.

However, the empirical analyses developed so far have not been able to confirm the relationships predicted by the models.

Recent studies evaluate the possibility that the dividend will send signals about the company's risk rather than the expected return. Consequently, changes in dividend policy would be interpreted as changes in the volatility of returns rather than changes in the expected value of future cash flows.

Grullon, Michaely, and Swaminathan (2002) develop the so-called theory of the *"firms maturity"*. This theory is rooted in a recurrent concept in business management and administration manuals according to which companies go through several stages during their life cycle, following a maturation process. According to Grullon, Michaely, and Swaminathan, when a company matures, there are two effects: it benefits from the reduction of systematic risk, but at the same time it suffers from a reduction of investment opportunities.

In this context, researchers claim that an increase in the dividend is a positive sign, first of all, because the markets may not be aware of the reduction in the company's risk, and then the increase in the dividend would be a positive surprise. Besides, since the greater the maturity of the company corresponds to a greater shortage of positive net present value projects, according to Grullon, Michaely and Swaminathan the markets appreciate that the manager, rather than burning resources in bad investment projects, increases payments to shareholders. Therefore, the market reacts positively for agency reasons, as proposed in Jensen (1986) and Stulz (1990).

1.3.2 Agency Theory

Simplifying, we can define a firm as a complex structure of contractual agreements between different actors (i.e., shareholders, managers, employees, and bondholders). The economic literature has long addressed the issue of conflicting interests between the company management and control. In this framework, the dividend policy can be framed as one of the tools to balance the complicated relationships between the various actors. The investigations focused mainly on two conflicts of interest: the bondholder-shareholder and the manager-shareholder conflict. We start by illustrating the dynamics of the conflict between bondholders and shareholders and the associated empirical literature.

Agency Theory: the Bondholders-Shareholders Conflict

The nature of the conflict between bondholders and shareholders derives from the substantial asymmetry in their payoff profiles. Indeed, in case the cash flow generated by the economic activity is not sufficient to repay the debt, bondholders have the right to take over the company's assets to offset (at least partially) their claim on the company. Therefore, bondholders usually solicit managers to have a behavior aimed at minimizing the default risk. On the other hand, the shareholders' payoff is given by the difference between revenues and debt. Therefore, the shareholders would like to make the difference between revenues and payments to bondholders as large as possible, at the cost of undermining the business solvency.

The conflict of interest between shareholders and bondholders influences the firm's payout policy. The manager can draw away resources from the bondholders' disposal through dividend payouts. Consequently, unexpected dividend payments can virtually increase the company insolvency risk and thus reduce the value of the debt. However, generally, bondholders impose restrictions on dividend payments.

Kalay (1982) examines a sample of stock contracts, specifically focusing on lenders restrictions imposed on dividend payout. These constraints can be either direct or indirect. Direct restrictions place limits on dividend payment and share repurchases over the life of the bond. Indirect constraints, on the other hand, essentially place restrictions on some balance-sheet items (i.e., requiring a minimum amount for equity or working capital, or else a maximum level for the debt to asset ratio). Usually, indirect constraints are much more powerful than direct constraints because once violated; they force shareholders to contribute with new capital or to lose shares. According to Kalay, the nature of the restrictions supports the assumption that dividends represent a tool to limit the conflict of interest between shareholders and bondholders.

Successive studies analyze the effect of an unexpected change in dividends on shares and stock prices. Consistently with the agency theory, an unexpected dividend increase should cause an increase in share price and at the same time, a reduction in bond price. However, if the increase in dividends indicates an increase in the company's growth opportunities, then it is plausible to think that an unexpected increase in dividend payout should also be considered as good news for bondholders. The main obstacle for this kind of analysis is given by the isolation of the effect of the payout policy variation, keeping constant all other variables. Handjinicolaou and Kalay (1984), Jayaraman and Shastri (1988), and Dhillon and Johnson (1994) confirm that the behavior of bond and equity prices concerning significant changes in dividends is consistent with the agency hypothesis.

Agency Theory: the Manager-Shareholders Conflict

The managers-shareholders conflict (as for the bondholders-shareholders conflict) stems from the divergence between their objective functions. This discrepancy becomes heavier as the dispersion of the shares' ownership increases. Essentially, the more the ownership is shared by a large number of shareholders the more expensive it will be for a single shareholder to monitor the manager performance since the benefits will be equally distributed among the all the shareholders.

Also, shareholders have the opportunity to diversify their portfolio. Therefore they are exposed to systematic/un-diversifiable risk only. Conversely, the manager compensation and prestige crucially depend on the success of the company. Indeed, the manager cannot diversify the insolvency or bankruptcy risk. Thus, the manager risk-aversion could be quite relevant for the firm investment policy (e.g., a risk-oriented manager may prefer a short-term view threatening the long-term profitability and stability of the company, Jensen and Meckling (1976)). Once again, the agency conflict increases as many "outside" security holders (i.e., shareholders who do not have management tasks) are involved in the company ownership.

Therefore, the asymmetry between the managers and shareholders' returns affects the company's dividend policy. Indeed, the divergences between the managers and shareholders' objectives could induce the former to accumulate liquid assets to obtain greater discretion on the operational choices of the company, and the latter to put constraints on the management to avoid behaviors that would risk burning the company's liquidity. It is complex to assess whether the manager's choices are not maximizing the firm's value. Therefore, very often, the shareholders use remuneration contracts to align their interests with those of the managers. Stock options are an example of managers' remuneration designed to alleviate manager-shareholders conflict. Indeed, the stock options give the manager the right to buy the company's shares at a predetermined price (strike price). However, stock options negatively affect dividend payments also. Indeed, in perfect capital markets, the shares' price is reduced by an amount equal to the dividend. As a result, managers are encouraged to reduce or avoid dividend payments until they have the opportunity to exercise the stock option.

Easterbrook (1984) argues that dividends mitigate shareholders' monitoring costs. The researcher assumes that shareholders expect dividends to be distributed so that the manager is forced to raise external funds to finance new investment projects. Thus, shareholders prefer a certain debt level because the bondholders, such as investment banks and funds, provide further control over the management. Dividend payments allow shareholders to "externalize" monitoring, thus reducing agency costs. Therefore, we expect that companies with dispersed shareholding ownership and high debt-to-equity ratio, payout a constant level of dividends. On the contrary, companies with a single large shareholder, who has a strong incentive to monitor the manager's choices, will pay little or no dividends. Easterbrook's model is also compatible with the evidence on companies that pay dividends and, at the same time, raise capital by issuing bonds on capital markets. Several studies confirm the Easterbrook hypothesis and note that shareholders impose dividend payments to reduce the free cash flows available to the manager and to prevent sub-optimal investments (e.g., investing in unprofitable acquisitions and/or mergers).

Numerous empirical analyses confirm the influence of agency problems on payment policy. Lang, Stulz, and Walkling (1989) and later Yoon and Starks (1995) report that the shares' prices in companies with poor investment opportunities are much more sensitive to changes in payout policy than companies with better growth opportunities. This result confirms the importance of the dividend policy in resolving conflicts of interest, which are particularly relevant in the case of companies with low investment opportunities.

Lambert, Lanen, and Larcker (1989) examine agency conflicts by analyzing the connections between manager compensation and payout policy. The researchers find that most of the managers' remuneration is aligned with shareholders goal; fewer dividends are paid. Indeed, Eckbo and Verma (1994) and Agrawal and Narayanan (1994) find that the managers with greater control over the company make lower cash payments to shareholders.

La Porta et al. (2000a) exploit countries variation in shareholders protection laws. They find that higher shareholders protection increases the probability to pay out dividends, in particular for firms with low investment opportunities.

1.4 Dividends and Transaction Costs

A method for classifying financial markets refers to the measurement of transaction costs. The level of transaction costs can influence the investors' trading choices.

It is possible that investors would opt for stocks of companies that do not pay dividends to avoid the transaction costs associated with the dividend reinvestment. Conversely, investors who want to periodically obtain a specific return from their capital investments (e.g., to finance their consumption) may prefer shares that pay dividends.

Hence, companies could exploit investors preferences to enhance their market value. However, as suggested by Black and Scholes

(1974), in equilibrium the firms will adjust their payout policy such that the marginal investor would be indifferent to the level of dividend paid. Moreover, Allen and Michaely (2003) register a significant reduction of small investors on the financial markets, but the size of aggregate dividends has not changed significantly.

Rozeff (1982) investigates on the relationship between dividend policy, agency costs, and transaction costs. Rozeff assumes that an increase in dividend payout ratio (keeping constant the profit) reduces agency costs but increases transaction costs related to external financing.[8] The optimal dividend level is the result of the minimization of the cost. Rozeff's model is based on the trade-off theory of optimal capital structure.[9] According to this theory at the end of each period managers compare costs and benefits of holding liquid assets; consequently, the optimal liquidity level is given by the amount of cash flow that equates the marginal cost and the marginal revenue. Specifically, the cost is given by the opportunity cost linked to investments with the same degree of risk; the benefit instead is given by the possibility to avoid financial constraints.[10] The trade-off theory forecasts a negative relationship between dividends and the level of external financing. Essentially, it assumes that heavily indebted companies with high volatile yields (e.g., growing young companies)[11] do not distribute dividends to avoid high transaction costs associated with external funds acquisition.

Del Guercio (1996) estimates the impact of transaction costs on the portfolio composition of some institutional investors. Exploiting a reform on the U.S. securities market aimed at reducing transaction costs for small investors, Del Guercio concludes that dividends do not affect the portfolio composition of the mutual funds observed.

[8]Transaction costs associated with external funding are given by subscription fees, administration costs, management time, and legal fees.

[9]Initially proposed by Kraus and Litzenberger (1973)

[10]Ferreira and Vilela (2004).

[11]Dempsey and Laber (1992) and Moh'd, Perry, and Rimbey (1995).

1.5 Pecking Order Theory

Myers (1984) develops an alternative capital structure theory to trade-off theory. Basically, the model (called the *hierarchical model of financing decisions* or simply the *pecking order*) assumes a residual role of dividends about the investment needs of the company.

Meyers assumes that transaction costs and costs arising from information asymmetries between managers and investors about prospects and the value of the company determine a hierarchical order between sources of finance. In this context, capital increases through the issuance of new shares are the most expensive source of financing. Intuitively, if a manager predicts an increase in future earnings, shareholders should not be willing to share higher earnings with new investors. Consequently, the issue of new securities is interpreted by the market as a desire to share more risks and investors; therefore, suffer from the problem of asymmetric information on the price of new shares issued. In some cases, managers may even be forced to abandon profitable investment projects because of the cost of information asymmetries. Therefore, firms are forced to finance their projects mainly through retained earnings, that is considered the source of financing with the lowest cost. Only when the liquid assets are exhausted companies ask for new debt, and ultimately choose to issue new shares.

Meyers assumes that payout policies are strongly influenced by considerations on the hierarchical order of financing decisions. The model's predictions imply that companies that expect to make large investments with extremely volatile returns and companies with high leverage avoid paying dividends.

Fama and French (2002) for the first time compare trade-off theory with the pecking order theory, and they find that data support many of the predictions of both models. The results confirm the relationship between profitability and the use of leverage in a company. The trade-off theory predicts that the most profitable companies will make greater use of the possibilities of external funding, but the test results do not support this hypothesis. Fama and French also find that companies paying dividends make significantly fewer equity issues. Moreover, Fama and French find that among the companies that distribute dividends, the small and quickly growing companies are those that make the most use of the issuance of new securities, contrary to the theory of hierarchical order. Ultimately, Fama and French find that the results do not fully support either theory.

1.6 Empirical Evidence

The empirical analysis of the dividend policy is made incredibly complicated by the strong simultaneity in the manager's decisions. Indeed, in the empirical corporate finance, it is unlikely that an econometrician observes reasonable exogenous variation in a variable. Furthermore, the scarcity of data does not make it possible to extend the results from the sample to the population, without generating strong doubts about the stability of the results obtained. Indeed, researchers are continually looking for new data-sets that give the possibility to extrapolate more information about investors' and managers preferences.

Black and Scholes (1974), in their famous article *"The Effects of Dividend Yield and Dividend Policy on Common Stock Prices and Returns"*, wrote:

There have been many attempts in recent years to verify whether or not the payout policy of a firm affects the price of its shares, but these tests have never been sufficiently satisfactory. Most of the authors used sampling-based tests of companies, which attempt to compare the share prices of companies that differ only in dividend policy. A problem with such tests is that it is very difficult to control variables other than payout policy, and it is tough to obtain accurate estimates of the meaning of the results obtained from regressions based on sampling. It is challenging to say whether a relationship found in a regression represents a causal relationship, and if so, in *which direction does the randomness run.*

The constant search for precise identification, a ceteris paribus comparison, has led academic literature to analyze in isolation the choices on dividends and repurchases concerning all other moments of the life of a company. Indeed, the analysis method most widely adopted in the literature on dividend payout policy is the *quasi-experimental* approach. In these applications, economists are interested in the effects of structural government interventions on shares price and dividend variables. These studies aim to isolate the impact of payout policy on financing and investment choices.

However, despite the considerable difficulties, has been made significant progress in the empirical analysis on the effects of payment policy on firms' value. Below we summarize the main results obtained in the literature. In the next section, we start by assessing the quantitative incidence of payments, and we continue by highlighting the main features of dividends and repurchases.

1.6.1 Evidence on Aggregated Data

Until the early 80*s*, dividends were the main mean of payment, and share repurchases was a marginal phenomenon. However, Skinner (2008) shows that in the last decades, the number of buybacks exceeded the companies' dividend payments, becoming the dominant form of payment. Grullon, Michaely, and Swaminathan (2002), observe that the noticeable increase in repurchases is a sign of the regular dividends replacement. The proportion of companies distributing dividends on the total number of listed companies has progressively decreased from 80*s* to the early years of the new century. Until the early 2000s, empirical studies tried to discern the reasons for the observed payment patterns by focusing mainly on the effect of taxation, agency costs, and signaling. Fama and French (2001) show that one of the main reasons for the fall in dividends is the explosion in the number of small companies with low profitability (e.g., all dot-com listed firms in the 90s linked to the internet expansion).

New theories consider the managers' remuneration as the main reason for the dizzying growth in the use of share repurchase as shareholders payment method. Specifically, Young and Yang (2011) note that managers' compensation is very often linked to earnings per share (EPS), i.e., managers are rewarded as this measure increases. Since this ratio increases as the number of outstanding shares decreases, managers are inclined to prefer to share repurchase rather than pay out dividends. Researchers find strong evidence to support these assumptions.

At the same time, the reduction in the proportion of companies that distribute dividends has been followed by a substantial increase in the amount of the dividends paid by companies that distributed higher dividends in previous years.

However, in the last decade we observe a trend reversal.[12] There has been an increase in the number of (U.S. and European) listed companies distributing dividends. This evidence suggests that managers consider dividends and share repurchase as complementary methods.

1.6.2 Evidence on Firm-level Data

Lintner (1956) conducts the first survey on payout policies in 1956, which was aimed at managers of major U.S. listed companies. Analyzing the surveys from 28 selected firms, Lintner finds that for most managers, the stability of payout policy is a priority, even over investment policy. He notes that a large percentage of managers prefer to increase debt rather than cut dividend payments to finance an investment.

According to this survey, the main objective for managers is to ensure the payout stability of shareholders compensations. However, in case a change in dividend policy is deemed necessary, Lintner shows that the entity of the variation in payments is decided based

[12] Floyd, Li, and Skinner (2015) document this new upsurge for dividends.

on the variation in profits.

Based on the results of the study, Lintner elaborates an equation that captures the behavior underlying the payout policy of a generic firm i:

$$\Delta D_{it} = a_i + c_i(D^*_{it} - D_{i(t-1)}) + u_{it} \qquad \text{with } D^*_{it} = r_i P_{it},$$

where P_{it} represents the after-tax profit during the period, and r represents the percentage of profit that the manager would like to pay its shareholders. The parameter c represents the rate with which managers change their payout policy, taking into account the dividend paid in the previous year. Lintner tests this model and confirms the assumptions and shows that this equation can capture the 85% of the variations in payout policies in the sample.

Baker, Powell, and Weaver (1999) conduct a very similar analysis through a survey on managers of the major companies listed on the New York Stock Exchange (NYSE) in 1997. Their results confirm Lintner's findings. According to Baker and Powell, past, current, and expected profits prove to be the variables that most influence managers' payment decisions. Besides, researchers observe that company managers are incredibly aware that investors interpret payout policy corrections as changes in the company's profitability. Moreover, Baker and Powell find that managers avoid increasing dividends, and consequently alter the dividend to profit ratio when they predict that the increase will not be sustainable in subsequent periods.

Brav et al. (2005) conduct further survey interviewing financial executives and obtaining their thought on payment policy choices. They also confirm Lintner's central finding, i.e., managers primarily pursue a stable payment policy. The survey also confirms the underlying assumption of both signaling models (Miller and Rock, 1985) and agency models (Jensen, 1986) that managers are willing to give up positive net present value investment projects before cutting dividends. It is clear from the survey that dividend payments are extremely binding on managers, with more than 65% of the managers surveyed saying that they are also willing to use funds outside the company to avoid dividend reductions. Also, around 80% of financial executives agree that dividends provide information to investors. According to the managers, the information transmitted through the payment of the dividend is not intended to attract a particular class of investors (as assumed by the clientele theory) or the level of future returns (as described by the theory of signal).[13] Rather, some managers argue that the transmitted information affects the volatility of returns and specifically the systematic risk associated with the company. Brav, Graham, Harvey, and Michaely also point out that share repurchases transmit almost the same information as dividends. However, the analysis of the survey shows that managers do not consider buyback plans as binding as dividend payment plans. It appears that managers are not willing to increase external debt or equity, nor to give up investment projects to finance repurchases. This distinctive element between the two payment methods would confirm that buybacks and dividends cannot be regarded as perfect substitutes (as noted by Grullon and Michaely, 2002).

All over the world, firms that distribute dividends exhibit similar dynamics. The propensity to pay dividends is higher among the largest and relatively stable firms, as well as among companies for which retained earnings constitute a larger fraction of the total capital and with low growth rates. The increase in dividends recorded since the early years of the new century is mainly due to large companies that liquidate substantial dividend amounts. In fact, through an analysis conducted on 15 member nations of the European Union from 1989 to 2005, von Eije and Megginson (2006) show that the number of listed companies that pay dividends is steadily decreased, despite the overall dividends have increased. Also in Europe, as in the case of US companies, repurchases increased significantly from 17% of total payments in 1989 to 35% in 2005.

DeAngelo, De Angelo, and Stulz (2004) study the dividend policies using an approach based on the theory of optimal capital struc-

[13] Grullon and Michaely (2004) find a similar result for buybacks.

ture that assumes an optimal dividend level based on the specific characteristics of a company. The researchers hypothesize that companies with a high ratio between retained earnings and total capital are mature companies, able to set aside profits and distribute the optimal level of dividend, not suffering the distorting effects of market frictions, such as agency conflicts, transaction costs, asymmetric information, etc. According to this theory, they focus on the characteristics of the companies that distribute dividends, presuming that the companies that generate more profits are also those most likely to borrow to obtain the maximum profit in favorable market conditions. However, Baskin (1989) reports a negative relationship between the profitability ratios and the debt ratios of a company, confirming the mixed empirical evidence about the relationship between profits, debt, and dividends.

Booth and Cleary (2006) empirically analyze the connection between the presence of information asymmetries and the propensity of managers to gradually adjust dividends. They find that companies with a bond rating pay dividends following Lintner's rule. On the contrary, firms without a bond rating that rely exclusively on private (banking) debt do not make gradual adjustments to dividends and seem to follow a residual payout policy compared to investment policy. Leary and Michaely (2011) show that more mature companies with low revenue volatility have a lower dividend variability. The researchers conclude that the gradual adjustment of dividends is negatively correlated with information asymmetry indices. Indeed they find that firms with more financial analysts and consultants have a higher propensity to *dividend smoothing*.

Michaely and Roberts (2011), on the other hand, hypothesize that agency conflicts influence dividend smoothing. The researchers conducted an interesting analysis of private companies where the firm's ownership is highly concentrated, so the conflicts between ownership and control are minimized. In these firms, Michaely and Roberts note that the choice of the number of dividends is residual concerning investment and financing policies. Furthermore, the researchers observe that unlisted companies have a significantly lower probability of reducing dividends, and consequently, the gradual adjustment of dividends does not seem to be a priority for these companies. These results confirm the influence of agency costs on companies' payout policies. However, Michaely and Roberts stress that agency costs cannot fully explain the practice of gradual adjustment of dividends.

Dividends and Cash Holdings

Several empirical studies carry out analysis of the increasing secular trend of cash and cash equivalents (Bates, Kahle, and Stulz, 2009; Opler et al., 1999; Ozkan and Ozkan, 2004). Studying the balance-sheets of U.S. companies, they identify four main causes for the increase in cash holdings:

- a substantial increase in expenses for research and development;
- superior management and consequently a reduction in unused cash;
- a reduction in investment in fixed assets;
- an increase in cash flow risk.

Pinkowitz, Stulz, and Williamson (2006), estimate the effect of agency costs on the firm's value. In practice, they assume that the market value of cash holdings is greater in countries with a financial system strongly oriented towards the protection of minority shareholders. Therefore the controlling shareholders have a lower possibility to obtain personal benefits from the management of liquidity. For all the years examined, Pinkowitz, Stulz, and Williamson divide the sample to the median country's protection level. The authors find that the relationship between cash holdings and market value is much weaker in countries with poor regulation on minority shareholders' protection. Moreover, as evidence of the influence of agency costs, Pinkowitz, Stulz, and Williamson find that the relationship between dividends and the value of the company is weaker in countries with strong shareholder protection. Therefore they conclude that agency costs have a strong impact on firms' value.

Pinkowitz and Williamson (2007) estimate the market value of a unit of firms' liquid assets. Employing a sample of 13,000 U.S. companies observed from 1965 to 2004, they try to determine the actual value attributed to cash holdings by investors. Through their analysis, they find a wide variety in the way firms evaluate a marginal dollar of liquid assets. The valuation ranges from 0$ to 1.60$ depending on company's characteristics and industry in which it operates.

If the real expected rate of return necessary for a company is constant, then its intrinsic value per share at time $t, V(t)$, is defined as the present value of the company's expected future real cash flows that will be available to be distributed for each share currently issued. Given the well-known accounting identity. It follows that a company's payout policy must necessarily satisfy the following equation:

$$V(t) = E_t\left[\sum_{k=0}^{\infty} \frac{D(t+k)}{(1+r)^{k+1}}\right]$$

Although the manager can influence the intrinsic value of his company through his investment decisions, he cannot control the stochastic process or unexpected deviations of $V(t)$. However, the manager has control over the dividends paid by the company under the constraint described above.

This constraint is very similar to the inter-temporal budget constraint on rational consumption choices in the problem of consumption choices over the lifetime of an individual. In this analogy, the intrinsic value of an enterprise, $V(t)$, corresponds to the permanent income or wealth of the individual, and the payout policy of the enterprise corresponds to the consumption policy of the individual. Just as there is an infinite number of rational consumption plans that satisfy the consumer's budget constraint for a given amount of wealth, so there is an endless number of dividend policies that satisfy the constraint for a given intrinsic value of the enterprise.[14]

As previously seen, the choices relating to the financial policy of a company are extremely interconnected and, at the same time, they are not immune to changes in the internal equilibrium of the shareholder structure. Information asymmetries represent the reason for the synchronous among mutual influences. Debt, dividend policies, and changes in private ownership are all tools used to reduce asymmetric information; but these tools involve costs. Indeed, managers who want to increase control incur in costs resulting from the misdiversification of their portfolio. At the same time, debt reduces free cash flows under the control of the manager, but it generates new conflicts between creditors and shareholders. Similarly, a reduction in dividends may favor creditors at the cost of diverting resources from shareholders, whereas an increase in dividends may reduce information asymmetries at the cost of diverting liquid resources from managers.[15]

Dividends and Earnings' Volatility

As noted in previous sections, according to the complete market's assumption, the dividend payment should generate a decrease in share value equal to the amount of the dividend. Moreover, if a company decides not to distribute dividends from one year to the next, we should not observe any market reaction.

However, an unexpected dividend increase leads to a rise in shares price and, conversely, an unexpected dividend cut generates a sharp fall in shares price (Michaely, Thaler, and Womack, 1995a). Moreover, Healy and Palepu (1988) show that market reactions are more intense for companies that for the first time announce to distribute a dividend or for companies that, from one year to the next one, decide to omit dividend payment.

Grullon and Michaely (2004) also note that the reaction of the market is proportional to the entity of the variation in dividends

[14] Mash and Merton, (1986).
[15] See Jensen, Solberg, and Zorn (1992).

or share repurchases. Indeed, more the dividend differs from the expected one, stronger the impact on the share price.

According to Fama and Babiak (1968), earnings' volatility is higher than dividends' volatility. This observation is supported by numerous analyses that demonstrate the aversion of managers to modify the payout policy.

Conversely, several studies show that share repurchases are highly pro-cyclical and that a variation in repurchase policy has no consequences on shares price.Lee and Rui (2007), through a structural vector autoregressive analysis, show that share repurchases are associated with transitory increases in profits, whereas dividends are related to the maturity of a company and are therefore used to distribute the gains considered stable over time. Jagannathan, Stephens, and Weisbach (2000) confirm that repurchases are more flexible than dividends. They show that more than 70 percent listed companies do not complete the announced repurchase program, moreover these firms do not suffer any significant market disadvantage.

In summary, dividends indicate the company's past performance, but its trend is not able to signal future profitability, as predicted by signaling theory (Benartzi, Michaely, and Thaler, 1997).

However, Rozeff (1982) notes that firms that increase dividends show a significant decrease in systematic risk, vice versa firms that reduce dividends suffer a significant increase in systematic risk. Besides, Rozeff notes an improvement in bond ratings and a reduction in short-term investments and cash holdings for companies that increase dividends. In line with these results, Grullon, Michaely, and Swaminathan (2002) find a significant relationship between the payout policy and the systematic risk of a company. They suppose that the variation in returns following the announcement of dividend payment may be associated with variation in the company's risk profile. Indeed, they find that variations in returns linked to announcements of dividend payment that persist over the long term are negatively correlated with future variation in systematic risk. Therefore, they conclude that dividend payments facilitate investors, who learn about the variation in a company's risk profile only gradually, in equity pricing.

These results suggest the existence of firms' transition from a phase of sustained growth to a phase of low growth. The maturity theory, also called life-cycle theory,[16] defines a negative relationship between the profitability of a company and dividends. According to this theory, firms in an expansionary phase with strong investment opportunities, tend to take advantage of periods of growth and therefore, consider profits as necessary resources to increase investment and thus achieve higher revenues. On the contrary, mature companies face a decline in investment opportunities, a reduction in systematic risk and, consequently, greater availability of liquid resources that can be used to pay out dividends.

According to the life-cycle theory of dividends, DeAngelo, DeAngelo, and Stulz (2006) define mature companies as those capable of self-financing, i.e., with a high ratio of retained earnings to equity. They test the existence of firm's life-cycles examining the relationship between the payout policy and the degree of maturity of the company and find a positive statistically significant relationship, consistent with life-cycle theory. Systematic risk, therefore, plays an important role in the definition of payout policy.

According to Venkatesh (1989), a firm's specific risk component also affects the volatility of the firm's payments, especially if distributes dividends for the first time. In line, Grullon and Michaely (2012) discover the existence of an inverse relationship between the level of competition in the sector in which the company operates and the payout policy. They find that companies in sectors with a lower degree of competition (i.e., low idiosyncratic risk) exhibit a lower probability of increasing dividends.

So, we can conclude that both systematic and specific risk influence the payout policy, specifically an increase in dividends will result in a reduction in business risk and vice versa.

[16] Mueller (1972).

1.7 Conclusion

This chapter aims to provide an overview of the different strands of critical theories formulated to explain the payout policy. However, any theory nor empirical analysis completely explain the features of the optimal payout policy. The results of the empirical analysis are inconclusive, mixed, or contradictory. Frankfurter and Wood Jr (1997) observes that:

Dividend-payment patterns (or what is often referred to as "payout policy") of firms are a cultural phenomenon, influenced by customs, beliefs, regulations, public opinion, perceptions and hysteria, general economic conditions and several other factors, all in constant change, impacting different firms differently. Accordingly, it cannot be modeled mathematically and uniformly for all firms at all times.

This is the starting point for the next chapter. We develop an optimal payout policy model by considering all the previous results and paradigms to identify the relevant factors that collectively determine the manager's payout decisions.

Chapter 2

Dynamic Discrete Choice Model

Our goal in this chapter is to understand the behavioral process that leads to the managers' choices. We begin by establishing the bases of stochastic discrete choice dynamic programming models, such as to formulate a parametric specification of the utility function of a generic manager who must choose the optimal dividend policy. Ultimately we conduct a counterfactual analysis to study the effects deriving from the introduction of a subsidy on retained earnings, the so called allowances for corporate equity.

The objective of discrete choice analysis is to investigate the decision-making process of an agent, defining the factors that collectively determine the agent's choice. Dynamic choice models differ from static models in the specification of the latent variable. Indeed, in dynamic models agents take into account the effect of their choice and accordingly maximize their expected intertemporal utility. In static models, the latent variable is given by the difference between the alternative single period utility, while in the case of dynamic models the latent variable is given by the difference between the value functions given by the alternative choices. The value functions represent the expected value of future payoffs, and are given by the solution to the dynamic programming problem.

The parameters to be estimated are defined as "structural" because they describe the preferences and expectations of an agent and the evolution of the state variables that characterize the model. The *theory of revealed preferences* provides the conditions such that it is possible to estimate the parameters of interest through micro-data on agent choices and state variables. Therefore, the choice models allow to empirically test the assumptions and the implications of a theoretical model through a simple interpretation of the parameters that govern the Markov decision process. Moreover, these models represent useful tools for counterfactual analysis. Indeed, they are regularly used for the evaluation of the effects of the implementation of specific public policy.[1] Hence, this close link between economic theory and the econometric model provides new perspectives for the comprehension of controversial empirical issues. Among the most relevant works in the literature we mention Wolpin (1984) on child fertility and mortality, Miller (1984) on occupational choices, Griliches, Pakes, and Hall (1986) on patent renewal, and Rust (1987) on machine replacement.[2]

However, in addition to the classic problems of any econometric choice model (such as endogeneity, measurement errors, truncated data, and permanent unobservable heterogeneity) the complexity of the estimation of structural dynamic programming discrete choice models is further complicated by computational issues. The estimation of these models generally requires the use of algorithms where the solution to the dynamic programming problem is nested within the maximization of the parameter's estimates. Therefore, the expected value function must be calculated for each point of the state space. Clearly, with continuous state variables the problem of dimensionality makes quite impossible the solution to the program-

[1] See Wolpin (1996).

[2] See Aguirregabiria and Mira (2010).

ming problem for every point of the state space. Instead, considering a representation in a finite state space, the size of the space grows exponentially with the number of state variables.[3]

Thus, the estimation requires that the dynamic programming problem is solved for each trial vector of parameters in order to obtain the solution for maximizing the estimation criterion (generally the objective is to maximize the likelihood function). Hence, in some case it is necessary to solve the programming problem thousands of times. Over the years, different methodologies have been developed in order to reduce the dimensionality problem deriving from the computation of the expected value function for all the alternative agent's options: the discretization of state variables, the approximation and interpolation of the expected value function[4], and the randomization of the Bellman equation[5].

In the next section we introduce the reader to the basic structure for this type of model, having in mind the final purpose of evaluating the dividend policy of a company listed on the stock market. Specifically, in the next section we evaluate the payout policy of a manager in a framework without uncertainty and considering only three periods.

2.1 Payout Policy Model

2.1.1 Three Periods without Uncertainty

In this section, we consider the optimal dividend policy problem for a manager of a listed firm. Assume the company's profits are independent on the number of companies active in the market. Thus, we are considering a firm operating in a monopolistic or a perfectly competitive market. The optimal dividend policy problem consists in a rational manager who must choose whether to settle a dividend

[3]This issue is referred as *curse of dimensionality.* See Bellman (1957).
[4]See Kean and Woplin (1994).
[5]See Rust (1997).

payment with shareholders or not.

We develop a model with only three periods, where in the first two periods the manager has to choose whether to payout a dividend or not, and in the third period the manager is forced to shutdown the firm and to payout the firm's value to shareholders.

Among all the factors that influence the decision of the manager we concentrate on the agency conflict. Essentially, we assume that the manager is under shareholders pressure, who require the dividend payments to reduce the risk associated to the possibility that the manager wastes their wealth in unsuccessful projects. Moreover, we assume that the payment of a dividend represents a disutility for the manager given by a lower resources availability.

For simplicity we assume that the manager is perfectly able to observe the second period utility, conditional on the choice made in the first period. Let's define with U_1^D the manager's utility in the first period whether the manager chooses to payout a dividend D, and with U_1^0 the manager's utility in the first period in case of no-dividend payment. U_{2j}^D indicates the utility obtained by the manager in the second period (with $j = \{D, 0\}$) in case the manager has chosen to payout a dividend in the first period, and U_{2j}^0 defines the manager's utility whether in the first period the manager has chosen to do not distribute a dividend. Considering the absence of uncertainty about future impacts of manager's decision, we know that in the second period the manager will choose the dividend policy that provides the maximum utility, $U_2^j = \max_j(U^j j_2)$. Finally, U_3^{jj} is the manager's utility deriving from the firm's liquidation in the third period, which depends on the dividend policy in the previous periods.

Therefore, assuming a time-separable utility, we can define the manager's total expected utility (TEU) as:

$$TEU^D = U_1^D + \beta U_2^D + \beta^2 U_3^{Dj}$$
$$TEU^0 = U_1^0 + \beta U_2^0 + \beta^2 U_3^{0j}$$

where TEU^D and TEU^0 are the total expected utility respectively in case the manager has chosen to payout a dividend in the first period or not, and β is the discount factor. Thus, the manager will choose to pay a dividend if and only if $TEU^D > TEU^0$:

$$TEU^D = U_1^D + \beta U_2^D + \beta^2 U_3^{Dj} > TEU^0 = U_1^0 + \beta U_2^0 + \beta^2 U_3^{0j}$$
$$\Rightarrow U_1^D - U_1^0 > \beta(U_2^0 - U_2^D) + \beta^2(U_3^{0j} - U_3^{Dj})$$

However, the researcher observes only a limited set of the factors that affect the manager's utility. Therefore, we need to decompose each manager's utility into an observed and unobserved part:

$$U_1^D = u_1^D + \varepsilon_1^D$$
$$U_1^0 = u_1^0 + \varepsilon_1^0$$

for the first period,

$$U_2^{Dj} = u_2^{Dj} + \varepsilon_2^{Dj}$$
$$U_2^{0j} = u_2^{0j} + \varepsilon_2^{0j}$$

for the second period, and

$$U_3^{Dj} = u_3^{Dj} + \varepsilon_3^{Dj}$$
$$U_3^{0j} = u_3^{0j} + \varepsilon_3^{0j}$$

for the last period.

Denoting with $f_\varepsilon(\varepsilon)$ the density function for the vector of unobserved factors, $\varepsilon = \{\varepsilon_1^j, \varepsilon_2^{jj}, \varepsilon_3^{jj}\}$, we can define the probability of a dividend payout in the first period as:

$$
\begin{aligned}
P_D =& Prob\big(TEU^D > TEU^0\big),\\
=& Prob\big[U_1^D + \beta \max_j (U^D j_2) + \beta^2 U_3^{Dj} >\\
& U_1^0 + \beta \max_j (U^0 j_2) + \beta^2 U_3^{0j}\big],\\
=& Prob\big[u_1^D + \varepsilon_1^D + \beta \max_j (u_2^{Dj} + \varepsilon_2^{Dj}) + u_3^{Dj} + \varepsilon_3^{Dj} >\\
& u_1^0 + \varepsilon_1^0 + \beta \max_j (u_2^{0j} + \varepsilon_2^{0j}) + u_3^{0j} + \varepsilon_3^{0j}\big],\\
=& \int I\Big[u_1^D + \varepsilon_1^D + \beta \max_j (u_2^{Dj} + \varepsilon_2^{Dj}) + u_3^{Dj} + \varepsilon_3^{Dj} >\\
& u_1^0 + \varepsilon_1^0 + \beta \max_j (u_2^{0j} + \varepsilon_2^{0j}) + u_3^{0j} + \varepsilon_3^{0j}\Big] f(\varepsilon) d\varepsilon,
\end{aligned}
$$

where $I[\cdot]$ is an indicator function which is equal to one when the statement inside the parenthesis is true, and zero otherwise. Taking N different draws from $f_\varepsilon(\varepsilon)$ it is possible to compute the total expected utility for the two choices and calculate the simulated choice probability as the average of the N values for the indicator function: $\hat{P_D} = \sum_n I^n/N$. Clearly, a "*myopic*" manager (i.e., $\beta = 0$) will choose the payout policy without taking into account the effects of his choice on future utility.[6]

In the next subsection we introduce uncertainty about future impacts of the current choices. For instance, assume the manager is no more able to perfectly foresee the state of the economy in the next period. Moreover, we specify how to handle the dimensionality problem that arises from the introduction of greater realism into the model.

[6]Therefore, the manager chooses to pay a dividend only if $U_1^D > U_1^0$. Accordingly, it would be possible to compute the simulated probability of paying a dividend. See McFadden (1984).

2.1.2 Three Periods with Uncertainty

In this subsection we assume that the manager is no more able to predict the transition of the state variables. Thus, the manager no longer observes the utility of the second period conditional on the first-period choice, U_{2j}^{D} and U_{2j}^{0} $\forall\ j \in \{0, D\}$.

Although the manager is not able to perfectly predict the realization of the state variables, we assume that he has subjective beliefs about the probability associated to a specific realization of these variables (i.e., the manager associates a probability to each possible realization of the state variables).

Therefore, we rewrite the second period utility as a function of unknown factors e: $U_{2j}^{D}(e)$ and $U_{2j}^{0}(e)$. The variable e represents all those factors that the manager does not observe in the first period, but will become known to the manager in the second period. The manager ascribes a probability to each possible future realization of the factors that belong to the variable e. Therefore, we indicate with $g(e)$ the density function for the unobservable variable e.

However, for any value assumed by e we know that in the second period the manager will choose the policy that gives him the maximum utility. For example, the second period manager's expected utility in case he chooses to payout the dividend in the first period, can be written as:

$$\int [\max_j (U_{2j}^{D}(e))] g(e) d(e).$$

Consequently, we can write the total expected utilities for the two dividend policies as:

$$TEU^D = U_1^D + \beta \int [\max_j (U_2^{Dj}(e))] q(e) d(e) + \beta^2 U_3^D \tag{2.1}$$

$$TEU^0 = U_1^0 + \beta \int [\max_j (U_2^{0j}(e))] q(e) d(e) + \beta^2 U_3^0 \tag{2.2}$$

Thus, a rational manager will choose to payout a dividend in the first period only if $TEU^D > TEU^0$. In the second period, the unobervable factors will be revealed and if the manager chose to settle a dividend payment with shareholders in the first period, then he will choose to pay a dividend again only if $U_2^{DD}(\hat{e}) > U_2^{D0}(\hat{e})$, where $\hat{e}$ is the realized value of e.

Therefore, for the researcher a further complication is added given by the impossibility to observe the manager's distribution function, $g(e)$. The solution to this problem is given by the specification of a parameterization of the probability, $h(e|\theta)$, assuming that for the true values of θ the two density functions are equivalent: $h(e|\theta^*) = g(e)$. As a consequence, the probability that a manager payouts a dividend is now given by:

$$\begin{aligned}
P_D =& Prob(TEU^D > TEU^0), \\
=& \int I\Big[u_1^D + \varepsilon_1^D + \beta \int \Big\{ \max_j \big(u_2^{Dj}(e) + \varepsilon_2^{Dj}(e)\big) + \\
&+ \beta\big(u_3^{Dj}(e) + \varepsilon_3^{Dj}(e)\big)\Big\} h\big(e|\theta) d(e)\big) > \\
& u_1^0 + \varepsilon_1^0 + \beta \int \Big\{ \max_j \big(u_2^{0j}(e) + \varepsilon_2^{0j}(e)\big) + \\
&+ \beta\big(u_3^{0j}(e) + \varepsilon_3^{0j}(e)\big)\Big\} h\big(e|\theta) d(e)\big)\Big] f(\varepsilon) d\varepsilon.
\end{aligned}$$

We could approximate this probability through multiple draws for ε from $f_\varepsilon(\varepsilon)$ and for e from $h_e(e|\theta)$ simulating the inside integral within the simulation of the outside integral, and averaging the results for the indicator function $I[\cdot]$. However, the computational burden becomes extremely severe as the dimension of states increases.[7]

In order to handle the dimensionality problem, in the next subsections we introduce the conditional independence assumption proposed by Rust (1987). Moreover, assuming the manager has an infinite lifetime, we specify a parametrization of the manager's utility function and describe the assumptions needed to estimate the parameters of the utility and the density $h_e(e|\theta)$.

[7] See Train (2009).

2.1.3 Infinite Horizon with Uncertainty

In the previous subsections we introduced the basic concepts of the discrete choice dynamic programming models in a simple three periods framework. In this subsection, we further extend the model assuming an infinite horizon choice model. Hence, the time evolves discretely and it is indexed by t, for $t = 0, ..., T$, with $T = \infty$.

Again, we assume that firms' profits are independent relative to the number of active companies in the market (i.e., consider a dynamic model of monopolistic competition). Therefore, we focus on the optimal dividend policy problem of a rational manager. Every period the manager decides whether to keep inside the company the free-cash flow without making a dividend payment ($d = 0$), or to payout a dividend ($d = 1$).

The manager chooses the dividend payout policy to maximize the expected and discounted stream of current and future values of his utility function. Once again, we assume that the manager's preferences are represented by a time-separable function. Therefore, the manager's preferences are given by an infinite discounted sum of a state-dependent utility function $\sum_{t=0}^{T} \beta^t U(d_t, x_t, e_t)$, where $\beta \in (0, 1)$ is the discount factor, $U(d_t, x_t, e_t)$ is the utility function at time t, x_t represents the state variables that the manager observes, and e_t represent the unknown factors that becomes known to the manager after his choice. We specify the managers' beliefs on the evolution of future values of the state variables by a Markov transition distribution function $F(x_{t+1}, e_{t+1}|x_t, e_t, d_t)$.

Blackwell's Theorem establishes that under very general conditions the solution to a Markovian decision problem exists and is unique.[8] The solution to the dynamic model takes the form of a decision rule that relates the state variables to the manager's choice $\{d_t = f_t(x_t, \epsilon_t)_{t=0}^{T}\}$ that specifies the agent's optimal action d_t in state (x_t, ϵ_t). The function $\delta = \{d = f(x, e)\}$ defines the optimal agent's decision rule and is considered deterministic. Namely, conditional on the realizations of x and e, and observing the man-

[8] Blackwell (1965).

ager's beliefs, then the manager's choice will be completely determinable.[9] By Bellman's "principal of optimality", we can separate the manager's current decision-making from the future decision process. Using the recursive expression, we define the value function of the dynamic programming problem by:

$$V(x,e) = \max_{d\in\{0,1\}} \left\{ U(d,x,e) + \beta \int V(x',e')dF(x',e'|x,e,d) \right\}, \tag{2.3}$$

accordingly, the optimal decision rule is given by:

$$\delta(d,x,e) = \arg\max_{d\in\{0,1\}} \left\{ U(d,x,e) + \beta \int V(x',e')dF(x',e'|x,e,d) \right\}. \tag{2.4}$$

From a causal perspective, our objective is to analyze the manager's decision process by defining the factors that jointly cause the manager's choice. Unfortunately we are able to observe only a limited set of variables that influence the manager choice, as a consequence the choice of the manager cannot be exactly predicted. As we have seen in the previous paragraph, the computational burden is very high, especially in a framework with uncertainty and infinitely lived firms/managers.

The dynamic conditional logit model first advocated by Rust (1987) provides a large gain in computational feasibility, allowing the estimation of the structural parameters in the manager's preferences, transition probabilities, and the discount factor. The intuition behind the Rust model is to consider the factors that the agent/manager observes only after he took his choice, as the same factors that the researcher does not observe either before or after the agent's decision.

In the next section we state the assumptions entailed by the dynamic programming conditional logit model, and we specify the estimation strategy for the primitive structural parameters.

[9] Notice that we omitted the time subscripts. In an infinite-horizon framework we assume that the dynamic problem is stationary. Therefore, the optimal policy rule and the corresponding value function are time invariant.

2.2 MLE Estimation for DDC Model

In this section we define the assumptions so that it is possible to obtain a closed form of the conditional choice probability.

Indicate with the variable x the vector of observable factors within the data set (i.e. firm's and market's demographics, firm's free-cash flow, and the dividend policy of the previous period), and with the variable ε the vector of unobservable factors for the researcher. As in the section 2.1.3, define with θ the vector of structural parameters for the utility function and the transition of x, and with $l_i(\theta)$ the log-likelihood function for manager i. Accordingly, the manager's decision problem is then to choose a sequence of payout decision rules $\delta = \{d = f(x, \varepsilon, \theta)\}$ to maximize the expected and discounted stream of current and future values of his lifetime utility.

Assumption 1. The unobservable state variables are independently and identically distributed over agents, alternatives, and time. The CDF $F_\varepsilon(\varepsilon)$ has finite first moments and is continuous and twice differentiable in ε. Specifically, we assume that the shocks ε_t have an extreme value type I distributions centered around 0.

Assumption 2. Assume that the unobservable state variables $\varepsilon(d)$ enter additively in the manager's utility function. They can be thought as transitory shocks to the manager's utility.

Given these assumptions we can rewrite the Bellman's equation from the researcher perspective as:

$$V_\theta(x, \epsilon) = \max_{d \in \{0,1\}} \Big\{ u(d, x, \theta) + \varepsilon(d) + \beta EV_\theta(d, x, \varepsilon) \Big\}, \tag{2.5}$$

with the function $EV_\theta(x, \varepsilon, d)$ defined by:

$$EV_\theta(d, x, \epsilon) \equiv \int_y \int_\eta V_\theta(y, \eta) p(dy, d\eta | x, \varepsilon, d, \theta), \tag{2.6}$$

where the expectation is taken with respect to the transition density for the controlled stochastic process $\{x, \varepsilon\}$ defined by the decision rule $\delta(x, \varepsilon) \in D(x)$ and the transition density $p(x', \varepsilon'|x, \varepsilon, d)$,$D(x)$ represents the finite choice set of payout policy given x.[10] Blackwell's theorem states that the sequence of decision rules $\{\delta_t, \delta_{t+1}, \delta_{t+2}, ...\}$ is stationary and Markovian, so the agent's optimal decision rule depends only on the current values of the state variables, and is determined by finding the alternative payout policy that provides the maximum in Bellman's equation. Specifically, the optimal time-invariant policy rule is given by:

$$\delta(x, \varepsilon, \theta) = \arg\max_{d \in \{0,1\}} \Big\{ u(d, x, \theta) + \varepsilon(d) + \beta EV_\theta(d, x, \varepsilon) \Big\}. \tag{2.7}$$

Our objective is to find the vector θ^* that maximizes the sum of the log-likelihood for the N managers selected from a random sample. In particular, the sample likelihood function is derived from the conditional choice probabilities $P(d|x)$, which are obtained from the agents' optimal decision rule by integrating out over the unobserved state variable ε given $f_\varepsilon(\varepsilon|x)$. However, since ε is a continuously distributed on R^S, where $S = \#D(x)$, the approximation of (2.7) is computationally unattainable. Moreover, from the last equation notice that ε enters nonlinearly in the unknown conditional value function EV_θ, therefore the computation of $P(d|x)$ requires to integrate the value function with respect to the density $p(x_{t+1}, \varepsilon_{t+1}|x_t, \varepsilon_t, d_t)$ to solve the Bellman's equation (2.5). Rust proposed the following conditional independence assumption on the Markovian transition probabilities to alleviate the computational burden:

Assumption 3. The future realizations of the observable state variables are independent of the present unobservable factors conditional on the current choice and realization of the observable state variables. That is: $p(x_{it+1}|x_{it}, \varepsilon_{it}, d_{it}) = p(x_{it+1}|x_{it}, d_{it})$. This assumption implies that the joint probability of the state variables can be written as:

$$p(x_{it+1}, \varepsilon_{it+1}|x_{it}, \varepsilon_{it}, d_{it}) = p(x_{it+1}|x_{it}, d_{it}) q(\varepsilon_{it+1}|\varepsilon_{it}). \tag{2.8}$$

[10] In the bivariate case: $D(x) \in \{0, 1\}$

The additive separability and the conditional independence assumptions are sufficient to guarantee that the *conditional choice probability* is positive for all possible parameters: $P(d|x,\theta) > 0$. As Rust (1987) noted, this result is equivalent to say that the set $\{\epsilon | d = \delta(x,\epsilon)\}$ has positive probability under $q(d\epsilon|x)$.[11] Under the assumptions **2** and **3** it's possible to write again the Bellman equation:

$$V(x,\varepsilon) = \max_{d\in(0,1)} [\upsilon(x,d) + \varepsilon(t)] \tag{2.9}$$

with

$$\upsilon(x,d) \equiv u(x,d) + \beta \int_x \int_\varepsilon V(x',\varepsilon')q(d\varepsilon|x')p(dx|x,d). \tag{2.10}$$

Therefore, it is possible to reach the same structure of static discrete choice problems, the only difference is the value function υ that substitutes the single period utility function u as argument of the conditional choice probability. The optimal decision rule δ is given by

$$\delta(x,\epsilon) = \arg\max_{d\in(0,1)}[\upsilon(x,d) + \epsilon(d)], \tag{2.11}$$

where υ is the solution to the dynamic programming problem. The conditional choice probability $P(d|x)$ can be defined in terms of the *social surplus* function:[12]

$$G([\upsilon(x,d) + \epsilon(d)]|x) = \int \max_{d\in(0,1)} [\upsilon(x,d) + \epsilon(d)]q(d\varepsilon|x), \tag{2.12}$$

[11] Rust (1987) defines *saturated* a specification for unobservables if does not exists a combination of choice and state variables that contradicts the DDP model for any value of ϵ.

[12] See McFadden (1981) to go deeply in the definition and properties of the social surplus function.

taking the partial derivative of G with respect to $\upsilon(x,d)$

$$\begin{aligned}\frac{\partial G([\upsilon(x,d)+\epsilon(d)]|x)}{\partial \upsilon(x,d)} &= \int \left(\frac{\partial \max_{d\in\{0,1\}}[\upsilon(x,d)+\epsilon(d)]}{\partial \upsilon(x,d)}\right) q(d\varepsilon|x) \\ &= \int I\{d = \arg\max_{d'\in(0,1)}[\upsilon(x,d')+\epsilon(d')]\} q(d\varepsilon|x) \\ &= P(d|x).\end{aligned} \tag{2.13}$$

Hence, the conditional choice probability $P(d|x)$ will be equal to the partial derivative of G with respect to the unique fixed point υ. The assumption **3** of conditional independence allows us to determine the fixed point υ, avoiding having to integrate over the entire state space (x,ε). Hence, the controlled process $\{x_t,\epsilon_t\}$ is Markovian with transition probability:

$$Pr\{dx_{t+1},d_{t+1}|x_t,d_t\} = P(d_{t+1}|x_{t+1})p(dx_{t+1}|x_t,d_t). \tag{2.14}$$

Thus, substituting the 2.9 into 2.10 we can rewrite the equation for υ as:

$$\begin{aligned}\upsilon(x,d) &= u(x,d) + \beta \int_x \int_\varepsilon \max_{d\in(0,1)} [\upsilon(x,d)+\epsilon(d)] q(d\varepsilon|x')p(dx|x,d) \\ &= u(x,d) + \beta \int_x G([\upsilon(x',d'), d' \in \{0,1\}|x']p(dx|x,d).\end{aligned} \tag{2.15}$$

With the assumption **1** we assumed that the unobservable state variable $\{\epsilon_t(d_t)\}$ follows an i.i.d. bivariate extreme value process. Therefore, we can write the conditional choice probability as:

$$P(d|x) = \frac{exp\{\upsilon(x,0)\}}{\sum_{d\in\{0,1\}} exp\{\upsilon(x,d)\}}, \tag{2.16}$$

where υ is the unique fixed point to the contraction mapping Ψ:

$$\Psi(\upsilon)(x,d) = u(x,d) + \beta \int_x log\left[\sum_{d\in\{0,1\}} exp\{\upsilon(x,d)\}\right] p(dx|x,d). \tag{2.17}$$

Given these assumptions we obtain a closed-form expression for $G(\cdot)$ and $P(\cdot)$, and we can define the estimation criterion for the structural parameters of the controlled process $\{x_t, d_t\}$. We assumed that the observable state variables (x) have a *discrete and finite* support, and from the initial values x_0 they follow a first-order Markov chain with transition probability matrix Π.[13] Lastly, we define the likelihood function for N independent managers:

$$\prod_{i=1}^{N} \ell(x,d|x_0,d_0,\theta) = \prod_{i=1}^{N}\prod_{t=1}^{T} P(d_{it}|x_{it},\theta)p(x_{it}|x_{it-1},d_{it-1}). \tag{2.18}$$

We employ the nested fixed point (NFXP) algorithm to estimate the parameters of the model. The NFXP algorithm proposed by Rust (1987) involves a 3-stage procedure that yields consistent, asymptotically normal and efficient estimates. In the first stage we nonparametrically estimate the partial likelihood for the transition of the observable state variable. In the second stage we estimate the vector Θ of parameters of the utility function using the first stage estimate as if we knew the true process of x:

$$\hat{\Theta}^p = \arg\max \prod_{i=1}^{N}\prod_{t=1}^{T} P(d_{it}|x_{it},\theta). \tag{2.19}$$

As showed, we need to solve the discrete decision problem at each likelihood function evaluation. The third stage consists in one more Newton-Raphson iteration on the full likelihood function

[13] With element $p_{j,k}$ representing the conditional probability of moving from state j to state k, $p_{i,j} = Pr[x_{t+1} = j|x_t = i]$.

$\ell(x, d|x_0, d_0, \theta)$ using as starting values the estimates of the first two stages.[14]

The next subsection provides a parametric specification of the manager's preferences such that we are in the position to estimate the structural parameters governing the dividend payout policy.

2.2.1 Specification of Manager's Preferences

In this section we specify the parametric structure of the utility function for a representative rational manager, so as to identify the set of *primitives* (u, p, β) of the MDP. The construction of the theoretical model reflects constraints relative to computational feasibility and availability of good data.

In the literature review we have seen that signaling motives and agency costs are identified as the main causes of dividend policy changes. Indeed, Rozeff (1982), Jensen (1986), and La Porta et al. (2000b), consider that dividend payments represent a tool to reduce agency costs. Asquith and Mullins Jr (1983) find that dividend initiations have a positive announcement effect on stock prices. The researchers conclude that investors interpret dividend initiations as good news in terms of firm growth opportunities, thus they put a premium on the stocks of dividend payers versus non-payers. Consistently, Baker and Wurgler (2004) argue that managers cater to investors by initiating dividends, and they show results in favor of this theory. Moreover, according to Michaely, Thaler, and Womack (1995b), firms that omit dividend payments are characterized by negative excess returns.

Consequently, we examine whether the entry benefit and exit cost are able to explain the widely established smoothed behavior of dividends. In particular, we test whether managers behave "myopically" or take into account the effects on future periods of the policy chosen in the current period.

Although our partial equilibrium model does not endogenously

[14] Rust (1994).

incorporate shareholders and investors reactions to the manager's dividend policy we assume that managers' beliefs are coherent with the standpoint that investors always reward companies that distribute dividends, and vice versa they punish companies that stop distributing dividends. This assumption is consistent with the empirical evidences on manager-shareholders agency conflict, dividend initiations and omissions.

Therefore, our model incorporates these factors that simultaneously affect the managers' decisions. Specifically, we allow for three features in the manager's utility function: the entry benefit for initializing a dividend payment; the exit cost of omitting dividend payouts; the agency conflict between manager and shareholders. Arguably, in this way it is possible to explain the managers' reluctance to modify the dividend policy.

Basically, we present a model where every period a rational manager wants to minimize the disutility of agency cost deciding whether payout a dividend or not. Thus, the expected one-period utility function for manager i is given by:

$$u(x_t, \varepsilon, d_t, \theta) = \begin{cases} -\theta_{01} y_t - \theta_{02} a_t - \theta_{03} k_t + \varepsilon_t(0) & \text{if } d_t = 0 \\ -\frac{\theta_{11}}{y_t} + \theta_{12}(1 - k_t) + \varepsilon_t(1) & \text{if } d_t = 1 \end{cases} \tag{2.20}$$

where y_t is the free-cash flow at the beginning of time t, and a_t represents the number of periods since last dividend payment. The inclusion of the i.i.d. error term $(\varepsilon_t(d_t))$ in the manager's utility function controls for exogenous factors that affect the payout plans.

The term a_t is included in the agency cost function consistently with life-cycle theory of dividends, where managers of more mature and profitable companies face higher agency costs of cash retention.[15] The state variable $k_t \equiv d_{t-1}$ is an indicator of the manager's choice in the previous period, which is equal to "1" if the manager chose to payout the dividend. What follows is a discussion on the

[15] See Denis and Osobov (2008) for international evidence supportive of agency-cost based on dividend lifecycle theory.

interpretation of the parameters we are going to estimate.

The parameter θ_{01} is the agency conflict disutiltiy of the manager when he decides not to pay dividends. We assume that shareholders observe y_t at beginning of the period, thus the shareholders-manager conflict is proportional to the free-cash flow level.[16] The parameter θ_{11} captures the disutility of paying dividends, representing the manager's agency cost to commit financial resources. We assume that the disutility of paying dividends is decreasing with respect to the free-cash flow level at beginning of the period, consistently with Brav et al. (2005) who find that managers consider dividends less flexible than repurchases and provide dividend payments only when they can be sustained. The parameter θ_{03} in (2.22) is the lump-sum cost of a dividend omission, (i.e., $d_t = 0$ and $k_t = 1$). Specifically, this parameter measures the sunk cost effect extensively documented by social scientists (see Thaler, 1980 and Staw, 1981): once having committed to a course of action, the decision maker sticks to the same policy despite he discovers new information that indicates that continuing the earlier commitment would likely result in worse consequences than switching.[17] Finally, the parameter θ_{12} is the entry gain of initiating an enduring dividend program, (i.e., $d_t = 1$ and $k_t = 0$).

In order to estimate the vector θ^* that maximizes the sum of the log-likelihood for the N managers, we firstly estimate the transition probabilities for the observable state variables, then we employ the method of successive approximations to compute the fixed point V^*. Once computed the fixed point, we may establish the optimal decision rule $\delta(x, \varepsilon)$.

In the next section we describe the selection method for the companies in our sample and we provide descriptive statistics for the variables of interest.

[16] We specify this structure of the agency costs consistently with the findings of DeAngelo, DeAngelo, and Stulz (2006). In particular, they find a highly significant relation between the decision to pay dividends and the earnings to total assets ratio.

[17] Kanodia, Bushman, and Dickhaut (1989).

2.3 Estimation Analysis

In this section we describe the sample and define the set of observable state variables. Furthermore, we provide estimates for the transition probabilities and the specification of the manager's utility function that characterize the dividend policy. Finally, through the DCDP model, we estimate the primitives for the manager's decision rule, $\delta(x, \varepsilon)$.

2.3.1 The Sample Data

The data are taken from the Orbis database compiled by the Bureau van Dijk (BvD) which provides detailed accounting information of more than 10 million companies worldwide.

In this section we focus on listed firms located in the Euro-area for the period 2009-2017. Given the assumption of homogeneity among firms, we focus on French and German companies, as the respective countries are the most similar economies among those within the monetary union.[18] We excluded from the sample the companies that report one or more missing values in the dividend variable in the time-span considered. Moreover, we removed from the sample all the financial firms and those firms that experienced exceptional liquidity events (e.g. capital increase, management buy-in or buy-out, mergers and acquisitions, initial public offering, private equity and venture capital financing). Lastly, we dropped those firms that exhibit extraordinary variation in the main observable state variable, return to asset (ROA) index.[19] The final sample consists of 473 companies, Table 2.1 and 2.2 shows descriptive statistics.

[18] Despite the Italian economy shares several aspects with the French and German economies, we excluded Italian companies as in 2011 the Italian government implemented a reform that likely changed the managers' preferences. We investigate the Italian case in the next chapter.

[19] We removed those firms that for at least one year are below the 1^{st} percentile and above the 99^{th} percentile of the ROA year-differences distribution.

Table 2.1: **Summary Statistics**

	Mean	*Median*	*Std.Dev.*
EBITDA	9.33%	10.00%	0.13
Equity	43.52%	4.60%	0.38
Fix.	47.97%	46.26%	0.21
Mrkt Cap	105.06%	64.00%	3.26
Dividends	1.76%	0.89%	0.04

Note: Summary statistics refer to the period 2009-2017 for 473 firms located in France and Germany. All the variables are scaled by firm's total assets.

The Orbis dataset provides an indicator of ownership independence based on the percentage of shares outstanding owned by a single shareholder. Table 2.2 presents the companies' distribution by ownership indicator. In particular, a firm is indicated with "A" if are not recorded shareholders that directly or indirectly own more than 25% of shares outstanding. The firms indicated with "B" do not present a shareholder with more than 50% direct or indirect ownership, but one or more shareholders are recorded with more than 25% direct or total ownership. Finally, the firms in the group "D" have one shareholder with a direct ownership of over 50%. The Table 2.2 confirms the predictions of the agency theory. In fact, companies with greater shareholders dispersion distribute dividends more frequently.

In the next subsection, we estimate the conditional probability distribution for the state x_{t+1} at time $t+1$ conditional on the current state (x_t) and plan (d_t). Then we present the estimates of the parameter vector θ. In the basic model we consider the binary choice to distribute the dividend or not. In order to differentiate the dividend omission cost, in subsection 2.3.4 we extend the model allowing for more payout policies.

In both models we consider two sub-samples based on the indicator of share ownership dispersion. Consistently with Rozeff (1982), we expect that the agency cost estimates monotonically increase with respect to the dispersion indicator.

Table 2.2: **Choice Distribution: Ownership Dispersion**

Indep. Indicator	$d = 0$	$d = 1$	*Total*
$A - B$	834	1,502	2,336
$C - D$	531	917	1,448
Total	1,365	2,419	3,784

Note: The observation are divided by the ownership concentration identifier and the yearly payout policy.

2.3.2 Estimation of the Manager's Beliefs

In this section we estimate the transition probabilities of the state variables y_t and a_t. The two variables are assumed to be discrete, therefore we estimate the transition matrix (Π) for the joint distribution of the observable state variables.

The decision period is assumed to be a year. The discrete decision d_t is the manager's "plan" regarding dividend payment at the end of the year, that is revised at one-year time intervals. The state variables x_t refer to the manager's state at beginning of the year. Specifically, the variable y is computed as the earnings to total assets ratio, while the variable a is the number of periods since the last dividend payment. We discretized the variable y into 20 intervals of equal length. We assume that the transitions of y from t to $t + 1$ follows a first-order Markov process. a_t follows a clear deterministic distribution and it is discretized into 30 intervals, with $a_{max} = 30$ as absorbing state.[20]

[20] $a_t = T$ means that the company does not pay dividends for T consecutive

The *Rust's conditional independence assumption* implies that the transition probability of the vector of observable state variables x_t is:

$$p(x_{t+1}|x_t) \equiv p(y_{t+1}, a_{t+1}|y_t, a_t, d_t). \tag{2.21}$$

We nonparametrically estimate this joint transition probability using the corresponding sample relative frequencies for the grid values of x_t and d_t. In particular, we compute a frequency estimate of the Markov transition matrix from the transition data:

$$\begin{aligned}\hat{p}_{ij} &= Prob(x_t = j|x_{t-1} = i) \\ &= \frac{n_{ij}}{\sum_{s=1}^{m} n_{is}},\end{aligned}$$

where n_{is} is the number of times that the process moved from state i to s, and the denominator is the number of transitions out of state i.

The conditional independence assumption ensures that the expected value function is also independent with respect to unobservable state variables, i.e. $EV_\theta(x, \varepsilon, d) = EV_\theta(x, d)$.

Given the discretization of y_t and a_t, the fixed point $EV(\cdot)$ is computed as an element of the Banach space $B = R^{20x30}$.

With the estimate of $p(x_{t+1}|x_t)$ and $EV(\cdot)$, we are in the position to estimate the vector of parameters θ by the two stage algorithm.

2.3.3 Estimation of the Manger's Utility Function

We formalize the revealed preference problem as a problem of statistical inference. The null hypothesis is that the data $\{d, x\}$ are realizations of a controlled stochastic process generated from the solution to a stochastic dynamic programming problem with utility function u that depends on a vector of unknown parameters θ. The

periods. If the manager chooses to payout the dividend at time t ($d_t = 1$), next year state is equal to one ($a_{t+1} = 1$).

underlying preferences u are "uncovered" by finding the parameter vector $\hat{\theta}$ that maximizes the likelihood function for the sample of data. The associated log-likelihood function is:

$$L(\theta) = \sum_{i=1}^{480} \sum_{t=1}^{8} \left[I(d_{it} = 0) \log \left(\frac{exp_0(\cdot)}{exp_0(\cdot) + exp_1(\cdot)} \right) + \right.$$

$$\left. + I(d_{it} = 1) \log \left(\frac{exp_1(\cdot)}{exp_0(\cdot) + exp_1(\cdot)} \right) \right]$$

$$\text{with } exp_0(\cdot) = \exp\left(-\theta_{01} y - \theta_{02} a_t - \theta_{03} k_t + \beta EV(x'|x, d = 0)\right),$$

$$\text{and } exp_1(\cdot) = \exp\left(-\frac{\theta_{11}}{y_t} + \theta_{12}(1 - k_t) + \beta EV(x'|x, d = 1)\right).$$

We do not directly estimate β because is highly collinear with the preference parameters.[21] However, as usual in dynamic models estimation, we establish subjective discount factor β via grid search: we start maximizing the likelihood function at $\beta = 0$ and use these estimates as initial values for estimations with higher values of β.

Table 2.3 presents estimates of the utility function with discount factor $\beta = 0.95$, and separately for the group of firms with ownership dispersion indicator (A-B) and (C-D). The maximum likelihood estimates are statistically significant. The predictions provided by the agency theory are confirmed. The pool of firms with higher ownership dispersion (A-B) show higher cost of cash retention with respect to firms with low ownership dispersion (C-D). Table 2.3 provides the "Heterogeneity test" that assess the equality of the agency cost parameters between the two groups of firms. The data reject the hypothesis that the structural coefficients (θ_{01}) are the same for firms groups (A-B) and (C-D).

The estimates obtained fixing the discount rate at zero ($\beta = 0$) provides the "myopic test", as suggested by Rust (1987). Basically, with $\beta = 0$ the manager chooses to payout the dividend evaluating the single period utility only. Comparing the estimations with $\beta = 0$ and $\beta = 0.95$, we can asses whether the manager takes in consideration the effect on the future of the current choice. Table 2.3 provides

[21] See Rust (1994).

the likelihood ratio test with the null hypothesis of equality between the two models. We rejected the null and conclude that the dynamic model explains the data better than the static model.

The χ^2 goodness-of-fit statistic provides an overall test of the null hyphothesis that the econometric model is correctly specified, (Rust, 1994). The test assesses whether managers are rational, in the sense of acting “as if” they were solving the specified dynamic programming problem. If the data appear to be consistent with the dynamic programming model, the estimated model can be used to forecast the effect of policy changes such as the introduction of a reform. In our model, the χ^2 has 35 degrees of freedom (the number of relevant cells (20×2) minus the numbers of parameters 4 minus one), and it is equal to 3.6. Thus, it may be concluded that statistically our model describes the data well.

The next subsection provides the estimation results allowing the manager to choose among five dividend policies.

Table 2.3: **Structural Estimates for the Agency Cost Function**

Parameter	Estimate	Std Error
Firm's ownership indicator: A-B		
θ_{01} (agency cost)	-0.0799	0.0033
θ_{02} (time)	-1.5419	0.7820
θ_{03} ($d = 1 \rightarrow d = 0$)	-2.7193	0.1328
θ_{11} (opport. cost)	-0.8870	0.0811
Firm's ownership indicator: C-D		
θ_{01} (agency cost)	-0.0610	0.0038
θ_{02} (time)	-1.0224	0.5312
θ_{03} ($d = 1 \rightarrow d = 0$)	-2.7620	0.1550
θ_{11} (opport. cost)	-0.6232	0.0960
$\beta = 0.95$		
Heterogeneity Test: (A-B) vs (C-D)		
LR Statistic (df = 4)	20.54	
"Myopia" Test: β=0 vs β=95		
LR Statistic (df = 1)	23.56	28.64
χ^2 (df = 35) = 3.621		

Note: the covariance matrix is computed by inverting the information matrix for the partial likelihood function 2.19.

2.3.4 Dividend Policy with Multiple Options

In this subsection we increase the manager's dividend policy options. Expanding the set of manager's options gives us the possibility to distinguish between dividend payout reductions and omissions, and between dividend payout increases and initiations. Therefore, the choice variable is no more binary but we consider d as the dividend free-cash flow ratio, and the manager has the possibility to choose among five different policies.

Grullon and Michaely (2004) note that the reaction of the market is proportional to the entity of the variation in dividends or share repurchases. Indeed, more the dividend differs from the expected one, stronger the impact on the share price. The model with multiple options reflects the Grullon and Michaely evidence in the manager's utility function.

Basically, we split the dividend payout ratio (computed as the dividend to equity ratio) in five intervals of the same length. The single period utility function for the manager becomes:

$$u(x_t, \varepsilon, d_t; \theta) = \begin{cases} -\theta_{01} y - \theta_{02} a_t + \sum_{j=1}^{4} \theta_{03j} I\{d_t = 0, k_t = j\} + \varepsilon_t(0) \\ \qquad \text{if } d_t = 0 \\ \sum_{i=1}^{4} \sum_{j=1}^{5} -\frac{\theta_{1i}}{y_t} - \theta_{1ij} + \varepsilon_t(i) \\ \qquad \text{if } d_t = i \end{cases} \tag{2.22}$$

where $I\{\cdot\}$ is an indicator function that defines the transitions of the dividend policy from $t-1$ to t. In case the dividend policy does not change from a period to the subsequent we assume that the lump-sum cost or benefit are equal to zero.

For the estimation procedure of the DPDC model nothing changes except the computational cost which increases considerably. The Table 2.4 presents the estimates. We see that our predictions are confirmed also by providing more flexibility to the manager's choice.

In the next chapter we use the structural estimates obtained in the two versions of the dividend payout model to simulate the probability of paying a dividend to the introduction of the so-called "Allowances for Corporate Equity", (ACE). The ACE (also known as Notional Interest) is a tax system able to equalize the tax treatment between debt and equity at the corporate level. We briefly explain the ACE tax system. Then, we evaluate the impact of the ACE relief on Italian companies. Indeed, in 2011 Italian government implemented the ACE regime. Finally, through the DPDC model, we simulate the variation of the probability to payout a dividend for different percentages of the ACE relief.

Table 2.4: **Structural Estimates for the Agency Cost Function**

Firm's ownership indicator:	A-B	C-D
θ_{01} (agency cost)	-0.0282	-0.0252
	(0.0034)	(0.0044)
θ_{11} (opp. cost)	-1.6117	-0.8140
	(0.1722)	(0.1881)
θ_{12} (opp. cost)	-1.4276	-1.4841
	(0.1672)	(0.1863)
θ_{13} (opp. cost)	-2.6300	-4.3164
	(0.2535)	(0.4547)
θ_{14} (opp. cost)	-1.8348	-1.6413
	(0.2234)	(0.2071)
θ_{02} (time)	-1.7135	-1.5420
	(1.022)	(0.9561)
θ_{031} ($d = 0$, $k = 1$)	-3.5852	-3.8690
	(0.5517)	(0.9290)
θ_{032} ($d = 0$, $k = 2$)	-5.5929	-5.9137
	(0.4316)	(0.5820)
θ_{033} ($d = 0$, $k = 3$)	-7.1369	-7.7413
	(0.4091)	(0.6591)
θ_{034} ($d = 0$, $k = 4$)	-8.2632	-9.6813
	(0.4351)	(0.6075)
θ_{110} ($d = 1$, $k = 0$)	0.0000	0.0000
	(0.5169)	(0.8792)
θ_{112} ($d = 1$, $k = 2$)	-2.7612	-3.4968
	(0.5921)	(0.9082)
θ_{113} ($d = 1$, $k = 3$)	-5.5096	-6.9193
	(0.6562)	(1.1509)

θ_{114} $(d = 1,\ k = 4)$	-6.7009	-7.8273
	(0.5968)	(0.7832)
θ_{120} $(d = 2,\ k = 0)$	0.8058	1.0239
	(0.3608)	(0.5439)
θ_{121} $(d = 2,\ k = 1)$	0.0000	0.0000
	(0.5928)	(0.9096)
θ_{123} $(d = 2,\ k = 3)$	-2.6820	-2.9922
	(0.3582)	(0.5886)
θ_{124} $(d = 2,\ k = 4)$	-5.4121	-5.8109
	(0.4422)	(0.5858)
θ_{130} $(d = 3,\ k = 0)$	1.7898	2.4207
	(0.2587)	(0.4195)
θ_{131} $(d = 3,\ k = 1)$	0.0000	0.0000
	(0.7953)	(1.3137)
θ_{132} $(d = 3,\ k = 2)$	0.0000	0.0000
	(0.4229)	(0.5800)
θ_{134} $(d = 3,\ k = 4)$	-2.3675	-2.8289
	(0.1932)	(0.3572)
$\beta = 0.95$		
Heterogeneity Test:(A-B) vs (C-D)		
LR Statistic (df = 35)	15.33	
"Myopia" Test: β=0 vs β=95		
LR Statistic (df = 1)	34.65	37.21
$\chi^2 = 4.978$		

Note: Standard errors in parentheses.

Chapter 3

Case Study: The ACE Tax Regime

In almost all developed economies we find a tax system that allows the deductibility of interest payments, while equity returns are fully taxed. This tax discrimination between debt and equity generates the so-called debt bias, that is an excessive use of leverage by companies. In countries with weak equity markets and strong exposition to debt this distortion can make the entire economy extremely vulnerable to business cycle downturns, in fact the failure of multiple companies could cause significant damage to the financial system.[1]

In 2011 the Italian government, within the fiscal policy package aimed at limiting the financial and sovereign debt crisis of the last decade, enforced a tool to limit the equity-debt distortion: the Allowances to Corporate Equity (ACE) tax regime. The ACE system provides for a tax relief calculated by applying a notional interest rate to a net equity base.[2] The ACE base is determined as the

[1]See De Mooij (2012) for an extensive discussion on the effects of debt bias on the financial sector.

[2]The ACE notional rate was set at 3% for the first three years of the program,

positive variation of equity occurred since the end of the year 2010. The relevant variation in equity for the computation of the ACE base is determined as the sum of contributions in cash from shareholders and the retained earnings that increment reserve provisions (except non-distributable reserves) minus voluntary distributions to shareholders and reductions due to anti-avoidance rules.[3]

Intuitively, the implementation of the ACE regime should have straightforward consequences on the corporate dividend policy. Indeed, we expect that those Italian companies that are used to distribute dividends to interrupt dividend payments in order to take advantage of the subsidy. Furthermore, those companies that have not paid any dividend in the previous year, we expect they do not initialize a dividend payment after the 2011 ACE reform.

In this chapter, we first estimate the impact of the ACE relief on Italian companies' dividend decisions with a reduced form equation. Then, in a structural estimation framework, we simulate the manager response for different values of the ACE relief. The structural estimation provides a useful environment to achieve this purpose since we can explicitly solve the optimization problem and determine a new optimal decision rule.

3.1 Empirical Predictions of the Dividend Literature

In this section of the chapter we briefly reviews the predictions on the determinants of corporate dividend policy provided by the empirical dividend literature. Based on these findings, we develop a model in reduced form that allows us to correctly estimate the impact of the

and to 4%, 4.5%, 4.75%, 1.6% and 1.5% for the years 2014, 2015, 2016, 2017, and 2018 respectively.

[3]The anti-avoidance rule aims at eliminating the "cascade effects" of tax reliefs. Therefore, if shareholders injects new equity in a company and this capital is again transferred to a subsidiary, then only the subsidiary benefits of the tax relief.

ACE subsidy taking into account all the specific determinants that affect dividend decisions.

Based on the literature review made in the first chapter, we provide a list of the relevant predictions for the specification of the regression model that we employ in the next section:

1. Firms that have higher uncertainty about future earnings tend to payout none or lower dividends, indeed Jensen, Solberg, and Zorn (1992) report a negative relation between business risk and dividend policy supporting this hypothesis.

2. Myers (1984) and Myers and Majluf (1984) hypothesize that companies finance their investments through a hierarchy among funding resources. According to this theory internal funds are the main source of financing, thus dividend payments are negatively related to firm's investment opportunities.

3. According to Bhattacharya (1979), Miller and Rock (1985), and John and Williams (1985) initiations and increases of dividend payments signal an improvement in the company's profitability. Therefore, there is a positive relationship between profitability and the dividend payments.

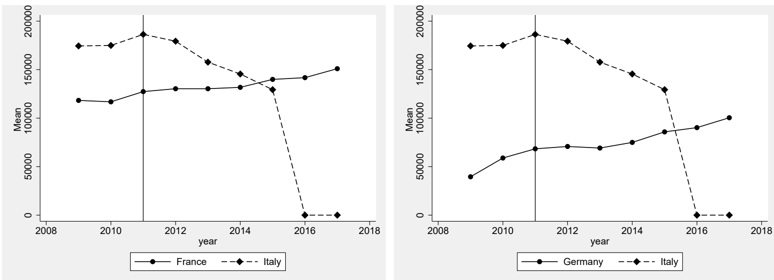
4. According to Jensen and Meckling (1976) and Jensen (1986), debt and dividend policies are the most relevant mechanisms to regulate agency costs of free-cash flow. Hence, the dividend literature predicts a negative relationship between debt policy and the dividend payments.

The following sections describe the methodology used in this chapter of the thesis. First of all, the sample data is explained, subsequently the variables, and the models are presented, lastly the results from the estimations are shown and commented.

3.2 The ACE Implementation in Italy

The purpose of this section is to investigate the sample data employed in order to test the research hypothesis after the implementation of the ACE regime in Italy. In order to achieve this purpose the next section proposes a Differences-in-Differences (DiD) approach to obtain casual estimates of the ACE policy change that affected Italian firms since the end of 2011. We compare Italian firms affected by the reform before and after and firms from the Euro-area unaffected by this reform. We need to assume that the firms in the two groups are subject to the same time trends such that the DiD approach estimates the effect of the ACE reform. For this reason we restrict the analysis to companies located in countries very similar to Italy, specifically we chose France and Germany. Among the countries belonging to the eurozone, we selected France and Germany on the basis of the companies distribution by economic sectors, nominal gross domestic product, and dividend on equity ratio of these countries. Figure 3.1 shows the average dividends time series comparing Italy with France and Germany.

Figure 3.1: Average Dividends Time Series



The two figures confirm the assumption of common trend before the implementation of the ACE reform. The source of the data is the Orbis database that contains detailed accounting and financial information. Following the related literature we excluded those firms operating in the financial and utilities sector. We consider the 2009-2017 period and we exclude from the sample those firms with missing values in the dividend variable in any of the selected years, and those firms that during this period experienced relevant liquidity events such as: acquisition, initial public offering, institutional buy-out, management buy-in and buy-out, private equity and venture capital financing. The sample selection criteria result in a panel data set of 555 non-financial companies: 209 French, 306 German and 40 Italian companies.

Table 3.1: Summary Statistics: Dividends

Country	*Mean*	*Median*	*Std.Dev.*	*Obs.*
France	130.3	2.7	509.2	1,881
Germany	73.6	1.0	344.5	2,754
Italy	127.5	2.9	584.4	360
Total	98.9	1.6	434.0	4,995

Note: Summary statistics refer to 559 firms over the period 2009-2017. Values are expressed in millions of euros.

Table 3.1 and 3.2 present some descriptive statistics for the dividend variable for each country. The tables show that these companies pay very high dividends both in absolute terms and with respect to the amount of liquid assets. However, from the Table 3.2 it is possible to note that on average Italian companies started to reduce the dividend payments since the year 2012. As can be seen from Table 3.3, the reduction in dividends is not a consequence of a reduction in earnings, in fact the average earnings to liquid assets ratio remains stable over the period. These data confirm that due to changes in the Italian corporate tax system Italian firms have progressively reduced the dividend payouts. However, it seems that

Table 3.2: Dividend Payout

	France		Germany		Italy	
	Div.	D.P.R.	Div.	D.P.R.	Div.	D.P.R.
2009	118.3	3.69%	39.5	2.49%	174.4	5.07%
2010	116.8	4.21%	58.9	4.02%	174.9	5.07%
2011	127.4	3.65%	68.4	4.05%	186.3	5.42%
2012	130.3	4.40%	70.8	4.21%	179.3	5.23%
2013	130.3	3.44%	69.2	3.92%	157.7	4.60%
2014	131.7	3.09 %	75.0	4.19%	145.5	4.00%
2015	139.9	2.88%	85.8	4.28%	129.3	3.93%
2016	141.7	2.93%	90.2	4.05%	0.00	0.00%
2017	151.0	3.21%	100.4	3.92%	0.00	0.00%

Note: The table reports the time series of the average dividend payout in millions of euros and the average dividend payout ratio. The dividend payout ratio is given by the dividend payment divided by the total equity at the beginning of the year.

Italian companies have needed to take time to adjust their dividend policies. We believe that the difficulty of Italian firms to adjust their dividend policy is mainly due to the high costs resulting from a sudden reduction of the dividend payout ratio.

3.3 Econometric Models and Results

In this section, we estimate the impact of the ACE reform on the dividend payout policy of Italian firms. Intuitively, since dividend payouts reduce the net equity base for the calculation of the subsidy, Italian companies that regularly payout a dividend before the implementation of the ACE reform should significantly reduce their div-

Table 3.3: Earnings

	France	Germany	Italy
	Earnings to Liquid Assets Ratio	Earnings to Liquid Assets Ratio	Earnings to Liquid Assets Ratio
2009	1.22	1.52	1.26
2010	1.42	1.62	1.28
2011	-2.73	1.36	1.28
2012	1.00	1.37	1.27
2013	0.91	1.34	1.25
2014	1.13	1.25	1.26
2015	0.18	0.77	1.25
2016	0.98	1.34	1.27
2017	1.29	1.31	1.30

Note: The table reports the time series of the average of EBITDA at the end of the year plus liquid assets at the beginning of the year divided by liquid assets at the beginning of the year.

idend payments.[4] Moreover, firms that omitted dividend payments before the reform should not initiate a dividend payment after the implementation of the ACE reform.

We employ the identification strategy for the direct effect of the ACE subsidy on the dividend payout policy of Italian companies. Namely, we assume a linear model for dividends:

$$y_{it} = \alpha + \beta_2 Italy_i + \beta_3 Post_t \otimes Italy_i + \mathbf{x_{it}}\boldsymbol{\beta} + \tau_t + \varepsilon_{it}, \quad (3.1)$$

where i and t index companies and years respectively. The empirical specification in equation (3.1) is implemented to measure the

[4]The Italian companies could benefit from the subsidy without limitations. However, the reform states that the subsidy cannot exceed the net worth of the company existing at the end of the tax year.

impact of the ACE allowance both on the *dividend level* and the *dividend payout ratio*.[5] The dummy *Post* is "1" for the period after the implementation of the ACE regime and zero otherwise. While *Italy* is a dummy variable equal to unity for Italian companies and zero otherwise. Therefore, the coefficient β_3 for their interaction ($Post_t \otimes Italy_i$) is "1" for Italian companies in the post-ACE reform period and "0" otherwise, and it measures the effect of the ACE subsidy on Italian companies.

Following Fama and French (2001), the basic equation (3.1) includes a vector $1 \times$ K of explanatory variables ($\mathbf{x}$) to control for possible confounding factors. Clearly, to each dependent variable is associated a specific vector of regressors $\mathbf{x}$.

Namely, considering the dividend level as dependent variable, the vector $\mathbf{x}$ includes the level of earnings (*Earnings*) to control for firm's profitability, the level of current liabilities (*CurrentLiab.*) and net debt (*NetDebt*) to control for the firm's debt policy, and the firm's market capitalization ($MarketCap$) to capture influences of the financial markets on firm's dividend policy. Moreover, we include net assets ($NetAssets$) and equity (*Equity*) to control for the firm's size, and retained earnings (*RetainedEarn.*) to capture the company's propensity to keep financial assets inside the firm. Lastly, we added year dummies to control for time-varying factors such as macroeconomic dynamics that affect firms' dividend policy.

On the other hand, when we consider the dividend payout ratio as dependent variable the vector $\mathbf{x}$ includes the return on asset (ROA) that is given by the ratio of net earnings to total assets and accounts for firms' profitability. Following Parkinson (1980) we proxy the business risk for each company with the stock returns volatility ($Ret.Vol.$) of the firm, which is computed as the standard deviation of the log-returns calculated as the difference between the highest, the lowest, and the closing log-price minus the open log-price for every year from 2009 to 2017. We add the market-to-book

[5]The dividend payout ratio is measured as the ratio of the dividend level paid to shareholders in a year on the equity level at the beginning of the same year.

ratio (M/B) to control for firms' investment opportunities. The ratio of cash and equivalents to total liquid assets ($Liq.Ratio$) is added to capture the firm's highly liquid assets disposal, on the other hand, we capture the firm's flexibility with the ratio of fixed assets on total assets ($FixedAss.Ratio$). The ratio of total debt to total assets (Debt Ratio) to account for firms' debt policy, the ratio between retained earnings and liquid asset (RE) is added to measure the firm's propensity to accumulate financial resources, moreover we added year dummies (τ_t).

Table 3.4 presents the estimation results considering the dividend level as dependent variable, while Table 3.5 shows the estimates considering the dividend payout ratio as dependent variable. The tables present regressions with and without firm fixed effects. Furthermore, the estimates of the ACE relief effect are unaffected by the decision to pool French and German companies considering a unique control group. Thus, we chose to separately compare them with Italian companies. In the first two columns, we consider France as a comparison country, while in the third and fourth columns we consider German companies as a comparison group.

In the regressions without firms fixed effects, we also included a set of dummy variables to control: for age; ownership dispersion; industry effects. The age dummies are added to capture firms' "maturity".[6,7] The ownership dispersion (OD) dummy is added to control the effect of the manager-shareholders conflict on the dividend policy.[8] Lastly, industry dummies are included in the vector of re-

[6]Grullon, Michaely, and Swaminathan (2002) proposed the *maturity hypothesis* which suggests that stable dividend increases signal the firm's life cycle change, in particular they signal a transition to a more mature phase.

[7]The companies were divided into four groups based on the year in which the initial public offering (IPO) took place. Specifically, the age group 1 includes companies that submitted the IPO in the years after 2005; the age group 2 includes the companies that submitted the IPO between the years 2000 and 2005; the age group 3 includes the companies that submitted the IPO between the years 1995 and 2000; and the age group 4 includes companies that submitted the IPO before 1995.

[8]The Orbis database provides an indicator of the ownership dispersion. A

gressors **x** in case some industries rely more on dividend payments than others.

The estimates consistently suggest a negative effect of the ACE reform on dividends.

During the 2009-2011 period, the average payout of Italian companies is 178.5 million euros, while the average payout ratio is 5.18%.[9] Given the DiD estimates, Italian companies paid on average 30,000 euros in dividends less than French companies, which represents about 16.8% $\left(\frac{30{,}056.937}{178{,}500} \times 100\right)$ of the pre-treatment period average amount. Besides, Italian companies paid 48,000 euros in dividends less than German companies, which represents about 23.3% $\left(\frac{48{,}115.928}{178{,}500} \times 100\right)$ of the pre-ACE reform period amount. On the other hand, following the implementation of the ACE reform, the dividend payout ratio decreased by about 1.8 p.p. (percentage points) relative to French companies, and by about 2.5 p.p. relative to German companies.

Considering the lowest ACE rate we calculate that Italian companies have benefited from a tax relief equal to 901,708.11 euros (30,056,937×3%), or 1,443,477.84 euros (48,115,928×3%) depending whether we consider France or Germany as comparison country. If Italian companies had not paid dividends in the years following the reform they could have benefited from an overall tax relief of about 18 million euros.[10] Therefore, Italian companies have renounced on average to an ACE relief of about 17 million euros, in the period 2012-2017. This result supports the theoretical hypothesis that

firm is classified with "A" if are not recorded shareholders that directly or indirectly own more than 25% of shares outstanding. A firm is classified with "B" if it is not recorded a shareholder that directly or indirectly owns more than 25% of shares outstanding, but one or more shareholders are recorded with more than 25% direct or total ownership. A firm is classified with "C" or "D" if there is a shareholder that directly or indirectly owns over 50% of shares outstanding. Given this classification the dummy variable *OD* is equal to "1" if a firm is classified with "A" or "B", and zero otherwise.

[9]These data are taken from Table 3.2.

[10]We applied the ACE rate to the dividends actually paid during the period 2012-2017.

public listed companies face substantial sunk cost following a sudden omission of dividend payments.

The model estimations are significant at the 1% level as evidenced by the F-statistic reported at the bottom of the tables. Most of the results found in the literature are confirmed. We observe a positive effect of the earnings, indicating that firms with higher profitability present a higher dividend level and dividend payout ratio. Moreover, we find a negative effect of returns volatility on dividend payouts confirming that higher uncertainty negatively affects the dividend payout ratio. The estimates of the coefficient for the net debt variable are positive, confirming that a negative debt position enhances agency conflicts between bondholders and shareholders resulting in lower dividend payout ratios. However, the results for the effect of the growth opportunities (captured by the market to book ratio coefficient) are contradictory with respect to the literature. Although, the market-to-book ratio (or Tobin's q) is also used as a proxy for many other variables such as corporate performance, intangibles, the quality of management, agency problems, and firm value. Thus, its value as a proxy for growth opportunity remains unclear.[11] The age-dummies confirm that young companies have a lower dividend payout ratio. Moreover, the dummy for the ownership dispersion confirms the effectiveness of agency theory, indeed companies with higher share ownership dispersion tend to distribute higher dividends.

In order to capture the dynamic effects of dividend policy and to control for autocorrelation, we consider a lagged dependent variable (LDV) model by adding the lagged value of dividends in the right-hand side of the equation (3.1).[12,13] The results for the LDV estimation are reported in Table 3.6 and 3.7. In both tables, we ob-

[11] Adam and Goyal (2008).

[12] Such models are often referred to as partial adjustment models.

[13] Lintner (1956) assumes that shareholders prefer steady dividend payments. Therefore, Lintner developed a model where the manager determines the level of dividend based on the deviation of past dividends from the optimal dividend level.

serve that the lagged dependent variable represents the main driver for determining both the current dividend level and the current dividend payout ratio. Estimates of the impact of the ACE subsidy remain negative and statistically significant when we consider the dividend payout ratio as dependent variable.

As evidenced by Nickell (1981) the limited availability of years determines bias in the LDV model, especially when we add firms fixed effects. Indeed, due to the demeaning operation, the lagged dependent variable cannot be independently distributed with respect to the error term. We employ a System Generalized Method of Moments (GMM) estimator to deal with this issue.[14] The results for the System-GMM estimation model are reported in Table 3.8. This estimator derives from a system of two simultaneous equations: one in levels with lagged first differences as instruments, and the other in first differences with lagged levels as instruments. Following Roodman (2009) advises, we employ small-sample adjustments, orthogonal deviations, and two-step robust standard errors.[15]

Arellano and Bond (1991)'s test is provided at the bottom of the table and it checks for serial correlation. If the model is well specified then we expect to not reject the null hypothesis of no autocorrelation of the second order (AR(2)). The tests support the model specifications. Moreover, the Table 3.8 presents the Hansen (1982) overidentification test (J statistic) for the validity of instruments, where under the null hypothesis the over-identifying restrictions are valid. The high p-values for both comparison groups suggest that the instruments are exogenous, therefore valid.

As a further robustness check, we focus on the likelihood to pay-

[14] See Blundell and Bond (1998).

[15] With small-sample adjustments t test statistic are applied instead of z test statistic for the coefficients, and F test instead of $Wald\ X^2$ test for the overall fit of the model. Moreover, we use the "forward orthogonal deviations" (Arellano and Bover, 1995) subtracting all future available observations of a variable instead of subtracting the previous observation from the contemporaneous one. Lastly, the estimation for the System-GMM estimator is performed with the two-step robust standard errors that provide Windmeijer (2005)'s finite-sample correction for the two-step covariance matrix.

out a dividend, accordingly we consider as dependent variable a binary variable that is equal to "1" if the company has paid a dividend during the year and zero vice versa. Here we briefly describe the variables employed in order to test the research hypotheses.

$$Logit(y_{it}) = \alpha + \beta_2 Italy_i + \beta_3 Post_t \otimes Italy_i + \mathbf{x_{it}}\boldsymbol{\beta} + \tau_t + \varepsilon_{it}. \tag{3.2}$$

Table 3.9 presents the estimates of the log odds for this specification model. The estimator for the DiD dummy is once again significantly different from zero and negative, therefore the ACE subsidy had a statistically significant impact on the likelihood of Italian firms of paying out a dividend.

Hence, we conclude that the ACE regime had a negative impact on the dividend payout ratio and more generally on the likelihood of paying a dividend. The evidences suggest that companies did not fully exploit the tax benefits provided by the ACE reform. The rigidity of the dividend policy of Italian companies is in line with previous evidences on the effectiveness of sunk costs deriving from a sudden omission of dividend payouts. Through a back-of-envelope calculations we provided a lower-bound of the agency and signaling cost the manager's decisions.

In the last section, we simulate the response of a manager to the introduction of a tax relief as the ACE regime using the estimated manager's preference parameters obtained from the estimation of the dynamic programming discrete choice model in the previous chapter. The objective is to simulate how the subsidy can reduce or eliminate the cost of varying the dividend policy.

Table 3.4: **Difference-in-Differences Analysis**

Empirical Model:	*Difference-in-Differences*			
Dependent Variable:	*Dividend Level*			
Comparison Country:	**France**		**Germany**	
Italy	24382.1* (13463.0)		41536.7** (16885.7)	
Post⊗Italy	-30056.9** (14985.6)	-28409.1** (12827.9)	-48115.9** (20810.7)	-23529.5* (12353.8)
Earnings	0.122*** (0.021)	0.170*** (0.013)	0.116*** (0.029)	0.128*** (0.034)
Current Liab.	-0.010*** (0.004)	0.016 (0.010)	-0.001 (0.005)	-0.014 (0.012)
Net Debt	-0.018* (0.009)	0.017 (0.013)	-0.009** (0.004)	0.001 (0.008)
Market Cap.	0.012*** (0.002)	0.003 (0.004)	0.016*** (0.002)	0.005* (0.003)
Net Assets	-0.181*** (0.040)	-0.093*** (0.030)	-0.186*** (0.057)	0.029 (0.020)
Equity	0.201*** (0.040)	0.088*** (0.023)	0.173*** (0.061)	0.006 (0.023)
Retained Earn.	-0.027** (0.013)	-0.011** (0.005)	0.003 (0.004)	-0.021*** (0.006)
OD	22900.6*** (5048.881)		4985.2 (4026.211)	
Age-Group 1	-2480.0 (7056.4)		35236.3*** (8307.0)	
Age-Group 2	-5857.9 (7929.9)		35080.3*** (8049.7)	
Age-Group 3	16045.3** (7076.6)		17946.3** (7808.0)	

Constant	4885.0	-16117.2	-17174.8	-10059.2
	(9720.9)	(26332.1)	(11007.4)	(15130.2)
Year	Yes	Yes	Yes	Yes
Industry	Yes	-	Yes	-
Firm Fixed Effects	-	Yes	-	Yes
No. of Obs.	1808	1808	2501	2501
R-Squared	91%	55%	91%	63%
F-Statistic	117.53***	362.41***	60.58***	194.04***
LR X^2	547.87***	144.23***	761.09***	111.51***

Note: The table reports the difference in differences estimates of the ACE subsidy. t statistics are reported in parentheses, and *, **, *** stand for significance at the 1%, 5%, and 10% levels respectively. The independent variables are one-year lagged. The models are tested with White's corrected heteroscedasticity robust regressions.

Table 3.5: **Difference-in-Differences Analysis**

Empirical Model:	*Difference-in-Differences*			
Dependent Var.:	*Dividend Payout Ratio*			
Comparison Country:	**France**		**Germany**	
Italy	0.016** (0.007)		0.018** (0.007)	
Post⊗Italy	-0.018** (0.007)	-0.017** (0.007)	-0.025*** (0.008)	-0.026*** (0.007)
ROA	0.001** (0.000)	0.000* (0.000)	0.000 (0.000)	-0.000 (0.000)
Ret. Vol.	-0.032*** (0.012)	0.005 (0.013)	-0.044*** (0.007)	-0.001 (0.005)
M.B. Ratio	0.006** (0.003)	0.004 (0.003)	0.000 (0.000)	0.000 (0.000)
Liq. Ratio	0.009 (0.010)	0.032* (0.018)	0.031*** (0.009)	0.024 (0.022)
Fixed Ass. Ratio	-0.000*** (0.000)	-0.000 (0.000)	-0.000*** (0.000)	-0.000 (0.000)
Debt Ratio	0.001* (0.000)	0.000 (0.000)	0.000* (0.000)	0.000 (0.000)
RE Ratio	0.009*** (0.002)	0.000 (0.005)	0.000*** (0.000)	0.000 (0.000)
Age-Group 1	-0.008** (0.004)		-0.010*** (0.004)	
Age-Group 2	-0.008* (0.004)		-0.000 (0.004)	
Age-Group 3	-0.010*** (0.003)		-0.005 (0.004)	
OD	0.015*** (0.002)		0.005 (0.003)	
Constant	0.024*** (0.007)	0.032*** (0.005)	0.023*** (0.006)	0.035*** (0.006)

Year	Yes	Yes	Yes	Yes
Industry	Yes	-	Yes	-
Firm Fixed Effects	-	Yes	-	Yes
No. of Obs.	1776	1776	2464	2464
R-Squared	9%	3%	6%	2%
F-Statistic	10.85***	4.06***	6.59***	2.52***

Note: The table reports the difference in differences estimates of the ACE subsidy. t statistics are reported in parentheses, and *, **, *** stand for significance at the 1%, 5%, and 10% levels respectively. The independent variables are one-year lagged. The models are tested with White's corrected heteroscedasticity robust regressions.

Table 3.6: **Difference-in-Differences with Lagged Dependent Variable**

Empirical Model:	*Difference-in-Differences*			
Dependent Variable:	*Dividend Level*			
Comparison Country:	**France**		**Germany**	
Italy	12334.9		6178.5	
	(12778.2)		(9951.1)	
Post⊗Italy	-20279.1	-25808.7**	-22305.1	-14389.2
	(12702.3)	(11775.0)	(14600.0)	(10693.1)
Earnings	0.064**	0.148***	0.025	0.083**
	(0.031)	(0.024)	(0.036)	(0.034)
Current Liab.	-0.003	0.012*	0.005*	-0.013
	(0.004)	(0.007)	(0.003)	(0.009)
Net Debt	-0.014	0.015	-0.003	-0.000
	(0.009)	(0.014)	(0.002)	(0.006)
Market Cap.	0.008***	0.002	0.008***	0.004**
	(0.003)	(0.004)	(0.003)	(0.002)
Net Assets	-0.123***	-0.088***	-0.052**	0.028*
	(0.039)	(0.024)	(0.023)	(0.015)
Equity	0.132***	0.088***	0.039*	-0.003
	(0.041)	(0.020)	(0.023)	(0.017)
Retained Earn.	-0.022*	-0.012**	-0.000	-0.021***
	(0.013)	(0.005)	(0.003)	(0.003)
OD	14501.9***		-484.4	
	(4673.2)		(1842.4)	
Age-Group 1	-3133.7		11763.5**	
	(6100.1)		(5861.0)	
Age-Group 2	-3957.5		8855.7	
	(5240.3)		(5500.2)	
Age-Group 3	6502.2		6524.2	

	(7249.7)		(4972.0)	
Lag. Div.	0.476***	0.166	0.729***	0.388***
	(0.144)	(0.223)	(0.105)	(0.067)
Constant	8001.2	-17221.1	7469.6	-212.7
	(7897.1)	(24309.5)	(6631.3)	(11386.4)
Year	Yes	Yes	Yes	Yes
Industry	Yes	-	Yes	-
Firm Fixed Effects	-	Yes	-	Yes
No. of Obs.	1808	1808	2501	2501
R-Squared	93%	57%	96%	69%
F-Statistic	335.99***	567.71***	283.20***	364.27***
LR X^2	547.87***	144.23***	761.09***	111.51***

Note: The table reports the difference in differences estimates of the ACE subsidy. t statistics are reported in parentheses, and *, **, *** stand for significance at the 1%, 5%, and 10% levels respectively. The independent variables are one-year lagged. The models are tested with White's corrected heteroscedasticity robust regressions.

Table 3.7: **Difference-in-Differences with Lagged Dependent Variable**

Empirical Model:	*Difference-in-Differences*			
Dependent Variable	*Dividend Payout Ratio*			
Comparison Country:	**France**		**Germany**	
Italy	0.009 (0.006)		-0.001 (0.005)	
Post⊗Italy	-0.015** (0.006)	-0.016*** (0.006)	-0.008 (0.005)	-0.018*** (0.005)
ROA	0.000 (0.000)	0.000* (0.000)	-0.000 (0.000)	-0.000 (0.000)
Ret. Vol.	-0.007 (0.013)	0.010 (0.015)	-0.004 (0.004)	0.003 (0.005)
M.B. Ratio	0.003 (0.002)	0.003 (0.003)	-0.000 (0.000)	0.000 (0.000)
Liq. Ratio	0.005 (0.010)	0.027 (0.018)	0.010* (0.006)	0.018 (0.019)
Fixed Ass. Ratio	-0.000 (0.000)	-0.000 (0.000)	-0.000** (0.000)	-0.000 (0.000)
Debt Ratio	0.000 (0.000)	0.000 (0.000)	0.000** (0.000)	0.000 (0.000)
RE Ratio	0.004*** (0.001)	-0.001 (0.004)	0.000*** (0.000)	0.000 (0.000)
Age-Group 1	-0.005 (0.004)		-0.003 (0.002)	
Age-Group 2	-0.003 (0.004)		0.000 (0.002)	
Age-Group 3	-0.007** (0.003)		-0.001 (0.002)	
OD	0.007***		0.002	

	(0.002)		(0.002)	
Lag. D.P.R.	0.519***	0.183**	0.801***	0.367***
	(0.127)	(0.074)	(0.051)	(0.088)
Constant	0.010	0.025***	0.008*	0.023***
	(0.007)	(0.007)	(0.004)	(0.006)
Year	Yes	Yes	Yes	Yes
Industry	Yes	-	Yes	-
Firm Fixed Effects	-	Yes	-	Yes
No. of Obs.	1776	1776	2460	2460
R-Squared	28%	6%	62%	13%
F-Statistic	22.47***	5.68***	31.36***	6.86***

Note: The table reports the difference in differences estimates of the ACE subsidy. t statistics are reported in parentheses, and *, **, *** stand for significance at the 1%, 5%, and 10% levels respectively. The independent variables are one-year lagged. The models are tested with White's corrected heteroscedasticity robust regressions.

Table 3.8: **Dynamic Panel Data Estimation**

Empirical Model:	*System-GMM*	
Dependent Var.:	*Dividend Payout Ratio*	
Comparison Country:	**France**	**Germany**
Italy	0.008 (0.006)	0.003 (0.006)
Post⊗Italy	-0.013** (0.005)	-0.012** (0.006)
ROA	0.000 (0.000)	0.000 (0.000)
Ret. Vol.	-0.019** (0.009)	-0.013 (0.010)
M.B. Ratio	0.003 (0.004)	-0.000 (0.000)
Liq. Ratio	0.004 (0.010)	0.012 (0.008)
Fixed Ass. Ratio	-0.000** (0.000)	-0.000 (0.000)
Debt Ratio	0.001* (0.000)	0.000 (0.000)
RE Ratio	0.009 (0.007)	-0.000 (0.000)
OD	0.007** (0.003)	0.002 (0.002)
Age-Group 1	-0.005 (0.004)	-0.004 (0.003)
Age-Group 2	-0.004 (0.005)	-0.000 (0.003)
Age-Group 3	-0.006 (0.005)	-0.001 (0.003)
Lag. D.P.R.	0.450*** (0.133)	0.630*** (0.162)

Constant	0.025**	0.024**
Year	Yes	Yes
Industry	Yes	Yes
No. of Obs.	1776	2460
F-Statistic	9.98	23.99
Arellano-Bond test		
for AR(1):	0.013	0.004
for AR(2):	0.118	0.596
Hansen overidentifying test		
	Prob > chi2 = 0.116	0.486
Number of instruments		
	29	29

Note: The table reports the estimates for the system-GMM model. t statistics are reported in parentheses, and *, **, *** stand for significance at the 1%, 5%, and 10% levels respectively. The models are tested with two-step robust standard errors.

Table 3.9: **Panel Logit Estimation**

Empirical Model:	*Panel Logit*	
Dependent Var.:	*Dividend Payout Ratio*	
Comparison Country:	**France**	**Germany**
Post	0.246 (0.387)	0.356 (0.280)
Post⊗Italy	-2.093*** (0.811)	-2.831*** (0.771)
ROA	0.098 (0.075)	0.309 (0.280)
Ret. Vol.	0.296 (0.648)	-0.321 (0.615)
M.B. Ratio	0.270 (0.413)	0.768*** (0.293)
Liq. Ratio	2.219* (1.322)	-0.321 (0.890)
Fixed Ass. Ratio	0.017 (0.036)	-0.040 (0.038)
Debt Ratio	-0.207 (0.178)	0.018 (0.050)
RE Ratio	1.011 (1.391)	1.634** (0.804)
Lag. D.	1.887*** (0.247)	1.553*** (0.181)
Fixed Effects	Yes	Yes
No. of Obs.	705	1027
LR chi2(15)	207.07***	187.94***

Note: The table reports the logit estimates with firms fixed effects. t statistics are reported in parentheses, and *, **, *** stand for significance at the 1%, 5%, and 10% levels respectively. The models are tested with two-step robust standard errors.

3.4 Counterfactual Analysis of Tax Relief

Policy forecasts very often require a "structural" approach that attempts to uncover the underlying preferences u, differently from the traditional "reduced-form" approach which can be viewed as uncovering the historical stochastic process for $\{d_t, x_t\}$. The issue related to reduced-form methods is that policy changes induce managers to re-optimize, yielding a new controlled stochastic process for $\{d_t, x_t\}$, generally different from the historical process of the previous policy regime.[16] The structural approach instead allows us to solve the dynamic programming problem under a new policy regime and to derive the predicted stochastic process for $\{d_t, x_t\}$.

We evaluate the impact of a policy change on the conditional probability to payout dividends consistent with the ACE tax relief .

First of all, we provide further evaluation of the DP model directly comparing the nonparametric estimates of the actual conditional choice probability $\hat{P}(d|x)$ to the nonparametric estimates of the simulated conditional choice probability $P(d|x, \hat{\theta})$. Given the discreteness of the state and control variables, the nonparametric estimate of $\hat{P}$ is simply the sample histogram of choices made by firms whose state is x. The conditional choice probability function $P(d|x, \hat{\theta})$ for the dynamic programming model is computed as frequency estimator from the simulated series of managers' choices. To simulate the manager choices and calculate the conditional choice probability, we implemented the same estimation procedure provided in Section 2.3.3.[17]

We calculate the expected utility at time t and the expected discounted utility net of $\varepsilon(d)$ for each choice d, earning level x, and for the state dependence deriving from the choice of the previous period. Then, using the method of successive approximations we compute the fixed points v of the Bellman operator Ψ (Equation 2.17), that converges linearly and globally to a specific tolerance

[16] See Marschak (1953) and Lucas (1976).

[17] Specifically, we estimate the parameters of the manager's utility function pooling the sample, thus not considering the ownership dispersion indicator.

level.[18]

Once computed the differences in the expected discounted utility for all $(x, d) \in X \times \{0, 1\}$, we simulate the dividend policy for N firms and T periods. We settle $N = 1,000$ for a time-horizon of ten years ($T = 10$). We consider homogeneous companies, therefore adding one more year is equivalent to adding one more firm for the estimation. Furthermore, we assume that dividend choices are independent of the company's investment policy and the dividend policies of other companies on the market.[19]

The observable state variable (x_t) is a stationary ergodic process, and we assume that the first-period dividend payout equals to zero: $d_0 = 0$. Hence, we draw the first period earnings (x_{i1}) from the stationary probability $P_k^{\infty} = lim_{t \to \infty} Pr(x_{it} = x)$.

Hence, we simulate N choices for the first period. Specifically, we randomly draw the values of $\varepsilon_{i1}(1)$ and $\varepsilon_{i1}(0)$ and compare them with the difference in the utilities $U(x_{i1}, 1)$ and $U(x_{i1}, 0)$. If $\Delta U(x_{i1}, 0) > -\Delta\epsilon_{i1}$ then we set $d_{i1} = 1$; otherwise, $d_{i1} = 0$. Then, N new values of x_{it} are simulated using the transition probability matrix Π. Therefore, we iteratively proceed adding new rows and ultimately forming the T x N matrix of earnings histories, and the T x N matrix of dividend policy histories.

Figure 3.2 compares the actual and simulated conditional choice probability for each cell in x. We observe that the DP model can replicate the dividend choice frequencies of the sample, providing further validation. Hence, we are confident in the validity of the model's predictions, so we proceed to exploit the features of the stochastic dynamic programming model.

We aim to investigate the sensitivity of the payout conditional probability to different levels of tax relief. Therefore, we add to the manager's utility function a tax relief (τ) on dividend payments. Equation (3.3) shows the new specification for the manager's utility function.

[18] We set the maximum tolerance level to $1 * 10^{-10}$.

[19] Thus, dividend policy of firm i is not affected by the dividend policy of firm j.

$$u(x_t, \varepsilon, d_t, \theta) = \begin{cases} -\theta_{01} y_t + \theta_{02} k_t + \theta_{03} \tau y_t + \varepsilon_t(0) & \text{if } d_t = 0 \\ -\frac{\theta_{11}}{y_t} + \theta_{12}(1 - k_t) - \theta_{13} \tau y_t + \varepsilon_t(1) & \text{if } d_t = 1 \end{cases} \tag{3.3}$$

Again, the dynamic programming problem and the associated likelihood function can be numerically computed in a subroutine of a standard nonlinear maximum likelihood algorithm. Recovering the new underlying utility function is useful for quantifying the extent to which the policy change hurts managers.

Table 3.10 provides the parameter estimates of equation (3.3). The first column shows the parameter estimates for the actual choices and states given by the data sample on French and German companies. Taking these estimates as starting values, we simulated the manager choices, and we estimated the parameters for the simulated data. The second column provides the estimation results. The third and the fourth columns provide the estimates of the parameters of the manager's utility function for levels of the tax relief of 3% and 5%, respectively.

Table 3.10 shows that the introduction of tax relief significantly reduces agency conflict and sunk costs, θ_{01} and θ_{02} respectively. Figure 3.3 shows the distribution of the conditional choice probability with respect to the tax relief τ, and for different earning levels. As in Section 2.3.2, the earnings are discretized in in intervals of the same length. In Figure 3.3 we consider only three earnings intervals, y. Specifically, we consider the lowest ($y = 1$), the middle ($y = 10$), and the highest ($y = 20$) intervals. Considering ten years period, the Figure shows that the implementation of tax relief policy significantly reduces the conditional probability of paying dividends, especially for those companies in the highest earnings interval. In fact, with a 4% tax relief, we see a six percentage point reduction in the conditional probability of paying dividends.

Table 3.10: Θ **Estimates**

	Actual Choices	Sim. with $\tau = 0$	Sim. with $\tau = 3\%$	Sim. with $\tau = 5\%$
θ_{01}	0.0720	0.0731	0.0700	0.0688
	(0.0024)	(0.0029)	(0.0019)	(0.0027)
θ_{02}	2.7880	2.8181	2.7281	2.6952
	(0.1016)	(0.0553)	(0.0531)	(0.0598)
θ_{11}	0.7870	0.8181	0.8120	0.8410
	(0.0615)	(0.0446)	(0.0485)	(0.0575)

Note: $\beta = 0.95$; $\theta_{03} = \theta_{13} = 1$; $\theta_{12} = 0$.
In all the estimations, the unobservable state variables $\varepsilon_{i,t}(d_{i,t})$ are kept constant for each firm i and time t.
Standard errors in parentheses.

Figure 3.2: Dividend Payout Conditional Probability - Actual vs Predicted

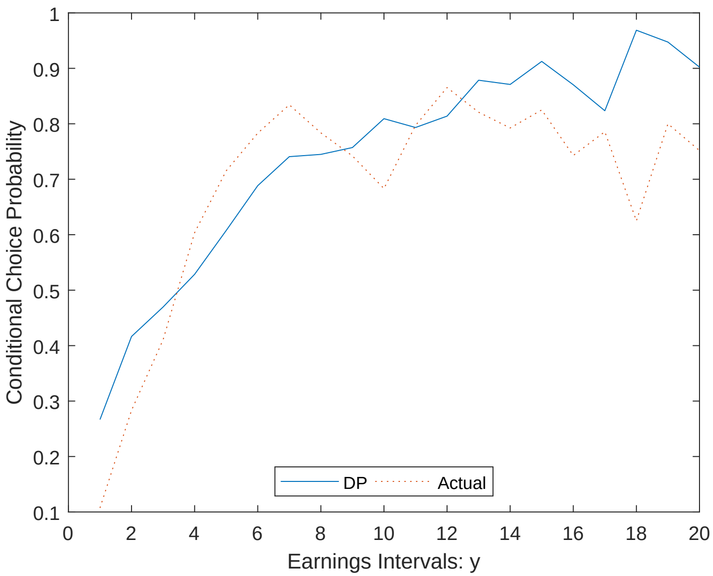
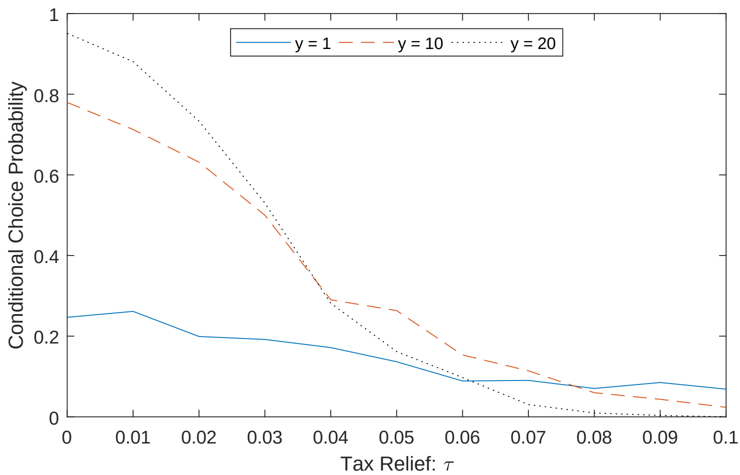


Figure 3.3: Simulation of the Conditional Choice Probability



Conclusion

This thesis starts reviewing the different theories on dividends and the empirical results in the literature. By following the dividend literature, we formulated a model to measure some of the regularities of the dividend payout policy, and to understand if company characteristics influence investors' preferences and therefore the decision to accumulate cash or pay shareholders. Specifically, we developed a discrete choice model where a rational, forward-looking manager chooses the optimal dividend payout policy to minimize the agency cost deriving from the manager-shareholders conflict. Moreover, we embodied the sunk cost fallacy within the manager's utility function, (Arkes and Blumer, 1985; Thaler, 1980). The definition and estimation of the sunk cost in dividend policy represent the novelty of this study. In particular, we estimated the discrete choice dynamic programming model through the nested fixed point algorithm proposed by Rust (1987). Our discrete choice model yields estimates consistent with existing empirical evidence; in particular, we observe that the ownership dispersion significantly affects the managers' dividend policy, (Eckbo and Verma, 1994; Jensen, Solberg, and Zorn, 1992).

Finally, we analyzed the allowances on corporate equity (ACE), a policy aimed at lowering the use of leverage by incentivizing the companies to retain earnings. Italy implemented this reform during the years 2011-2019. The reform has significantly impacted the dividend policy of Italian companies. However, we observed that Italian companies haven't fully exploited the tax relief because of the sunk cost of dividend policy changes.

Confident of the reliability of our dynamic discrete choice model, we implemented the effect of the ACE reform and measured the variation in the conditional probability of paying dividends for different levels of tax relief. We have estimated that the implementation of a tax relief of 4% for ten years results in an average decrease of 50% of the conditional probability of paying dividends.

Possible future developments of this work include the consideration of unobserved permanent state dependence and the endogenization of the managers' investment policy. The greater realism and sophistication of the model would reward the considerable computational complexity.

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