

# Behavioral Dividend Policy

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## 1. Introduction

Although dividend policy represents an intensely researched field of modern finance, it is still a challenge to financial economists to develop a framework of optimal dividend policy that is consistent with empirical observations. Especially two questions have almost remained unacknowledged. Due to the tax disadvantage of dividends, the question immediately comes up why firms distribute dividends at all.<sup>1</sup> In 1976 Black already defined this question as ‘dividend puzzle’ and nowadays Baker, Powell, and Veit (2002) show that it is still unsolved. Secondly, financial economists puzzle about the question why the nominal dividend per share fluctuates less than earnings per share for long time periods.<sup>2, 3</sup> Below, both questions are answered in a general setting with regard to a behavioral decision theory, i.e. ‘disappointment theory’<sup>4</sup>. Furthermore, Baker, Veit, and Powell (2001) empirically show past dividends and current earnings to be the most important factors influencing the current dividend decision.<sup>5</sup> We place this result on a firm theoretical footing.

The disappointment theory belongs to a research field of descriptive decision theories emerged at the end of the seventies. Such models are developed as a result of an increasing number of observations of anomalies in decision-making,<sup>6</sup> and are targeted on explaining actual behavior.<sup>7</sup> In particular, the economic theories, which are based on actual behavior, have to apply an accurate identified descriptive theory as the basis for modeling decisions. Thus, since the eighties a field of research arose in the range of capital market theory integrating certain anomalies of investors in existing literature with the objective to gain new insights, especially in terms of pricing. This field of investigation is meanwhile named ‘behavioral finance’.<sup>8</sup> By the involvement of investor anomalies, findings remain almost descriptive in the field of capital market theory; whereas in the area of corporate finance normative recommendations can even be given: in making financial decisions a (fully) rational management should be considerate of investor anomalies, and adjust its behavior to it to minimize welfare losses.

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<sup>1</sup> See Copeland and Weston (1988, p. 480), or Brealey and Myers (2000, pp. 455).

<sup>2</sup> See for an empirical observation Lintner (1956). For more recent evidence, see Baker and Powell (1999), Garrett and Priestley (2000) or Allen and Michaely (2001).

<sup>3</sup> Kumar (1988), Fudenberg and Tirole (1995) or Allen, Bernardo and Welch (2000) may also explain the smoothing of dividends, but their analysis is very complex in terms of signaling and based on restrictive assumptions. See furthermore Lease, John, Kalay, Loewenstein, and Sarig (1999), who review the existing literature about dividend policy and therewith theoretical attempts of solving the dividend puzzle.

<sup>4</sup> See Bell (1985) or Loomes and Sugden (1986), (1987) and, in addition, Zeelenberg, van Dijk, Manstead, and van der Pligt (2000) for an overview.

<sup>5</sup> See Lintner (1956) as well.

<sup>6</sup> See for a particularly prominent experiment of decisions against the expected utility theory Allais (1953).

<sup>7</sup> See for an overview of such new decision theories Weber and Camerer (1987).

<sup>8</sup> See for a collection of essays about behavioral finance for example Thaler (1993), and for a literature overview for instance Barberis and Thaler (2001).

Precisely, the following analysis is based on investors maximizing expected (modified) utility with a utility function according to Bell's (1985) disappointment theory. Pursuant to that theory, an investor will feel disappointment if his chosen option results in an outcome that is worse than expected. By anticipating these emotions the limited rational investor's utility of a risky alternative consists of a disappointment function in addition to the straight *von Neumann/Morgenstern* utility:<sup>9</sup> utility does not only depend on the consequence actually arrived, but also on the utility deviation from a reference point. On condition that the utility is higher than the reference point, an investor feels elation, otherwise disappointment.

Within the context of corporate dividend policy, we assume mental accounting of investors in a way that the stock price and the dividend of the evaluated stock are booked in separated mental accounts without the consideration of their mutual connection.<sup>10</sup> Such preference structures can express themselves as follows: if the reference point corresponds to the previously paid dividend, a dividend drop by one point will cause disappointment. Given an unchanged profitability, the stock price will increase by one point. With complete and perfect capital markets investors can swap that stock price growth for dividends by selling shares. Nevertheless, this transformation does not remove the loss in utility provoked by a dividend policy against investors' preferences, because emotions already arose. With limited rational investors, different kinds of payments are no longer perfect substitutes.

Even though, Thaler includes behavioral corporate finance on his wish list for further investigations in 1999, the following analysis is not the first trying to answer the above questions by involving limited rationality. Against the background of behavioral decision-making, Shefrin and Statman already deal with the question why corporations pay dividends at all.<sup>11</sup> At first, they argue dividends to be a mechanism of control for weak-willed investors, who tend to spend dividends for periodic consumption, and increases in stock quotation for retirement.<sup>12</sup> Furthermore, in case of mental accounting, dividend payments can result in a higher utility instead of share repurchases. Finally, different effects of regret can have an effect on the spending of funds.<sup>13</sup> All aspects may lead to a preference for dividends instead of capital ap-

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<sup>9</sup> See von Neumann and Morgenstern (1947).

<sup>10</sup> See Thaler (1985) for mental accounting as well as the further implementations in section 2.

<sup>11</sup> See Shefrin and Statman (1984) as well as DeBondt and Thaler (1995, p. 400).

<sup>12</sup> This idea bases on the theory of self-control by Thaler and Shefrin (1981).

<sup>13</sup> Like disappointment theory, regret theory – at the same time developed by Bell (1982) and Loomes and Sugden (1982) – includes emotions in the valuation of alternatives. However, emotions in regret theory appear due to a comparison of the arrived result with the result of other alternatives not being chosen.

preciation despite of the dividend tax disadvantage. Miller (1986) reviewed these approaches to be nice and interesting stories, but special and not formally founded. As the following approach is deduced from expected (modified) utility maximizing investors, here Miller's criticism is not suitable.

Concerning the smoothing of dividends, Lintner's model from 1956, which is meanwhile assigned to the field 'behavioral corporate finance', is up to now referred to.<sup>14, 15</sup> According to his survey, management decides about changes in dividends each period instead of the absolute dividend level. In addition, management aims at dividend smoothing in a way that the nominal dividend per share fluctuates less than net earnings per share. Though Lintner develops a model fitting his empirical observations, it is not based on managers maximizing firm profits nor investors maximizing utility. As Miller (1986, p. 467) says: "I assume it [Lintner's model] to be a behavioral model, not only from its form, but because no one has yet been able to derive it as the solution to a maximization problem, despite 30 years of trying it!" By maximizing expected utility of certain preference structures, which will lead to the optimality of stable dividends, the following approach is more fundamental on that score. Furthermore, empirical data supports the derived dividend policy.

The remainder of the paper is organized as follows: in section 2.1. the 'entrepreneurial' framework is concretized. Section 2.2. is concerned with the description of investor anomalies giving a rationale for the assumed utility function. From this, in section 2.3., optimal dividend policy in the presence of limited rational investors is deduced. Section 2.4. analyses dividend volatility over time. In section 2.5. the derived dividend policy is empirically tested. Section 2.6. contains discussion, and finally, section 3. concludes.

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<sup>14</sup> See Miller (1986), Thaler (1999) or Barberis and Thaler (2001) as well. Beyond, Benartzi, Michaely and Thaler (1997) regard Lintner's model as the best description of the choice of dividend policy available.

<sup>15</sup> Fama and Blacomin (1968) approve Lintner (1956).

## 2. The model

### 2.1. The 'entrepreneurial' framework

Consider a firm with an infinite time horizon where time is discrete with a set of dates indexed  $t$ . At each date  $t$ , the firm generates uncertain net earnings  $\tilde{x}_t$ , which are identically and independently distributed over time. The realization  $x_{tq}$  of the random variable  $\tilde{x}_t$  is determined by the state  $q \in \{1, \dots, J\}$  realized at date  $t$ . Thereby,  $x_{tj}$  is the minimum of all possible outcomes of  $\tilde{x}_t$  and  $x_{tj}$  is close to zero, but positive (i.e.  $x_{tj} > 0$ ,  $x_{tj} \rightarrow 0$ ) to guarantee that net earnings are not negative. Before state revelation, state  $q \in \{1, \dots, J\}$  occurs with probability  $p_q$ . Furthermore, we name the time-independent expected net earnings  $\bar{x} := \sum_{j=1}^J p_j \cdot x_{tj}$ .

At date  $t$  income is distributed in terms of a dividend payment  $D_t$  to the  $n_{t-1}$  stocks existing at the beginning of  $t$  whereby the dividend per share  $D_t/n_{t-1}$  is termed by  $d_t$ .<sup>16</sup> Management can enhance or cut distributable income by external financing on complete and perfect capital markets. Thus, distributable income at state  $q$  is defined by net earnings  $x_{tq}$  plus cash inflow generated by external financing and marked by  $F_{tq}$ . Formally, at each state  $q \in \{1, \dots, J\}$ , the corporate budget constraint is given by

$$x_{tq} + F_{tq} = D_{tq}. \quad (1)$$

Hence, the conditional equation of the dividend per share at date  $t$  and at state  $q$  directly results

$$d_{tq}(F_{tq}) = \frac{x_{tq} + F_{tq}}{n_{t-1}}. \quad (2)$$

As financial possibilities external equity financing by a variation of total shares outstanding  $n_{tq}$  and debt financing by raising funds  $B_{tq}$  at the risk-free rate  $i$  are available. Cash inflow using bonds  $F_{tq}^{(B)}(B_{tq})$  is embodied by the difference between the cash inflow  $B_{tq}$  by raising funds at date  $t$  and the cash outflow due to the repayment of debt financing done at date  $t-1$ :<sup>17</sup>

$$F_{tq}^{(B)}(B_{tq}) = B_{tq} - (1+i) \cdot B_{t-1}. \quad (3)$$

If the sign of  $B_{tq}$  is negative, there will be no raising of funds, but investment at the risk-free rate  $i$ . In case of external equity financing, the cash inflow  $F_{tq}^{(n)}(n_{tq})$  is given by multiplying

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<sup>16</sup> The number of stocks  $n_{t-1}$  entitled to dividend payments can no longer be influenced at date  $t$ .

<sup>17</sup> Liability is assumed to be unlimited.

the current stock price  $S_{tq}$  with the alteration of the number of total shares outstanding

$$n_{tq} - n_{t-1} :$$

$$F_{tq}^{(n)}(n_{tq}) = S_{tq} \cdot (n_{tq} - n_{t-1}). \quad (4)$$

In doing so, a positive sign of  $(n_{tq} - n_{t-1})$  denotes a capital increase; a negative sign characterizes a share repurchase. The stock price  $S_{tq}$  (ex dividend) is given by the ratio of the current equity value  $P_{tq}$  to the total number of shares outstanding  $n_{tq}$  at the end of date  $t$ :

$$S_{tq} = \frac{P_{tq}}{n_{tq}}. \quad (5)$$

The current value  $P_{tq}$ , in turn, equates the firm value  $\Phi_{tq}$  reduced by the amount of external debt financing  $B_{tq}$ :<sup>18, 19</sup>

$$P_{tq} = \Phi_{tq} - B_{tq}. \quad (6)$$

The firm value (ex dividend) is given by the sum of all expected future net earnings discounted by the cost of capital  $r := r' + i$ :<sup>20</sup>

$$\Phi_{tq} = \sum_{\lambda=1}^{\infty} \bar{x} \cdot \left( \frac{1}{1+r} \right)^{\lambda} = -\bar{x} + \bar{x} \cdot \frac{1}{1 - 1/(1+r)} = \frac{\bar{x}}{r} = \Phi. \quad (7)$$

The entire cash inflow is then given by

$$F_{tq} = F_{tq}^{(n)}(n_{tq}) + F_{tq}^{(B)}(B_{tq}) = P_{tq} \cdot (n_{tq} - n_{t-1}) / n_{tq} + B_{tq} - (1+i) \cdot B_{t-1}. \quad (8)$$

From equation (2) and with regard to the validity of  $\bar{x} + \Phi \stackrel{(7)}{=} (1+r) \cdot \Phi$ , at state  $q$  the dividend per share can be expressed by

$$\begin{aligned} d_{tq}(n_{tq}, B_{tq}) &= \frac{x_{tq}}{n_{t-1}} + \frac{P_{tq} \cdot (n_{tq} - n_{t-1})}{n_{tq} \cdot n_{t-1}} + \frac{B_{tq} - (1+i) \cdot B_{t-1}}{n_{t-1}} \\ &= \frac{(x_{tq} + \Phi) - (1+i) \cdot B_{t-1}}{n_{t-1}} - S_{tq}(n_{tq}, B_{tq}) \\ &=: S_{tq}^{(\text{cum})} - S_{tq}(n_{tq}, B_{tq}). \end{aligned} \quad (9)$$

Since  $[(x_{tq} + \Phi) - (1+i) \cdot B_{t-1}] / n_{t-1}$  just equals the stock price cum dividend  $S_{tq}^{(\text{cum})}$  at date  $t$ , the dividend is finally the difference between the stock price cum and ex dividend. Due to the

<sup>18</sup> The amount of external debt financing just equates the current value of debt.

<sup>19</sup> From  $P_{tq} \geq 0$  and the following equation (6),  $\Phi_{tq}$  serves as an upper limit for  $B_{tq}$ .

<sup>20</sup> The cost of capital  $r$  is given in such a way that the stock demand of limited rational investors is positive. Concerning the determination of such a cost of capital as well as an endogenous stock demand by limited rational investors we refer to further literature such as Shefrin and Statman (1994), because in the above approach these aspects are circumstantial.

fact that management cannot influence its current stock price cum dividend, because the investment program is already fixed and thus given, it can only choose the split-up of the stock price cum dividend between stock price and dividend via debt issues as well as equity issues. In this context, the current dividend level is not influenced by the particular kind of financing, so that the actual choice between debt and equity is irrelevant in accordance with Modigliani and Miller (1958). To simplify the model, we abstract from the concrete financing decision and assume pure debt financing (i.e.  $n_t = n_{t-1} =: n$  for all  $t$ ).<sup>21</sup>

Wealth  $v_{tq}$  at state  $q$  generated by holding one share for one period can be expressed by the sum of the dividend per share plus the stock price at date  $t$  minus the opportunity cost of holding that share. The latter is calculated by the stock price at date  $t-1$  added by accrued interest, because the share was bought at that price and funds could be invested risk-freely on the capital market. Thus, wealth  $v_{tq}$  is given by

$$v_{tq} = d_{tq} + S_{tq} - (1+i) \cdot S_{t-1} \stackrel{(9)}{=} S_{tq}^{(\text{cum})} - (1+i) \cdot S_{t-1}. \quad (10)$$

## 2.2. Investors' anomalies and the objective function of management

Rational investors evaluate wealth  $v_{tq}$  from equation (11) by a von Neumann and Morgenstern utility function  $U(v_{tq})$ . The value of this utility is not affected by current dividend policy or otherwise financial policy. Altogether, in this approach the conclusion of Miller and Modigliani (1961) is still valid with regard to only rational investors: a firm's dividend policy does not affect its value nor the utility of investors. With regard to empirical observations about dividend policy, we now attempt to reply to the two questions asked at the beginning of the paper. For that reason, the impact of limited rational investors to dividend policy is analyzed. And afterwards, the optimality of dividend smoothing is verified in the presence of investors with anomalies.

Henceforth, we assume  $\hat{n} > 0$  limited rational investors, each of them holding one share for one period, to exist besides  $n - \hat{n}$  rational investors.<sup>22</sup> As rational investors regard dividend policy as irrelevant, there is no conflict of aims between rational and limited rational investors concerning dividend policy. Therefore, management can completely align dividend policy

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<sup>21</sup> A formal proof is available by the authors.

<sup>22</sup> Rational investors could be taken by institutional investors, and limited rational investors by individual investors.

with the preferences of limited rational investors. To simplify, we assume all existing limited rational investors to have the same preferences. Moreover, the number of shares  $\hat{n}$  held by them is assumed to be exogenous, so that management maximizes investors' welfare by optimizing utility of one representative limited rational investor.

In the following, investor anomalies are specified. In accordance with Lintner (1956) as well as with Kahneman and Tversky (1979), we assume limited rational investors to evaluate dividend growth and stock price appreciation instead of the absolute level of wealth.<sup>23</sup> Regarding to Thaler (1985), we further assume investors to administer mental accounts for the dividend and stock price growth of the evaluated stock, which is expressed by two disjoint, separated utility functions  $U_t^{(m,d)}$  and  $U_t^{(m,S)}$ . Therefore, dividend and stock price growth is separately evaluated ignoring mutual connections. Beyond, we abut on disappointment theory by Bell (1986). Thus, investors evaluate dividend and stock price growth with a utility function modified by disappointment instead of a conventional von Neumann and Morgenstern utility function. This modified utility does not only depend on actual dividend and stock price growth, but also on the expectation about the corresponding growth.

The modified, separated utility functions are concretely given by the sum of the von Neumann and Morgenstern utility  $U(\cdot)$  over dividend, respectively stock price growth, and the felt emotions. The disappointment function  $U^{(D,d)}$  of the dividend account depends on the difference of the actual dividend growth  $(1 + \delta_{tq}) = d_{tq} / d_{t-1}$  evaluated by the utility function  $U^{(d)}(\cdot)$  and a reference point. As in Loomes and Sugden (1986) this reference point is the expectation of the assessed value. In this context, it is the dividend growth  $(1 + \delta_t^{(R)})$  expected before realization of state, which is given by<sup>24</sup>

$$1 + \delta_t^{(R)} = 1 + E(\tilde{\delta}_t) = 1 + \sum_{j=1}^J p_j \cdot \delta_{tj} . \quad (11)$$

Also corresponding to Loomes and Sugden (1986), the disappointment function is strictly monotonic increasing [i.e.  $U^{(D,d)'(\cdot)} > 0$ ], so that the degree of emotion rises with increasing distance from the reference point. But, as opposed to Loomes and Sugden (1986), we do not

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<sup>23</sup> Lintner (1956) investigated that management does not determine the absolute level of dividends, but rather dividend changes. As management decides in investors' interest, we assume the above mentioned. In addition, this assumption corresponds to the observation that investors evaluate changes in wealth rather than final states. See hereunto Kahneman and Tversky (1979).

<sup>24</sup>  $E(\cdot)$  denotes the expectation operator.

assume a function being symmetric to the origin, but a concave function with  $U^{(D,d)''}(\cdot) < 0$ . This assumption accords c. p. to the empirical observation that investors stronger evaluate unexpected changes in dividend payments than in stock prices.<sup>25, 26</sup>

The stock price disappointment function  $U^{(D,S)}$  satisfies the above conditions as well and the stock price growth rate  $\kappa_{tq}$  is given by:

$$\kappa_{tq} = \frac{S_{tq}}{S_{t-1}} - 1 \stackrel{(9)}{=} \frac{S_{tq}^{(cum)}}{S_{t-1}} - 1 - (1 + \delta_{tq}) \cdot \frac{d_{t-1}}{S_{t-1}}, \quad (12)$$

where  $S_{tq}^{(cum)} / S_{t-1} - 1$  is the firm's return  $r_{tq}$  and  $d_{t-1} / S_{t-1}$  the dividend yield at date  $t-1$ . Consequently, the expected growth rate  $E(\tilde{\kappa}_t)$  is

$$E(\tilde{\kappa}_t) = \sum_{j=1}^J p_j \cdot r_{tj} - \left( 1 + \sum_{j=1}^J p_j \cdot \delta_{tj} \right) \cdot \frac{d_{t-1}}{S_{t-1}} = \mu - \left( 1 + \sum_{j=1}^J p_j \cdot \delta_{tj} \right) \cdot \frac{d_{t-1}}{S_{t-1}}. \quad (13)$$

with  $\mu := \sum_{j=1}^J p_j \cdot r_j$ .<sup>27</sup> In addition, we assume the following relation between stock price and dividend disappointment function

$$U^{(D,S)}(g) = (1/h) \cdot U^{(D,d)}(h \cdot g) \quad \text{with } h > 0. \quad (14)$$

The parameter  $h$  characterizes the different degree of 'absolute disappointment aversion' felt by the investor in the dividend and stock price account. This is analogous to the Arrow/Pratt measure of absolute risk aversion.<sup>28</sup> According to the latter, the measure of absolute disappointment aversion for dividends can be expressed by  $R_A^{(d)}(g) = -U^{(D,d)''}(g) / U^{(D,d)'}(g)$ , and the measure of absolute disappointment aversion for the stock price by  $R_A^{(S)}(g) = -U^{(D,S)''}(g) / U^{(D,S)'}(g) = h \cdot R_A^{(d)}(h \cdot g)$ . Particularly,  $h$  equates the ratio of  $R_A^{(S)}(0) / R_A^{(d)}(0)$ , i.e. the ratio of disappointment aversion in case of neither elation nor disappointment. In the special case of constant absolute dividend disappointment aversion, i.e.  $U^{(D,d)}(g) = -\exp(-a^{(d)} \cdot g)$ , we can further generalize the parameter  $h$ , because the absolute stock price disappointment aversion is then also constant [ $h = a^{(S)} / a^{(d)}$ ]. Thus, in that special scenario,  $h$  describes the ratio of the measured values of absolute stock price and dividend aversion independently of the concrete stock price and dividend value  $g$ .

<sup>25</sup> Aharony and Swary (1980) show that markets positively react to dividend enhancements and strongly negatively to dividend decreases. See also Kao and Wu (1994) or Benartzi, Michaely and Thaler (1997).

<sup>26</sup> See Anderson and Sullivan (1993) as well as Inman, Dyer and Jia (1997) who show that, ex post, disappointment has a larger impact on utility than elation.

<sup>27</sup> Since net earnings are i.i.d., returns are i.i.d. as well.

<sup>28</sup> See for the Arrow/Pratt measure Arrow (1971) and Pratt (1964).

Corresponding to the modified utility by Loomes and Sugden (1986), the modified separated utility functions for dividend and stock price are given by<sup>29</sup>

$$U_t^{(m,d)}(1+\delta_{tq}) = U^{(d)}(1+\delta_{tq}) + U^{(D,d)}[U^{(d)}(1+\delta_{tq}) - (1+\delta_t^{(R)})] \quad \text{and} \quad (15)$$

$$U_t^{(m,S)}(1+\kappa_{tq}) = U^{(S)}(1+\kappa_{tq}) + U^{(D,S)}[U^{(S)}(1+\kappa_{tq}) - (1+\kappa_t^{(R)})] \quad (16)$$

at date  $t$  and at state  $q$ .

The total modified utility  $U_t^{(m)}$  is composed by the weighted sum of modified dividend and stock price utility. The weights are given by the ratio of the corresponding previous values and the last stock price cum dividend. This leads to

$$\hat{U}_t^{(m)} = \frac{d_{t-1}}{S_{t-1}^{(\text{cum})}} \cdot U_t^{(m,d)}(1+\delta_{tq}) + \frac{S_{t-1}}{S_{t-1}^{(\text{cum})}} \cdot U_t^{(m,S)}(1+\kappa_{tq}). \quad (17)$$

For simplification of the later derivations,  $\hat{U}_t^{(m)}$  is positively and linearly transformed as follows<sup>30</sup>

$$U_t^{(m)} = (d_{t-1} + S_{t-1}) \cdot \hat{U}_t^{(m)} = d_{t-1} \cdot U_t^{(m,d)}(1+\delta_{tq}) + S_{t-1} \cdot U_t^{(m,S)}(1+\kappa_{tq}). \quad (18)$$

### 2.3. Optimal dividend policy in the case of limited rational investors

In the following, we assume the von Neumann and Morgenstern utility for the stock price and the dividend to be linear.<sup>31</sup> This is not synonymous to risk neutral investors, because in the present context, risk is measured in terms of disappointment.<sup>32</sup> It directly follows from (18) at state  $q$  and with  $U^{(i)}(g) = g$  for  $i = d, S$  as well as  $U^{(D)}(\cdot) := U^{(D,d)}(\cdot)$  and in consideration of (11) to (16)

$$\begin{aligned} U_{tq}^{(m)} &= d_{tq} + S_{tq} + d_{t-1} \cdot U^{(D)}[\delta_{tq} - E(\tilde{\delta}_t)] + \frac{S_{t-1}}{h} \cdot U^{(D)}[h \cdot (\kappa_{tq} - E(\tilde{\kappa}_t))] \\ &\stackrel{(9),(12),(13)}{=} S_{tq}^{(\text{cum})} + d_{t-1} \cdot U^{(D)} \left[ \delta_{tq} - \sum_{j=1}^J p_j \cdot \delta_{tj} \right] \\ &\quad + \frac{S_{t-1}}{h} \cdot U^{(D)} \left[ h \cdot \left( (r_{tq} - \mu) - \left( \delta_{tq} - \sum_{j=1}^J p_j \cdot \delta_{tj} \right) \cdot \frac{d_{t-1}}{S_{t-1}} \right) \right]. \end{aligned} \quad (19)$$

<sup>29</sup> However, Loomes and Sugden (1986) do not consider mental accounts, nor do they apply disappointment theory to corporate finance.

<sup>30</sup> Such a transformation has no impact on the ranking of alternatives.

<sup>31</sup> Bell (1985) and Loomes and Sugden (1986) also assume a linear von Neumann and Morgenstern utility function.

<sup>32</sup> See for similar considerations Jia and Dyer (1996).

Choosing the dividend growth rate  $\delta_{tq}$  management's objective is to maximize the modified utility of a representative investor. In doing so, management only influences the disappointment extend; the first part of equation (19) (i.e. the current stock price cum dividend) will remain constant. At each date  $t$ , the subsequent  $J$  simultaneous optimization problems follow

$$U_{tq}^{(m)} \rightarrow \max_{\delta_{tq}} ! \quad \text{for all } q \in \{1, \dots, J\} \quad (20)$$

subject to a positive stock price as well as a positive dividend:<sup>33</sup>

$$0 < d_{tq} < S_{tq}^{(\text{cum})} \Leftrightarrow -1 < \delta_{tq} < (1 + r_{tq}) \cdot \frac{S_{t-1}}{d_{t-1}} - 1 \quad \text{for all } q \in \{1, \dots, J\}. \quad (21)$$

While in Loomes and Sudgen (1986) only lotteries are evaluated, in this approach investor's modified utility is affected by an actual decision besides a random variable: via dividend policy, management has the possibility to minimize totally felt disappointment at each state  $q \in \{1, \dots, J\}$ , because the state is revealed before the choice of dividend policy, but after investors built expectations about the state and the concrete dividend policy. Insofar, this model is an extension of disappointment theory.

At state  $q$  the optimal dividend growth rate results from maximization problem (20), (21). Thus<sup>34</sup>

$$\delta_{tq}^* = \delta_{tJ}^* + \frac{h}{(1 + h \cdot d_{t-1} / S_{t-1})} \cdot (r_{tq} - r_{tJ}) \quad \text{with}^{35} \quad (22)$$

$$-1 < \delta_{tJ}^* < (1 + r_{tJ}) \cdot \frac{S_{t-1}}{d_{t-1}} - 1. \quad (23)$$

The optimal dividend growth rate  $\delta_{tq}^*$  at state  $q$  equates the growth rate  $\delta_{tJ}^*$  chosen at the worst state, plus a fraction of return enhancement between the current and the worst state. Consequentially, in this approach earnings as well as past dividends are crucial determinants of any change in dividends as Lintner (1956) and more recently Baker, Veit, and Powell (2001) empirically observed.<sup>36</sup> Calculating  $(\kappa_{tq} - \kappa_{tJ})$  from equation (12) and replacing  $(\delta_{tq}^* - \delta_{tJ}^*)$  with  $h \cdot (r_{tq} - r_{tJ}) / (1 + h \cdot d_{t-1} / S_{t-1})$  in accordance to (22) leads to the optimal stock price growth rate at state  $q \in \{1, \dots, J-1\}$

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<sup>33</sup> A zero dividend or stock price would lead to zero dividends and stock prices in all subsequent periods, because the parameters to choose are growth rates. Therefore positive instead of 'non-negative' values are required.

<sup>34</sup> See for proof Appendix 1.

<sup>35</sup> If the inequalities (23) hold, the border conditions (21) will also hold at each other state  $q \in \{1, \dots, J-1\}$ . See for proof Appendix 2.

<sup>36</sup> See also Pruitt and Gitman (1991).

$$\kappa_{tq}^* = \kappa_{tj}^* + r_{tq} - r_{tj} - (\delta_{tq}^* - \delta_{tj}^*) \cdot \frac{d_{t-1}}{S_{t-1}} = \kappa_{tj}^* + \frac{1}{(1 + h \cdot d_{t-1}/S_{t-1})} \cdot (r_{tq} - r_{tj}). \quad (24)$$

Again, the optimal growth rate equates the sum of the optimal growth rate at the worst state plus a fraction of return enhancement between the current and the worst state. The lower  $h$  the more does the stock price participate c. p. in changes in returns. Furthermore, as dividends are spent for current consumption, but stock price enhancements serve for retirement savings,<sup>37</sup> a more pronounced dividend than stock price disappointment aversion (and thus  $h \leq 1$ ) is plausible. Over the long run, risk becomes less important, and therefore, chances for stock price enhancement take center stage.

At state  $q$ , given an optimal dividend policy as indicated by (22), the utility of a representative limited rational investor can be shown as<sup>38</sup>

$$U_{tq}^{(m)*} = S_{tq}^{(cum)} + \frac{(S_{t-1} + h \cdot d_{t-1})}{h} \cdot U^{(D)} \left( \frac{h \cdot S_{t-1}}{(S_{t-1} + h \cdot d_{t-1})} \cdot (r_{tq} - \mu) \right). \quad (25)$$

Instead, stocks without dividend payments lead to a lower utility amounting to

$$\check{U}_{tq}^{(m)} = S_{tq}^{(cum)} + \frac{S_{t-1}}{h} \cdot U^{(D)} (h \cdot (r_{tq} - \mu)). \quad (26)$$

So, the first question can already be answered: dividend payments are optimal; and stocks without dividend payments result in welfare losses. Thus, the inclusion of disappointment and mental accounts can solve Black's dividend puzzle, i.e. why firms distribute dividends at all.<sup>39</sup> In the following, we deal with the second question: the puzzle of dividend smoothing.

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<sup>37</sup> See Shefrin and Statman (1984).

<sup>38</sup> To obtain (25) substitute  $\delta_{tq}^*$  according to (22) and insert the result in (19).

<sup>39</sup> Introducing taxes in the above framework, dividend payments will still be favored, if welfare losses due to limited rationality are higher than losses due to taxes.

#### 2.4. Dividend volatility over time

To solve the remaining second puzzle, we need a measure to quantify fluctuations of dividends. Therefore, we use the variance of the dividend growth rate given an optimal dividend policy. This variance can be expressed by<sup>40</sup>

$$\text{var}(\tilde{\delta}_t) = \text{var}(\tilde{x}_t) \cdot \mathbb{E} \left( \frac{1}{((\tilde{S}_{t-1}/h + \tilde{d}_{t-1}) \cdot n)^2} \right). \quad (27)$$

Provided that  $h \leq 1$ ,<sup>41</sup> the following particularly holds<sup>42</sup>

$$\text{var}(\tilde{\delta}_t) < \text{var}(\tilde{\varphi}_t), \quad (28)$$

with  $\varphi_{tq} := (x_{tq} - x_{t-1})/x_{t-1}$  as the net earnings' growth rate at state  $q$ . Hence, it is shown that the variance of the dividend growth rate is less than that of net earnings per existing shares. Therefore, the consideration of investor anomalies within the dividend decision leads besides the relevance of dividends to the optimality of stable dividends. Especially, this result is independent from the concrete choice of  $\delta_d^*$ .

#### 2.5. Empirical results

Now, we would like to empirically verify the above-derived dividend policy regarding the US-American stock market. For that purpose, we used S&P 500-stock prices, -dividends, and -net earnings for the period 1960-2001.<sup>43</sup> We set  $\delta_j^* \cong -0.0321$  and  $r_j \cong -0.2590$ , because these values were the lowest during the considered period of time. With  $h = 0.23$  we assume the investors to be much more (disappointment-) averse in the dividend account which agrees on *Lintner's* (1956) observations. Figure 1 shows the co-movement in cumulative and predicted dividends. It illustrates that the actual and predicted dividend series are much smoother than the earnings series which is also supported by the estimated variances of the growth rates.<sup>44</sup> With  $\text{var}(\tilde{\varphi}_t) = 1.98\%$  the earnings growth rate is much more volatile than that of the (actual) dividend growth rate which amounts to  $\text{var}(\tilde{\delta}_t) = 0.26\%$ . The growth rate of the predicted dividend is even smoother with a variance of 0.13 %.

<sup>40</sup> See for proof Appendix 3.

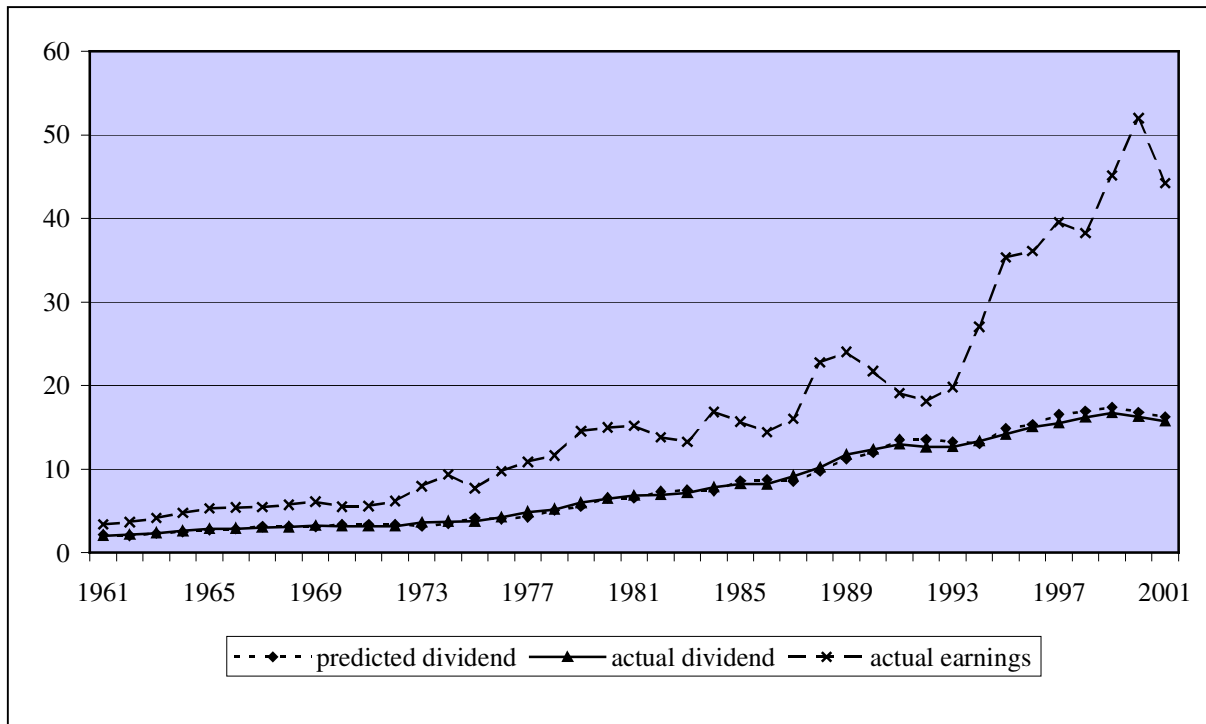
<sup>41</sup> See for a rationale section 2.3.

<sup>42</sup> See Appendix 3.

<sup>43</sup> The data is based on "Value Line Database", "Morningstar" and "Compustat". It is available at [http://pages.stern.nyu.edu/~adamodar/New\\_Home\\_Page/home.htm](http://pages.stern.nyu.edu/~adamodar/New_Home_Page/home.htm).

<sup>44</sup> A linear regression leads to the equation  $d_t$  (actual) = 0.26 + 0.95 ·  $\hat{d}_t$  (predicted) with  $R^2 = 99.4\%$ .

Figure 1: S&P 500-dividends and -earnings and predicted dividends,1961-2001



Thus, the consideration of emotions like disappointment and elation leads to a dividend policy which reproduces the path of the actually observed dividend payments.

## 2.6. Discussion

The presented model points out the possibility of gaining new insights by integrating limited rationality in corporate finance. Moreover, empirical observations can theoretically be described and explained. Concretely, we deduced why firms pay and smooth dividends and briefly showed that this dividend policy is supported by empirical data. For the derivation of an optimal dividend policy, we basically made three plausible assumptions about how limited rational investors evaluate dividends and stock prices. Firstly, investors are assumed to evaluate changes in instead of final wealth. Secondly, we assume that investors mentally divide dividends and stock prices. And thirdly, investors are assumed to feel and anticipate disappointment and elation in evaluating dividends and stock prices.

The presented approach is just a partial view, because the pricing on capital markets is deliberately neglected to keep it simple. Therefore, it remains ambiguous how the cost of capital  $r$  is determined in a way that both limited and fully rational investors hold shares. An explicit analysis of equilibrium has certainly to be developed, and will lead to interesting effects of

back coupling between dividend policy and firm valuation. However, the partial view already results in important and new insights.

Also, the assumption of the solely debt financing for dividend purposes barely does justice to the empirically observed endless diversity of financial instruments. Nevertheless, the irrelevancy of financial policy tracing back to Modigliani and Miller (1958) still holds. Only dividend policy becomes relevant whereby especially the form of payout (dividends versus capital gains) matters. In particular, the results will not change by equity financing as already shown by equation (9).

### 3. Concluding remarks

Recently, evidence about anomalies in individuals' decisions and evaluations is mainly integrated in the field of capital market theory for purposes of pricing. Even if the conclusions on this field are interesting, these approaches just serve to describe market behavior. However, the consideration of limited rationality in connection with corporate finance, which rarely is done, can even result in concrete recommendations for management – in this context about optimal dividend policy. Insofar, we wish to encourage further research in the area of 'behavioral corporate finance'.

## Appendix

### Appendix 1: Derivation of the optimal dividend growth rate

Under consideration of equation (19) we get the following necessary and sufficient conditions

$$\begin{aligned}
0 &= \frac{\partial U_{tq}^{(m)}}{\partial \delta_{tq}} = d_{t-1} \cdot U^{(D)} \cdot \left[ \delta_{tq} - \sum_{j=1}^J p_j \cdot \delta_{tj} \right] \cdot (1 - p_q) \\
&+ S_{t-1} \cdot U^{(D)} \cdot \left( h \cdot \left( (r_{tq} - \mu) - \left( \delta_{tq} - \sum_{j=1}^J p_j \cdot \delta_{tj} \right) \cdot \frac{d_{t-1}}{S_{t-1}} \right) \right) \cdot \frac{d_{t-1} \cdot (p_q - 1)}{S_{t-1}} \\
\stackrel{\substack{\Leftrightarrow \\ U^{(D)} > 0 \\ p_q < 1}}{\Leftrightarrow} & \delta_{tq} - \sum_{j=1}^J p_j \cdot \delta_{tj} = h \cdot \left( (r_{tq} - \mu) - \left( \delta_{tq} - \sum_{j=1}^J p_j \cdot \delta_{tj} \right) \cdot \frac{d_{t-1}}{S_{t-1}} \right) \tag{A1} \\
\Leftrightarrow & \delta_{tq} - \sum_{j=1}^J p_j \cdot \delta_{tj} = \frac{h}{(1 + h \cdot d_{t-1} / S_{t-1})} \cdot (r_{tq} - \mu) \\
&= \frac{h}{(S_{t-1} + h \cdot d_{t-1})} \cdot (S_{tq}^{(cum)} - E(\tilde{S}_t^{(cum)})) \text{ for all } q \in \{1, \dots, J\}.
\end{aligned}$$

In the following, the actual optimal dividend policy is deduced whereby the optimum's fulfillment of the border constraints (21) is proved in Appendix 2. Due to  $p_J = 1 - \sum_{j=1}^{J-1} p_j$  and

with  $h/(1+h \cdot d_{t-1}/S_{t-1}) =: c$  equation (A1) can be rewritten as

$$\sum_{j=1}^{J-1} p_j \cdot (\delta_{tj} - \delta_{tJ}) - (\delta_{tq} - \delta_{tJ}) = -c \cdot (r_{tq} - \mu) \quad \text{for all } q \in \{1, \dots, J-1\}. \quad (\text{A2})$$

Defining

$$\Delta := \begin{pmatrix} \delta_{t1} - \delta_{tJ} \\ \vdots \\ \delta_{tJ-1} - \delta_{tJ} \end{pmatrix}, \quad P := \begin{pmatrix} p_1 - 1 & \cdots & p_{J-1} \\ \vdots & \ddots & \vdots \\ p_1 & \cdots & p_{J-1} - 1 \end{pmatrix}, \quad R := \begin{pmatrix} r_{t1} - \mu \\ \vdots \\ r_{tJ-1} - \mu \end{pmatrix},$$

then, (A2) is equivalent to

$$P \cdot \Delta = -c \cdot R \Leftrightarrow \Delta = -c \cdot P^{-1} \cdot R. \quad (\text{A3})$$

$P^{-1}$  is given as<sup>45</sup>

$$P^{-1} = \begin{pmatrix} \pi_{11} & \cdots & \pi_{1J-1} \\ \vdots & \ddots & \vdots \\ \pi_{J-11} & \cdots & \pi_{J-1J-1} \end{pmatrix} \quad \text{with } \pi_{jj} = -p_j / p_J - 1 \text{ and } \pi_{qj} = -p_j / p_J \text{ for } j \neq q. \quad (\text{A4})$$

It results from (A3) in consideration of (A4) for all  $q \in \{1, \dots, J-1\}$

$$\begin{aligned} \delta_{tq}^* &= \delta_{tJ}^* - c \cdot \sum_{j=1}^{J-1} \pi_{qj} \cdot (r_{tj} - \mu) = \delta_{tJ}^* + c \cdot \left( \frac{1}{p_J} \cdot \sum_{j=1}^{J-1} p_j \cdot (r_{tj} - \mu) + (r_{tq} - \mu) \right) \\ &= \delta_{tJ}^* + c \cdot (r_{tq} - r_{tJ}) = \delta_{tJ}^* + \frac{h \cdot (r_{tq} - r_{tJ})}{(1+h \cdot d_{t-1}/S_{t-1})}, \end{aligned} \quad (\text{A5})$$

whereby  $\delta_{tJ}^*$  is given, and has to satisfy the following constraint

$$-1 < \delta_{tJ}^* < (1+r_{tJ}) \cdot \frac{S_{t-1}}{d_{t-1}} - 1. \quad (\text{A6})$$

## Appendix 2: Proof that the border conditions are fulfilled

If the postulated border condition  $-1 < \delta_{tq}^* < (1+r_{tq}) \cdot S_{t-1}/d_{t-1} - 1$  is fulfilled for  $q = J$ , the 'remaining' (locally) optimal dividend policy will fulfill the border conditions, too, and thus will be globally optimal as shown in the following

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<sup>45</sup> It is easy to show that  $P \cdot P^{-1} = P^{-1} \cdot P = I$ , whereby  $I$  is the identity matrix.

$$\begin{aligned}
\delta_{tq}^* &= \underbrace{\delta_{tj}^*}_{>-1} + \frac{h}{(1+h \cdot d_{t-1}/S_{t-1})} \cdot \underbrace{(r_{tq} - r_{tj})}_{\geq 0} > -1, \\
\delta_{tq}^* &\stackrel{(A5)}{=} \underbrace{\delta_{tj}^*}_{\frac{(1+r_{tj}) \cdot S_{t-1} - d_{t-1}}{d_{t-1}}} + \frac{h}{(1+h \cdot d_{t-1}/S_{t-1})} \cdot (r_{tq} - r_{tj}) \\
&< \frac{S_{tj}^{(cum)} - d_{t-1}}{d_{t-1}} + \frac{h}{\underbrace{(S_{t-1} + h \cdot d_{t-1})}_{<1/d_{t-1}}} \cdot (S_{tq}^{(cum)} - S_{tj}^{(cum)}) < \frac{(1+r_{tq}) \cdot S_{t-1} - d_{t-1}}{d_{t-1}}.
\end{aligned} \tag{A7}$$

### Appendix 3: Volatility

With  $S_{tq}^{(cum)} - E(\tilde{S}_t^{(cum)}) = (x_{tq} - \bar{x})/n$  it immediately results from (A1) as an optimal variance of dividend growth rate<sup>46</sup>

$$\begin{aligned}
\text{var}(\tilde{\delta}_t) &= \text{var}(\tilde{\delta}_t - E(\tilde{\delta}_t)) \stackrel{(A1)}{=} \text{var}\left(\frac{h \cdot (\tilde{x}_t - \bar{x})}{(\tilde{S}_{t-1} + h \cdot \tilde{d}_{t-1}) \cdot n}\right) \\
&= \text{var}\left(\mathbb{E}\left(\frac{h \cdot (\tilde{x}_t - \bar{x})}{(\tilde{S}_{t-1} + h \cdot \tilde{d}_{t-1}) \cdot n} \middle| \tilde{S}_{t-1}, \tilde{d}_{t-1}\right)\right) + \mathbb{E}\left(\text{var}\left(\frac{h \cdot (\tilde{x}_t - \bar{x})}{(\tilde{S}_{t-1} + h \cdot \tilde{d}_{t-1}) \cdot n} \middle| \tilde{S}_{t-1}, \tilde{d}_{t-1}\right)\right) \\
&= 0 + \text{var}(\tilde{x}_t) \cdot \mathbb{E}\left(\frac{1}{((\tilde{S}_{t-1}/h + \tilde{d}_{t-1}) \cdot n)^2}\right).
\end{aligned} \tag{A8}$$

It follows as the variance of the net earnings' growth rate  $\varphi_t$ <sup>47</sup>

$$\begin{aligned}
\text{var}(\tilde{\varphi}_t) &= \text{var}\left(\frac{\tilde{x}_t}{\tilde{x}_{t-1}} - 1\right) = \text{var}\left(\frac{\tilde{x}_t}{\tilde{x}_{t-1}}\right) \\
&= \text{var}\left(\mathbb{E}\left(\frac{\tilde{x}_t}{\tilde{x}_{t-1}} \middle| \tilde{x}_{t-1}\right)\right) + \mathbb{E}\left(\text{var}\left(\frac{\tilde{x}_t}{\tilde{x}_{t-1}} \middle| \tilde{x}_{t-1}\right)\right) \\
&= \text{var}\left(\frac{\bar{x}}{\tilde{x}_{t-1}}\right) + \text{var}(\tilde{x}_t) \cdot \mathbb{E}\left(\frac{1}{\tilde{x}_{t-1}^2}\right).
\end{aligned} \tag{A9}$$

The volatility of net earning's growth rate will be higher than that of dividend growth rate, if

<sup>46</sup> With regard to the second transformation see Rohatgi (1976, p. 170). According to him,  $\text{var}(\tilde{X}) = \text{var}(E(\tilde{X} | \tilde{Y})) + E(\text{var}(\tilde{X} | \tilde{Y}))$  holds for two random variables  $\tilde{X}$  and  $\tilde{Y}$ . Concerning equation (A8), we concretely set  $\tilde{X} := (\tilde{x}_t - \bar{x})/((\tilde{S}_{t-1}/h + \tilde{d}_{t-1}) \cdot n)$  and  $\tilde{Y} := (\tilde{S}_{t-1}, \tilde{d}_{t-1})$ .

<sup>47</sup> See the latter footnote and set  $\tilde{X} := \tilde{x}_t/\tilde{x}_{t-1}$  and  $\tilde{Y} := \tilde{x}_{t-1}$ .

$$\begin{aligned}
\text{var}(\tilde{\Phi}_t) - \text{var}(\tilde{\delta}_t) &\stackrel{(A8),(A9)}{=} \text{var}\left(\frac{\bar{x}}{\tilde{x}_{t-1}}\right) + \text{var}(\tilde{x}_t) \cdot \mathbb{E}\left(\frac{1}{\tilde{x}_{t-1}^2} - \frac{1}{((\tilde{S}_{t-1}/h + \tilde{d}_{t-1}) \cdot n)^2}\right) \\
&= \text{var}\left(\frac{\bar{x}}{\tilde{x}_{t-1}}\right) + \text{var}(\tilde{x}_t) \cdot \mathbb{E}\left(\frac{((\tilde{S}_{t-1}/h + \tilde{d}_{t-1}) \cdot n)^2 - \tilde{x}_{t-1}^2}{\tilde{x}_{t-1}^2 \cdot ((\tilde{S}_{t-1}/h + \tilde{d}_{t-1}) \cdot n)^2}\right) \\
&= \text{var}\left(\frac{\bar{x}}{\tilde{x}_{t-1}}\right) + \text{var}(\tilde{x}_t) \cdot \mathbb{E}\left(\frac{(\tilde{P}_{t-1}/h + F_{t-1} + \tilde{x}_{t-1})^2 - \tilde{x}_{t-1}^2}{\tilde{x}_{t-1}^2 \cdot (\tilde{P}_{t-1}/h + \tilde{D}_{t-1})^2}\right) \\
&= \text{var}\left(\frac{\bar{x}}{\tilde{x}_{t-1}}\right) + \text{var}(\tilde{x}_t) \cdot \mathbb{E}\left(\frac{(\tilde{P}_{t-1}/h + F_{t-1})^2 + 2 \cdot \tilde{x}_{t-1} \cdot (\tilde{P}_{t-1}/h + F_{t-1})}{\tilde{x}_{t-1}^2 \cdot (\tilde{P}_{t-1}/h + \tilde{D}_{t-1})^2}\right) > 0.
\end{aligned} \tag{A10}$$

The latter statement will hold, if  $0 \leq P_{t-1}/h + F_{t-1}$  for all  $t$ . This immediately results since

$$0 < D_{tj} \stackrel{(21)}{=} x_{tj} + F_{tj} \stackrel{(1)}{\rightarrow} F_{tj} \stackrel{(x_{tj} \rightarrow 0)}{\Rightarrow} F_{tj} > 0, \tag{A11}$$

$P_{tj} > 0$  and consequently

$$\begin{aligned}
0 < P_{tj} + F_{tj} &\stackrel{(3),(6)}{=} \Phi - (1+i) \cdot B_{t-1} \stackrel{(3),(6)}{=} P_{tq} + F_{tq} \\
&\leq_{h \leq 1} P_{tq}/h + F_{tq} \quad \text{for all } q \in \{1, \dots, J\} \text{ and all } t.
\end{aligned} \tag{A12}$$

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