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CAPITAL STRUCTURE AND INFLATION UNCERTAINTY: EVIDENCE FROM A POOLED SAMPLE OF DUTCH FIRMS

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Abstract:
This research extends the literature on the macroeconomic determinants of capital structure. In particular, I study the relationship between inflation uncertainty and firm's debt-to-equity ratio according to debt maturities, which to the best of my knowledge, previous papers have neglected. I also examine if inflation uncertainty interacts with firm's tangibility in lowering leverage. Using the pooled sample of listed Dutch firms in Euronext Amsterdam, the OLS panel data regressions show that inflation uncertainty has a strong negative relationship with firm's long-term leverage, after controlling for market-to-book ratio, tangibility, interest rate, and size. However, this finding only robust for large firms. Moreover, no evidence of the interaction between inflation uncertainty and firm's tangibility in influencing firm's leverage.

I. Introduction

Theories about capital structure determinants have been mostly developed around firm-specific factors. Titman and Wessels (1988) argue that firm's choice of financing is related to firm characteristics. These characteristics are, among others, asset structure, growth, size, operating income volatility, profitability, industry classification, non-debt tax shields, operating leverage, and uniqueness of firm's business line. Harris and Raviv (1991) later provided the survey for the literature.

Another firm-specific characteristic that is found to be related to firm's capital structure choice is business risk. There is a disagreement regarding the sign of the effect of this variable on the optimal debt level, which may be due to different measures business risk. Castanias (1983) uses tax shelter-bankruptcy cost to measure business risk and finds that ex-ante default costs are large enough to induce firms to hold an optimal mix of debt and equity. Meaning, there is roughly positive relationship between bankruptcy costs and optimal debt level, which contradicts static tradeoff theory. Carleton and Silberman (1977) use variance of return on assets as proxy for business risk and find negative effect on debt levels. This is due to variance of return increases cost of capital, hence reduces firm's leverage level. Conversely, Bradley, Jarell, and Kim (1984) find that operating income volatility lowers the use of debt as it increases uncertainty in tax shields. Long and Malitz (1985) use firms' unlevered beta as a measure of business risk and find an inverse relationship between beta and financial leverage. On the other hand, Ferri and Jones (1979), Flath and Knoeber (1980), and Titman and Wessels (1988) conclude that there is no significant relationship between business risk and debt levels.

While most of the papers discussed about the relationship between firm's capital structure and certain firm characteristics, one curiosity arises: is there a relationship between firm's debt levels with external factors, e.g. macroeconomic factors? Several studies have shown the evidence that firm's debt ratio is also affected by macroeconomic variables. Levy (2001) argues that firms prefer debt financing when equity market is bearish. Levy and Korajczyk (2003) conclude that leverage level varies counter-cyclically with macroeconomic conditions. Baker and Wurgler (2002) claim market timing plays an important role in equity issues decisions. These findings suggest that both macroeconomic conditions and firm-specific factors are found to be important to firm's capital structure choice

One of macroeconomic factors that are important in determining leverage is inflation. Financial economists agree that inflation is a social ill that imposes welfare costs. Even at its anticipated level, inflation can cause distortions in the distribution of income and wealth. The interesting part is that historical data shows inflation is rather unanticipated, suggesting that inflation is also rather uncertain. Chen and Boness (1975) pointed out that uncertain inflation leads to higher cost of capital and less investments. Hatzinikolaou, Katsimbris, and Noulas (2002) mention that inflation uncertainty increases business risk. This leads to tax shields become more uncertain, hence, the benefit of using debt is lowered.

Study regarding the relationship between inflation uncertainty and firm's debt-to-equity ratio by Hatzinikolaou, Katsimbris, and Noulas (2002) has provided some notable insights. Departing from their conclusion, this reseach specifically observe the interaction between time-varying inflation uncertainty with firm-specific characteristics in affecting firm's capital structure. Specifically, I will examine the interaction between inflation uncertainty and firm's tangibility level. Analysis from previous literature concludes that inflation uncertainty increases business risk, which refers to more volatile earnings, results in more uncertain tax shields. Thus, lowers the benefits of using debt. Interestingly, previous literature also mentions that, ceteris paribus, the use of fixed assets, and therefore the use of fixed operating costs can magnify volatility of earnings (operating leverage effect), and therefore reduce debt level. Another view argues that firms should increase fixed assets because these assets can be used as collateral (collateralization effect). It is a provoking thought to corroborate if inflation uncertainty interacts with firm's tangibility in affecting capital structure.

Previous discussions lead to key research questions: how does inflation uncertainty affect firms leverage level? Which debt (based on its maturities) is more influenced by inflation uncertainty? And, what effect does the interaction of firm's tangibility and inflation uncertainty have toward firm's debt levels, i.e, whether it strengthens "operating leverage effect" or creates "collateralization effect"? Answering these questions is the primary objective of this research. In addition, similar studies are still need to be extended.

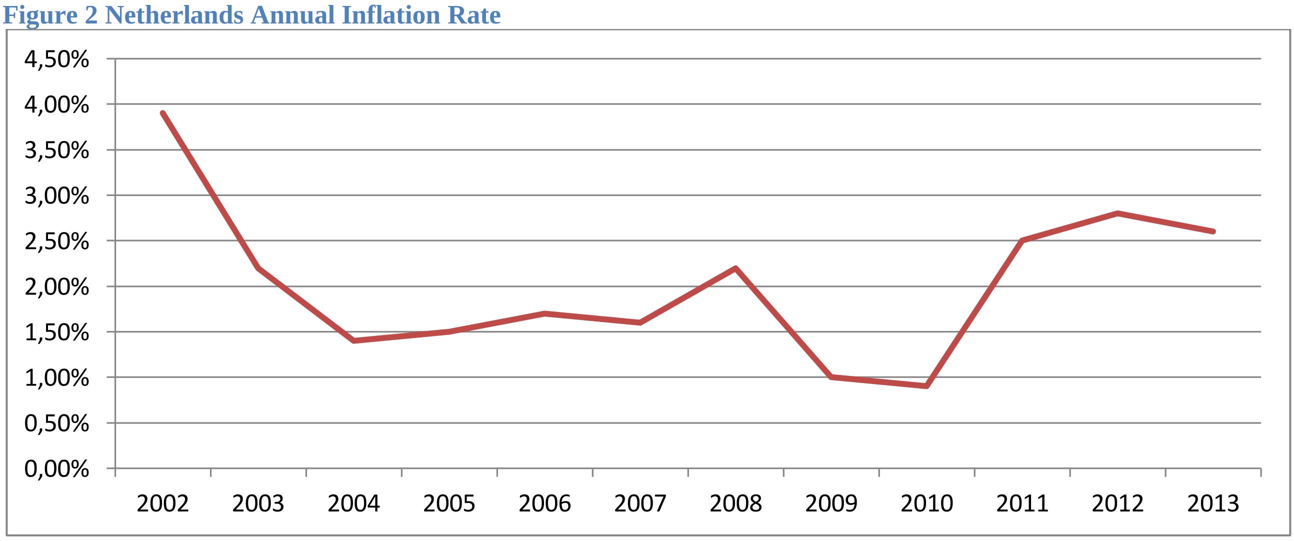
The purpose of this research is to fill in the gap within the existing literature regarding relationship between inflation uncertainty and firm's capital structure. Moreover, studies about capital structure have been mostly focused on American firms. To be distinctive, this research will focus primarily to analyze the relationship between inflation uncertainty and capital structure in a European setting.

Netherlands is chosen to be the new country setting for this research. This is due to the country, as well as other European countries, was known to have a relatively stable macroeconomic conditions. However, latest financial crisis in 2008 changed the situation. Data from Eurostat (Figure 1) illustrates that inflation rate in the Euro Area peaked at 4% and in the early 2010 it reached the lowest point of deflation since 2000. Compared to relatively stable pre-crisis period, post crisis inflation tends to become more uncertain in the Euro area. Figure 2 shows the annual inflation trend in Netherlands. Similar to the Euro area, pre-2008 period was relatively stable. Then again, post-2008 exhibits relatively unstable trend. Although the movement is still in the narrow range (1%-3%), this exemplifies period of heightened inflation uncertainty. To the extent that at firm level it makes earnings become more volatile and therefore reduces the usage of debt, it is interesting to observe the relationship between inflation uncertainty and capital structure exists within Dutch firms. It is also appealing to examine which effect (operating leverage or collateralization) emerges at firm level in the case of interaction between tangibility and inflation uncertainty.

Figure 1 Inflation Rate in the Euro Area

Source: www.tradingeconomics.com | Eurostat

Figure 2 Netherlands Annual Inflation Rate



Data source: Eurostat.

Result shows that inflation uncertainty has no significant relationship with total debt-to-equity ratio and short-term debt-to-equiy ratio. However, it exerts strong negative relationship with long-term debt-to-equity ratio controlling for firm's tangibility, nominal long-term interest rate, market-to-book ratio, size, and firm dummies. Nonetheless, no conclusion is found regarding the interaction of tangibility and inflation uncertainty in affecting firm's capital structure decisions.

This research continues in Section II, which consists of literature review. Section III discusses the research design, methodology used as well as data and sample selection. Hypotheses will also be developed in this section. Section IV provides analysis of the results and findings. Finally, Section V will discuss the conclusion as well as limitations and recommendations for similar research in the future.

II. Literature Review

a. The Big Picture about Capital Structure Theories

In their seminal paper about corporate finance, Modigliani and Miller (1958) state that under the absence of taxes and other market imperfections, firm's capital structure choice is irrelevant. This is because of future cash flows generated by firm for its debt and equity is unaffected by its debt-equity mix, which therefore, will have no effect on the total firm value. In addition, under the world without taxes and market imperfections, the required rate of return of levered firm is equal to the required rate of return of the unlevered firm (assuming no leverage) added by difference between required rate of return of the unlevered firm and cost of debt multiplied by firm's debt-to-equity ratio. These are explained by below propositions.

Proposition I

$V_L = V_U$

where:

V_L: value of firm composed from mixed of debt and equity (levered firm)

V_U: value of firm composed only of equity (unlevered firm)

Proposition II

$r_E = r_o + \frac{D}{E}(r_o - r_D)$

where:

r_E: required rate of return of levered equity

r_o: unlevered cost of capital

r_D: cost of debt

$\frac{D}{E}$: debt-to-equity ratio

From both propositions, the higher use of debt leads to higher required return on equity as there is a risk of the use of debt beared by equity holders. Again, these propositions are true under the following assumptions: no transaction cost, and individuals and corporations borrow at the same rate.

However, this premise does not apply in the real world since interest expense from the use of debt is tax-deductible. The propositions under world with taxes are:

Proposition I

$V_L = V_U + T_C D$

Proposition II

$r_E = r_o + \frac{D}{E}(r_o - r_D)(1 - T_c)$

The term T_C is the corporate tax rate and the terms $T_C D$ is present value of tax shields from the use of debt, assuming debt level is perpetual. This means that in the world with taxes, there is an advantage of using more debt. Value of the levered firm will be increased by the value of tax shields, which is value of tax savings created from the use of debt. Concluding, these propositions suggest firm to use more debt to maximize its value.

Since Modigliani and Miller (1958), theories about capital structure started to develop and have been a central topic in corporate finance. Some important developments are discussed below:

1. *Static Trade-off Theory*

   As aforementioned, firm should use debt as much as it can to gain the benefit from tax shields. However, this notion is criticized because the higher the use of debt, the higher the costs of financial distress. Financial distress refers to the costs of bankruptcy, reorganization, and agency costs arise when the firm's creditworthiness is in doubt. In his study about capital structure, Myers (1984) mentions that firm will borrow up to the point where the marginal value of tax shields on additional debt is offset by the increase in the present value of possible costs of financial distress.

   If this theory is right, a value-maximizing firm should never pass up the benefits of interest tax shields when probability of financial distress is low. Yet, there are many profitable companies with low debt ratios, including Microsoft and major pharmaceutical companies. Moreover, studies of determinant of actual debt ratios consistently find that the most profitable companies in a given industry tend to borrow less. High profits mean low debt, and vice versa.

   Myers (1984) has different explanation about this. He suggested that if managers can exploit valuable interest tax shields, as this theory predicts, one is able to observe the opposite relation. High profitability means that the firm has more taxable income to be shielded, and firm can have more debt without risking financial distress.

   In a more recent study regarding capital structure choice, Shivdasani and Zenner (2005) mention that costs of financial distress is typically harder to quantify. However, it is known that these costs relate directly to a firm's investment strategy and the importance of long-term contracting in its business model. They states that in some sectors where high rating is critical to winning customers, the costs of financial distress are material. They also mention some insights of tradeoff theory:

- Large and stable profits firms should, all else equal, make greater use of debt to obtain benefit of interest tax shields, because interest tax shields are more certain when the earnings are stable.
- Firms with non-interest tax shields do not benefit as much from debt and should therefore use less of it.
- Firms with high costs of financial distress (illiquid assets, emphasis on long-term contracting) should use less debt.
- There is a positive correlation between effective marginal tax rate and the leverage ratio.
- Firms in countries where equity financing is not double-taxed, or where equity receives some credits for corporate tax paid or taxed at lower personal tax rate, should have lower debt level.

2. *Pecking Order Theory*

In their paper regarding corporate financing and investment decisions, Myers and Majluf (1984) analyze that firm has two kinds of assets in its left side of balance sheet: assets in place and growth opportunities. Both require additional financing. They assumed perfect financial markets, except that investors do not know the true value of either assets in place or growth opportunities. Assume that firm will issue new stocks to finance its investment, it will be a good news for investors if the investment reveals a growth opportunities with positive net present value. Assume that managers act in the interest of the existing shareholders, they will issue new overvalued stocks to finance this investment. The price of these overvalued stocks will drop eventually, causing wealth transfer from new investors to the existing shareholders (if stocks is issued at undervalued price, the wealth transfer will go the other way). This is a result of information asymmetry between investors – who do not have information about value of firm's assets in place and growth opportunities – and managers.

Now suppose that firm can either issue debt or equity to finance new investment. Debt is the prior claim on assets and earnings while equity is the residual claim. Debt investors are therefore more protected from errors in valuing the firm than equity investors. This, in turn, will reduce information asymmetry between investors and managers. Therefore, if firm decides to issue debt, the impact of stock price drop is smaller than if the it issues an equity. This view suggests that managers will choose to issue debt than equity. Equity issues will only occur if debt is costly – that is, for example, when the firm that already has high level of debt where managers and investors concern about costs of financial distress.

This leads to the pecking order theory of capital structure:

1) Firms prefer internal financing to external financing. (Information asymmetry is likely to occur from external financing)
2) If external financing is required, firms will issue the safest security first, that is, debt before equity. If firm generates excess cash internally, this will be used to pay down debt rather than repurchase equity. As the requirement for external financing increases, the firm will issue safe to riskier debt, then go for hybrid securities (convertible bonds or preferred stock) and finally to equity as a last resort.
3) Dividends are "sticky", meaning that dividend cuts are not used to finance capital expenditure, and so that changes in cash requirements are not soaked up in short run dividend changes. Meaning, changes in net cash show changes in external financing.
4) Firm's debt ratio reflects its cumulative requirement for external financing.

Furthermore, Myers and Majluf (1984) suggest that managers who maximize firm's market value will avoid external equity financing if they have better information than outside investors and investors are rational. Pecking order theory also explains why more profitable firms borrow less, because they have more internal financing available. Less profitable firms have more external financing, and consequently accumulate debt.

The more recent study by Shivdasani and Zenner (2005) involved the explanation that profitable firms that generate more than enough cash flows to meet their investment needs, there is no obvious reason to raise capital. Pecking order places a premium value on retaining financial flexibility (more specifically, on minimizing the odds that the firm will have to raise costly equity financing). In this case, the pecking order fails to consider any possible costs related to having too much flexibility. Financial flexibility can be seen as "real options" in capital markets that would enable firm to finance valuable projects with external debt when firm does not have enough cash flow and reluctant to raise equity capital. Financial flexibility is value creating if:

- Firm intends to use its flexibility and willing to exercise call option – hence, willing to sacrifice its rating to take on debt
- Firms undertakes positive projects or investments that generates return on capital in excess of the cost of capital
- New growth possibilities are unpredictable and larger compared to what can be purchased from internal cash flow

Financial flexibility is value reducing if the abovementioned conditions are not met.

3. *Agency Costs Theory*

Since Berle and Means (1932), research about corporate governance has been stressing about the importance of separation of ownership and control in public corporations. Jensen and Meckling (1976) argue that agency costs are inevitable in corporate finance. Managers and agents will act for their own interests and will seek higher-than-market salaries, perquisites, job security, and in extreme cases, they also want to capture assets or cash flows directly. Shleifer and Vishny (1989) argue that managers and agents favor "entrenching investments" which adapt the firm's assets and operations to the managers' skills and knowledge, increase their bargaining power against shareholders. Shareholders can discourage such actions by various mechanisms of corporate governance and control, including supervision by independent directors and threat of takeover. Yet, these mechanisms are costly. In addition, Myers (1984) mentions that the interest of managers and shareholders can be aligned by design of compensation packages.

The use of debt can also reduce agency costs. Firms that use debt in their financing can enforce discipline and focus their work toward meeting sufficient cash flow to pay their obligation to debtholders. In relevance to static tradeoff theory, however, bankruptcy costs for the use of debt will also cause agency costs to arise. This time, it is a conflict between debtholders and shareholders. Hillier, Grinblatt, and Titman (2008) mention that there are four types of agency costs which are relevant to this conflict:

1) *Asset substitution.* If firm has large portion of debt compared to equity in its balance sheet, managers will undertake more risky projects even when they have negative NPV. This is because if the project is successful, shareholders will get all the benefits, whereas it is unsuccessful, debt holders will bear all the loss. There is a chance of decreasing in firm value and wealth transfer from bondholders to shareholders if these projects are undertaken.
2) *Debt overhang (underinvestment problem)*. If debt is risky (for example, in growth company), all gains from taking a project will go to debtholders' pocket rather than shareholders. Thus, managers have incentive to pass up positive NPV projects, although they can increase firm value.
3) *Investment myopia*. Firms with debt may favor short-term projects with lower NPV because this allows them to transfer resources from bondholders to shareholders.
4) *Reluctance to liquidate projects*. Shareholders might reluctant to liquidate projects as long as liquidation costs is higher than the benefit they might get if they projects are liquidated, e.g. wealth transfer from debtholders to shareholders. Shareholders, in this case, favor to continue the projects although they do not have positive NPV.

These agency costs can be mitigated by:

1) Impose protective covenants to debtholders to enforce discipline to managers and shareholders.
2) Closely held debt (private placements/banks) or short term debt for mititgating debt overhang.
3) Security design (convertible debt, project financing) to align incentives between debtholders and shareholders
4) Managerial compensation design, to align managers' incentives with shareholders.

b. The Importance of External Conditions and Inflation Uncertainty to Capital Structure Decisions

Since the seminal paper of Modigliani and Miller (1958), studies about determinants of capital structure have been evolved around firm-specific factors. In one major study about how a firm chooses its capital structure, Titman and Wessels (1988) find that firm's debt levels are related to the "uniqueness" of a firm's line of business. Other firm's characteristics that are important to firm's financing decision, among others, are asset structure, growth, size, operating income volatility, profitability, industry classification, non-debt tax shields and operating leverage.

Several other studies have shown that firm's capital structure is related to macroeconomic variables. Levy and Korajczyk (2003) showed that leverage level of financially unconstrained firms varies counter-cyclically with macroeconomic conditions. Levy (2001) studied that firms prefer debt financing when the equity market returns are low. Levy and Hennessy (2007) find that firms substitute debt for equity in order to maintain managerial equity shares during contractions. While during expansion, equity is substituted again for debt to for risk sharing purpose. Cook and Tang (2010) conclude that under good macroeconomic conditions, firms adjust their target leverage faster relative to bad macroeconomic conditions, regardless whether or not firms are subject to financial constraints.

Another relevant issue in firm's financing decision is market timing, which is said to be the behavioral finance part of capital structure theories. Empirical evidence suggests that the prediction of share price performance is important for equity issue decisions.[1] Additionally, in their research regarding market timing and capital structure, Baker and Wurgler (2002) claim that low-leverage firms tend to raise equity financing when their valuations are high, and conversely high-leverage firms tend to issue equity when their valuations are low. They also find that fluctuations in market valuations have large effects on capital structure that persist for at least a decade. They believe that the most realistic explanation is that capital structure is largely the cumulative outcome of past attempts to time the equity market. No optimal capital structure in this case, therefore market timing

[1] See Rajan and Zingales (1995)

financing decisions just accumulate over time into the capital structure outcome. These results are hard to understand within traditional capital structure theories. Furthermore, in a more recent research by Mahajan and Tartaroglu (2007), as claimed by its proponents, leverage is negatively related to firms' historical market-to-book ratio. Even so, they find that this negative relationship is not due to equity market timing, but close to tradeoff theory. They argue that the impact of equity market timing attempts on leverage is short-lived because most firms rebalance their capital structure in response to temporary shocks such as equity market timing attempts. This reveals that market timing is costly and firms need adjust their capital structure to its optimum level after considering these costs, which supports tradeoff theory rather than market timing hypothesis.

With regards to the effect of inflation uncertainty to firms' capital structure, Chen and Boness (1975) find that uncertain inflation affects cost of capital of a specific project, hence firm's investments decisions. Hatzinikolaou, Katsimbris, and Noulas (2002) mention that even at its anticipated level, inflation can cause distortions in distribution of income and wealth. Moreover, historical data suggest that inflation is rather unanticipated than anticipated. This had caused more welfare costs as it reduces efficiency of market system, which in turn, will cause misallocation of economic resources. Using the pooled sample of Dow Jones industrial firms from 1978-1997, they found that inflation uncertainty and expected long-term real interest rate are negatively related with firms' debt-to-equity ratio.

Additionally, Hatzinikolaou, Katsimbris, and Noulas (2002) mention inflation uncertainty makes corporate tax shields becoming more uncertain. The higher the operating income volatility leads to the higher probability of losing tax shields benefit. Therefore, inflation uncertainty will reduce debt-to-equity ratio and causes a loss of value to the firm's stockholders due to the loss of tax benefit associated with the use of debt.

Still in the same paper, Hatzinikolaou, Katsimbris, and Noulas (2002) pointed out that inflation uncertainty also causes more uncertain expected cash flows from investments project. Additionally, inflation uncertainty will increase cost of capital related to market risk premium, which therefore results in projects will be discounted at higher discount rates. This leads to less investment projects undertaken by firm, thus lowered the growth of the firm. In addition, inflation uncertainty also reduces the number of investment projects financed by debt. Inflation uncertainty may also reduce the number of capital investments projects that firm undertakes as it increases interest rate uncertainty. Higher inflation uncertainty increases interest rate uncertainty. Additional risk premium may be added to cost of debt to compensate this risk. As a consequence, cost of debt will also be higher, therefore reduces debt issued by firms.

Previous explanations leads to one notion: higher inflation uncertainty cause firm to use less debt. However, it is important to find out interaction between inflation uncertainty and firm-specific factors that affect debt levels. In relevance to Titman and Wessels (1988) study regarding capital structure determinants, inflation uncertainty has the same effect with firm’s operating leverage from the use of fixed assets toward leverage levels. Hatzinikolaou, Katsimbris, and Noulas (2002) mention that inflation uncertainty increases uncertainty in firm’s sales volume and cost structure, thus, increases volatility in operating income. This leads in more volatile cash flows and leads to higher insovency risk. It is important for a firm to maintain financial flexibility and preserve its unused debt capacity for the future in the case of such uncertainty. Therefore, in an environment with high inflation uncertainty, a firm with high business risk needs to raise funds for capital investments may choose to issue new equity rather than debt.

Similarly, firm’s tangibility, ceteris paribus, increases operating leverage. This also leads to more volatile earnings and thus, results in lower debt levels. Operating leverage view argues that in a highly inflationary environment with heightened inflation uncertainty, highly tangible firms may choose to retire their debt or issue equity capital instead to reduce operating leverage resulting from fixed charges of interest to debtholders (operating leverage effect). On the other hand, tangibility view argues that fixed assets can also be used for collateral to the firm, which in turn motivates firm to use more debt. At macro level, inflation uncertainty causes distortions in financial markets. Since business risk is high, equity investors will ask higher required rate of return. Cost of equity capital is higher during inflationary period. Thus, consistent with Pecking-Order Theory, highly tangible firms prefer debt financing to equity financing at these periods as a consequence of higher cost of equity. In addition, business risk is high at these periods and firms may be required to provide sufficient collateral to borrow funds. Therefore, under tangibility view, in a period with high inflation uncertainty, highly tangible firms may choose debt financing rather than raising funds through equity since they have sufficient collateral (collateralization effect)

Concluding, it is clear that, ceteris paribus, inflation uncertainty and tangibility reduce debt-to-equity ratio. The interaction of both variables generates either operating leverage effect or tangibility effect in affecting debt-to-equity ratio. Since I am examining listed Dutch firms, they are assumed to be financially unconstrained and have unlimited access to financial markets. They can either raise debt or equity to finance their projects or operational. Both “operating leverage effect” and “collateralization effect” have equal theoretical power in influencing firm’s capital structure. Therefore, it is interesting to find out which view that have more effect in affecting leverage levels in the case of inflation uncertainty.

III. Research Design and Methodology

a. Econometric model

The panel data regression model used for this research follows closely from Hatzinikolaou, Katsimbris, and Noulas (2002). The adjustments made are the addition of interaction between inflation uncertainty and firm's tangibility level, and historical market-to-book ratio as a control variable. The long-term nominal interest rate here replaces the expected real interest rate. The variable is used as a proxy for actual cost of debt. I employ three types of leverage based on its maturities in this research: total debt-to-equity ratio, short-term debt-to-equity ratio, and long-term debt-to-equity ratio to provide insightful analysis about which type of debt is more affected by inflation uncertainty. The basic equations are as follows:

$$DE_{i,t} = \alpha + \beta_1 INFUNC_t + \beta_2 FATA_{i,t} + \beta_3 (INFUNC * FATA)_{i,t} + \beta_4 LONGRATE_t + \beta_5 MTB_{i,t-1} + \beta_6 SIZE_{i,t} + \varepsilon_{i,t} \quad \textit{(Eq. 1)}$$

$$STDE_{i,t} = \alpha + \beta_1 INFUNC_t + \beta_2 FATA_{i,t} + \beta_3 (INFUNC * FATA)_{i,t} + \beta_4 LONGRATE_t + \beta_5 MTB_{i,t-1} + \beta_6 SIZE_{i,t} + \varepsilon_{i,t} \quad \textit{(Eq. 2)}$$

$$LTDE_{i,t} = \alpha + \beta_1 INFUNC_t + \beta_2 FATA_{i,t} + \beta_3 (INFUNC * FATA)_{i,t} + \beta_4 LONGRATE_t + \beta_5 MTB_{i,t-1} + \beta_6 SIZE_{i,t} + \varepsilon_{i,t} \quad \textit{(Eq. 3)}$$

where:

1. $DE_{i,t}$ is of total interest-bearing debt (both short-term and long-term) to total shareholders' equity ratio of firm *i* at time *t*. $STDE_{i,t}$ is short-term debt to total shareholders' equity ratio and $LTDE_{i,t}$ is long-term debt to total shareholders' equity ratio. These are the proxy of the firm's leverage which varies across firms and over time.
2. $INFUNC_t$ is a measure of inflation uncertainty at time *t*, proxied by conditional volatility of univariate inflation estimation at time *t*. This is the variable of interest and assumed to vary over time but not across firms.
3. $FATA_{i,t}$ is a ratio of firm *i*'s fixed assets to total assets, both in measured book value. This variable captures the operating leverage or tangibility effect of the firm.
4. $(INFUNC * FATA)_{i,t}$ serves as interaction between firm *i*'s fixed assets to total assets and inflation uncertainty at time *t*, which is assumed to vary across firms and over time.
5. $LONGRATE_t$ is long-term interest rate at time *t*, used as a proxy of nominal cost of debt. This variable is assumed to vary over time but not across firms.

6. $MTB_{i,t-1}$ is firm's ratio of firm i's market value to book value of assets at time *t-1*, used as a proxy of market timing factor.
7. $SIZE_{i,t}$ is firm i's size, defined as natural logarithm of total assets (book value).

All variables in the model are in annual figures. The model imposes that intercept term α and the slope coefficients β that are identical for all firms and time periods. The error term $\varepsilon_{i,t}$ varies over firms and time and captures all unobservable factors that affect dependent variables. To estimate this model by OLS panel data, usual assumptions of $E(\varepsilon_{i,t}) = 0$ (unbiasedness) and $E(x_{i,t}\varepsilon_{i,t}) = 0$ (consistency) needs to be achieved.

In panel data regression, however, since the same individual (in this case, individual refers to firm) are observed repeatedly, it is typically unrealistic to assume that error terms from different time periods are uncorrelated. As a result, routinely computed standard errors for OLS, based on the assumption of *iid* error terms, tend to be misleading in panel data regression. One solution is to calculate standard errors that are robust against correlation of the error terms, $E(\varepsilon_{i,t}\varepsilon_{i,s}) = 0$ for $i \neq s$, or clustered White covariance matrix. This is similar with White robust heteroskedasticity standard errors method. Another solution is to include firm-specific fixed effects in the model, in which $\varepsilon_{i,t} = \alpha_i + u_{i,t}$; and $u_{i,t} \sim IID(0, \sigma_u^2)$. This model allows error terms equal to individual intercepts α_i plus the individual components $u_{i,t}$ that varies over time, and treats α_i as unknown parameters to be estimated from the data. In other words, this model enables multiple intercepts and a set of N dummies ($\sum_{j=1}^{N} \alpha_i d_{i,j}$, where $d_{i,j} = 1$ if i=j and zero elsewhere). These combinations of individual intercepts and dummy variables capture the unobservable firm-specific effects, e.g. management characteristics and motivation to achieve the optimal debt-to-equity ratio. The implied β from this model is referred to least squares dummy variable (LSDV) estimator. In this research, I will apply fixed effects model to fix the standard errors robustness problem and to capture firm-specific effects.

b. Hypotheses Development

With analysis from previous literature, I arrive at the following hypotheses:

<u>Main hypotheses:</u>

1) Inflation uncertainty increases business risk, results in more volatile operating income, cash flows to the firm and leads to uncertain interest tax-shields. Hence, it reduces the benefits of using debt. It also increases interest rate uncertainty, which then result in higher cost of debt. Thus, inflation uncertainty reduces the number of investment projects financed by debt, since it increase cost of capital. I would expect that this holds for debt with both short-term and long-term maturities. However, long-term debt is expected to be more influenced by

inflation uncertainty since it is more sensitive to interest rate changes compared to short-term debt. Hence, inflation uncertainty is expected to influence firm's debt-to-equity ratio negatively ($\beta_1 < 0$).

2) The use of fixed assets captures firm's operating leverage. It also measures collateral value of a firm. However, for listed Dutch firms, I assume that "collateralization" is irrelevant. Operating leverage effect is more relevant in this case. Therefore, I expect fixed assets-to-total assets has inverse relationship with debt-to-equity ratio ($\beta_2 < 0$).
3) Literature analysis in Section II mentions that inflation uncertainty strengthens "operating leverage effect" or "collateralization effect". Since both have equal theoretical power, I expect two-sided hypothesis($\beta_3 \neq 0$); if β_3 is negative, operating leverage effect is stronger; conversely, if β_3 is positive, then collateralization effect exists.

Since our variable of interest is inflation uncertainty and its interaction with firm tangibility, other variables in the regression equation (long-term nominal interest rate, firm's historical market-to-book ratio, and size) are used as control variables to clean up the endogeneity effects. The following hypotheses are formulated for the control variables:

<u>Secondary hypotheses:</u>

1) An increase in long-term nominal interest rate increases cost of debt, makes borrowing more expensive and therefore motivates firm to reduce its debt-level. Consequently, long-term nominal interest rate is expected to have negative relationship with firm's debt-to-equity ratio ($\beta_4 < 0$).
2) Equity market timing is an important aspect of real financial policy. Firms issue equity when their historical market values, relative to book values, are high and repurchase them when market values, relative to book values, are low (see Baker and Wurgler (2002)). Similarly, firms' leverage level is negatively related to their historical market-to-book ratio (see Mahajan and Tartaroglu (2007)). Therefore, I expect the historical market-to-book ratio to be negatively related with firm's debt-to-equity ratio ($\beta_5 < 0$).
3) Since the selected sample consists of firms with different market capitalization (big-cap firms, mid-cap firms, and small-cap firms), I am expecting endogeneity in size differences. Therefore, size is included as one of control variables. According to Titman and Wessels (1988), larger firms tend to have more long-term borrowing capacity than small firms. This is because of larger firms have sufficient assets to cover transaction costs from long-term financing. Therefore, I expect firm size to be positively related to leverage level ($\beta_6 > 0$).

c. Estimating Inflation Uncertainty

Inflation uncertainty refers to the degree that future inflation rates are not known. Note that uncertainty is not equal to variability (variability measures variation in inflation rates and may impose negative values, while uncertainty not). Many researchers observed that there is a positive relationship between inflation and inflation uncertainty.[2] There are various ways to estimate inflation uncertainty. Golob (1994) mentions there are two approaches to estimate inflation uncertainty. First approach involves the use of survey about inflation from economists and consumers, by asking them to provide a range of values over which inflation rate might fall. Inflation uncertainty is measured by the variation of inflation figures provided by the survey. Second approach involves the use of econometric model for two measures of uncertainty: uncertainty in CPI and in GDP deflator. Hatzinikolaou, Katsimbris, and Noulas (2002) apply univariate MA(1) regressions recursively to estimate inflation rates and uses standard errors of those regression as a proxy of inflation uncertainty. On the other hand, Engle (1983) uses autoregressive conditional heteroskedasticity (ARCH) to estimate the conditional mean and variance of inflation to construct inflation uncertainty. ARCH models present time-varying estimates of conditional variance of errors from inflation forecast, which is used as a proxy of inflation uncertainty. Bollerslev (1986) develops generalized ARCH (GARCH) model to estimate conditional variance of error terms from time series inflation forecast. Many subsequent research use ARCH-GARCH model in estimating inflation uncertainty.

In constructing inflation uncertainty series, I follow similar ARCH/GARCH method from previous papers. First, I construct the inflation rates from Netherlands monthly CPI data. Let $\pi_t = 1200 * ln\left(\frac{CPI_t}{CPI_{t-1}}\right)$. The multiplication by 1200 serves as annualized factor of monthly percentage change in CPI. The time series models for π_t is formulated as follows:

$$\pi_t = X_t + \varepsilon_t \qquad \textit{(Eq. 4)}$$

$$\varepsilon_t \sim WN(0, \sigma^2)$$

where X_t is a vector consists of lagged variables of π_t. Test statistics performed by using Augmented Dickey-Fuller and Phillips-Perron unit root test for series π_t show values of -11.385 and -103.527 respectively, indicating that series π_t is stationary at 1% significance level. Ljung Box Q-statistics shows that there is a significant autocorrelation in lag-1 values, suggesting that π_t is not white noise. This explains that ARMA models fit the data π_t well. Autocorrelation function (ACF) of π_t indicates that there is a seasonal effect, as shown by subsequent signs of positive and negative in 3 months time. Furthermore, ACF shows slow convergence to zero; hinting AR models fit the data better. Partial autocorrelation function (PACF) of π_t shows significant spikes on lag 3, 9, and

[2] see, e.g., Friedman (1997), Ball (1992), and Cukierman and Meltzer (1986)

12, implying that current month inflation rate is correlated with inflation rates from the previous 3 months, 9 months, and 12 months. I consider AR(3,9,12), and AR(3,6,9,12) for modeling π_t, based on ACF and PACF. AR(3,9,12) achieves the best model based on Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). This is supported by its significant coefficients and Ljung-Box Q-statistics prove that the model is free from residual serial correlation. Table 1 summarizes the results of these time series regressions.

Next step is to construct conditional variance for π_t. Recall that AR(3,9,12) is the best model:

$$\pi_t = \alpha_0 + \pi_{t-3} + \pi_{t-9} + \pi_{t-12} + \varepsilon_t \quad \textit{(Eq. 5)}$$

$$\varepsilon_t = v_t\sqrt{\alpha_0 + \alpha_1\varepsilon_{t-1}^2} \quad \textit{(Eq. 6)}$$

where v_t is white noise with variance $(\sigma_v^2) = 1$, $\alpha_0 > 0$ and $0 < \alpha_1 < 1$. Equation 6 is standard autoregressive conditional heteroskedasticity process (ARCH) at lag 1. This model is introduced by Engle (1982) to estimate conditional variance of the error terms. Essential features of any ARCH process are 1) conditional and unconditional means of ε_t are 0, and 2) $\{\varepsilon_t\}$ sequence is uncorrelated. ARCH(p) model is similar to AR(p) for the squared residuals.

The generalized autoregressive conditional heteroskedasticity (GARCH) model proposed by Bollerslev (2001) allows the conditional variance depends on lagged values of squared residuals and also the lagged values of conditional variance. Let h_t be the conditional variance of AR(p). Recall from Equation 3, error terms are now formulated as below:

$$\varepsilon_t = v_t\sqrt{h_t} \quad \textit{(Eq. 7)}$$

$$h_t = \alpha_0 + \sum_{i=1}^{q}\alpha_i\varepsilon_{t-i}^2 + \sum_{i=1}^{p}\beta_i h_{t-i}$$

This is the GARCH(p,q) process where variance of the errors is a function its own lagged values and lagged squared residuals. It is similar to ARMA (p,q) process of variance of residuals. I consider ARCH(1) and GARCH(1,1) for conditional variance model of π_t. Summary from Table 2 presents the results. ARCH(1) achieves the best model for conditional variance of error terms from both AIC and BIC indicators. Conditional volatility (square root of these conditional variances estimations) serves as measure for inflation uncertainty. The annual figure of inflation uncertainty is the average of 12-months of conditional volatility.

d. Data and Sample Selection

Firms' balance sheet data, such as total interest-bearing debt (both short-term and long-term), total shareholders' equity (book value), fixed assets (property, plant, and equipment), and total assets as well as market value of equity (MV) data are obtained from Datastream. Macroeconomic data, such as Netherlands long-term interest rate and consumer price index are obtained from DG

ECFIN AMECO and International Financial Statistics (IFS). Dependent variables are calculated as total debt, short-term debt, and long-term debt divided by total shareholders' equity. Market-to-book ratio is defined as market value of assets (book assets minus book equity plus market value of equity) divided by book assets.

Listed Dutch firms in this research refer to firms listed in Euronext Amsterdam (AEX, AMX, and AScX) as of end of 2013. Sample criteria for firms is as follows: firms should have all the balance sheet data available throughout the regression period (1993-2012, T=20 years), and selected firms must be from non-financial industry (banks, investments companies, insurance etc are excluded from the sample due to different interpretation in right-side of balance sheet compared to, for example, industrial firms). The results are 37 firms from total 75 firms after sample selection is performed, therefore the total observation is 740 (N*T). Half of the total sample is excluded due to missing data in balance sheet. Most firms that are excluded are banks, investment companies, and young firms. Final sample consists of 17 firms from AEX index, 11 firms from AMX index, and 9 firms from AScX index.

Table 1 Summary of AR Models for univariate estimation in annualized monthly percentage change of Netherlands monthly CPI

	Coefficients						
	α_0	β_3	β_6	β_9	β_{12}	AIC	BIC
AR(3,9,12)	2.155649***	-0.1483969***	-	-0.1826836 ***	0.6085808***	1178.345	1195.748
AR(3,6,9,12)	2.159844***	-0.1340565**	0.0349206	-0.1681032***	0.6055500***	1179.872	1200.756

**** Denotes significance at 5% level**

***** Denotes significance at 1% level**

Table 2 Summary of ARCH(1) and GARCH(1,1) for estimating conditional variance of annualized percentage change of Netherlands monthly CPI

	Coefficients				
	α_0	α_1	β_1	AIC	BIC
ARCH (1)	30.94558***	-0.1391133**	-	1473.282	1483.724
GARCH (1,1)	43.05355***	0.1411144**	-0.7278099**	1475.658	1489.581

**** Denotes significance at 5% level**

***** Denotes significance at 1% level**

IV. Analysis of Results

a. Descriptive Statistics

Table 3 reports statistics of firm-specific variables grouped in each index. In general, firms from the sample have on average total debt-to-equity at 48.02% with median at 42.88%, suggesting a right-tailed distribution. All firms have roughly 29% long-term debt compared to their equity, while around 19% are short-term debt-to-equity. Firms from AEX and AMX indices averagely use more long-term debt than short-term debt for leveraging purpose as described by their ratios of long-term financing of 33.37% and 30.60% respectively. Conversely, firms from AScX index, on average, lever themselves by using short-term debt as described by their average short-term debt-to-equity ratio of 31.82%. The fact that AScX index consists of smaller firms, it is consistent with Titman and Wessels (1988) explanation mentioning smaller firms tend to use significantly more short-term financing than large firms due to higher transaction costs when issuing long-term financing ("small firm effect). To the extent that inflation uncertainty raises interest rate risk and increase cost of debt, firms from AEX and AMX indices are expected to experience decrease in their long-term leverage level. This is due to long-term leverage is more sensitive to interest rate changes. Similarly, inflation uncertainty is expected to decrease short-term leverage of AScX firms. This is consistent with Hatzinikolaou, Katsimbris, and Noulas (2002) who argue that inflation uncertainty increases interest rate risk and therefore leads to higher cost of debt.

All firms from the sample, on average, employ 32.37% fixed assets from their total assets, with a median of 30%. AEX firms use 37% fixed assets in the left-side of their balance sheet, with median 38.12%. AMX firms have 30% fixed assets of their total assets with a median of 28.20%. Whilst AScX firms employ 27.23% fixed assets from their total assets for with a median of 30%. Given that AEX firms are the most tangible ones, it is expected that AEX firms experience interaction effect between tangibility and inflation uncertainty more than firms from the other two indices. This is align with literature analysis in Section II, which states that in the case of inflation uncertainty, highly tangible firms either experience more volatile income or raise their borrowing capacity by using the existing fixed assets for collateral. I also expect that tangibility issue is more relevant for AScX firms, since their long-term borrowing capacity is less than AEX and AMX firms.

Average size of all firms from the sample is 14.3793 with a median of 14.0469. AEX firms, on average, are the largest firms among firms from all indices, whhile AScX firms are the smallest. AScX firms use significantly short-term debt more than AEX and AMX firms. Again, this is in line with Titman and Wessels (1988) that there is a"small firm effect" on the sample. Small firms borrow more on short-term because they face higher transaction costs when they want to issue long-term debt or equity.

Table 3 Descriptive Statistics of Firm-Specific Variables

This table displays descriptive statistics of firms' financial characteristics grouped by each index. D/E is total debt-to-equity ratio; STD/E is short-term debt-to-equity ratio; LTD/E is long-term debt-to-equity ratio; MTB is ratio of market value of assets to book value of assets; FATA is ratio of fixed assets-to-total assets; SIZE is defined as natural logarithm of total assets. Each ratio is calculated in book-value, except MTB. N denotes the number of firms in each index.

INDEX	Variables	Mean	Standard Deviation	Median	Minimum	Maximum	N
AEX	D/E	0.4624	0.2603	0.4349	0.0000	1.8366	17
	STD/E	0.1287	0.1314	0.0899	0.0000	0.7631	17
	LTD/E	0.3337	0.1969	0.3008	0.0000	1.1579	17
	MTB	2.3294	1.8012	1.8307	0.2974	20.826	17
	FATA	0.3657	0.2539	0.3812	0.0004	0.9787	17
	SIZE	15.8890	1.6822	15.8549	11.7688	19.6851	17
AMX	D/E	0.4763	0.2664	0.4342	0.0000	1.9856	11
	STD/E	0.1711	0.2178	0.1056	0.0000	1.9257	11
	LTD/E	0.3060	0.1626	0.3301	0.0000	0.6810	11
	MTB	1.6211	1.3028	1.2627	0.4703	13.140	11
	FATA	0.3008	0.2820	0.2093	0.0000	0.9845	11
	SIZE	13.5601	1.0776	13.6889	9.6173	15.7737	11
AScX	D/E	0.5185	0.8069	0.3827	0.0000	9.3617	9
	STD/E	0.3182	0.7798	0.1332	0.0000	8.7660	9
	LTD/E	0.2047	0.1803	0.1948	0.0000	0.7179	9
	MTB	1.5641	0.5790	1.4305	0.5449	3.8644	9
	FATA	0.2723	0.1365	0.3000	0.0076	0.5460	9
	SIZE	12.5287	0.9586	12.5978	10.4961	14.0251	9
Total	D/E	0.4802	0.4586	0.4288	0.0000	9.3617	37
	STD/E	0.1874	0.4185	0.1007	0.0000	8.7660	37
	LTD/E	0.2940	0.1903	0.2799	0.0000	1.1579	37
	MTB	1.9327	1.4856	1.5105	0.2974	20.826	37
	FATA	0.3237	0.2435	0.2997	0.0000	0.9845	37
	SIZE	14.3793	1.9868	14.0469	9.6173	19.6851	37

Table 4 Descriptive Statistics of Macroeconomic Variables

This table presents descriptive statistics of time-varying macroeconomic variables. INFUNC represents inflation uncertainty, in percentage. LONGRATE is nominal long-term interest rate.

Variables	Mean	Standard Deviation	Median	Minimum	Maximum
INFUNC (in %)	5.18376	0.13118	5.19232	4.78792	5.38231
LONGRATE	0.04593	0.01300	0.04460	0.01930	0.06900

On average, all firms from the sample have market-to-book ratio of 1.9327 with median of 1.4856, suggesting that the distribution of market-to-book ratio is right-tailed. Firms from AEX index have the highest valuation as shown by a mean and a median market-to-book ratio of 2.3924 and 1.8012 respectively. AMX index firms follow with a mean and a median of 1.6211 and 1.3028 respectively. AScX index firms have the lowest market valuation with mean and median of 1.5641 and 0.5790 respectively.

Table 4 reports descriptive statistics of time-varying macroeconomic variables. Inflation uncertainty is remarkably stable during the 20 years estimation period (1993-2012) with an average of 5.18% and a standard deviation of 0.13%. It proves that inflation rate in Netherlands is relatively stable throughout the period. This is consistent with Friedman-Ball hypothesis which states there is a positive relationship between inflation and inflation uncertainty[3]. However, this statistics suggests a bad news for the research question: stable inflation uncertainty may have no effect at all to firm's leverage level. Yet, it is still inconclusive as other tests and analyses have to be performed to prove otherwise

b. Univariate Tests

Table 5 reports univariate test analysis. Results from the table show no significant differences in average total debt-to-equity ratio among firms from each index. However, there are significant differences of short-term leverage and long-term leverage between index samples. There is a large difference long-term leverage level between AEX firms and AScX firms. This is in line with Titman and Wessels (1988) paper. Larger firms raise long-term financing more than smaller firms because they are more able to pay higher transaction costs associated with raising long-term financing. Based on this theory, it is expected that the long-term leverage level of AEX and AMX firms are more influenced by inflation uncertainty. While for AScX firms, inflation uncertainty is expected to decrease their short-term leverage level.

In terms of tangibility, there are significant differences among firms from each index. AEX firms, as aforementioned, are the most tangible firms compared than the firms from the other two indices. In contrast, AScX are the least tangible firms with AMX firms in between. According Hatizinikolaou, Katsimbris, and Noulas (2002), tangibility lowers leverage level of large firms as it increases operating income volatility and causes tax shields to become more uncertain. Thus, this operating leverage effect is more relevant to AEX and AMX firms. On the other hand, tangibility is important for smaller firms

[3] see, e.g., Friedman (1997), Ball (1992), and Cukierman and Meltzer (1986)

Table 5 Univariate Test

This table presents mean-comparison of firm-specific variables. The numbers displayed are the difference between sample means of each index. For example, numbers in the column AEX-AMX are the mean-difference between AEX firms and AMX firms. Note that the means are calculated by firstly constructing the average of all variables each year, which therefore creates 20-years paired-data for each index. These means are compared by using paired-sample mean comparison test. *, **, *** denote significance at 10%, 5%, and 1% respectively.

Variable	AEX-AMX	AMX-AScX	AEX-AScX
D/E	-0.01393	-0.04211	-0.05605
STD/E	-0.04233***	-0.14717***	-0.18951***
LTD/E	0.02772*	0.10130***	0.12902***
FATA	0.06485***	0.02854**	0.09339***
MTB	0.70819***	0.05711	0.76530***
SIZE	2.32885***	1.03139***	3.36025***

since fixed assets can be used as collateral for borrowing. Therefore, tangibility is expected to have positive relationship with leverage level among AScX firms.

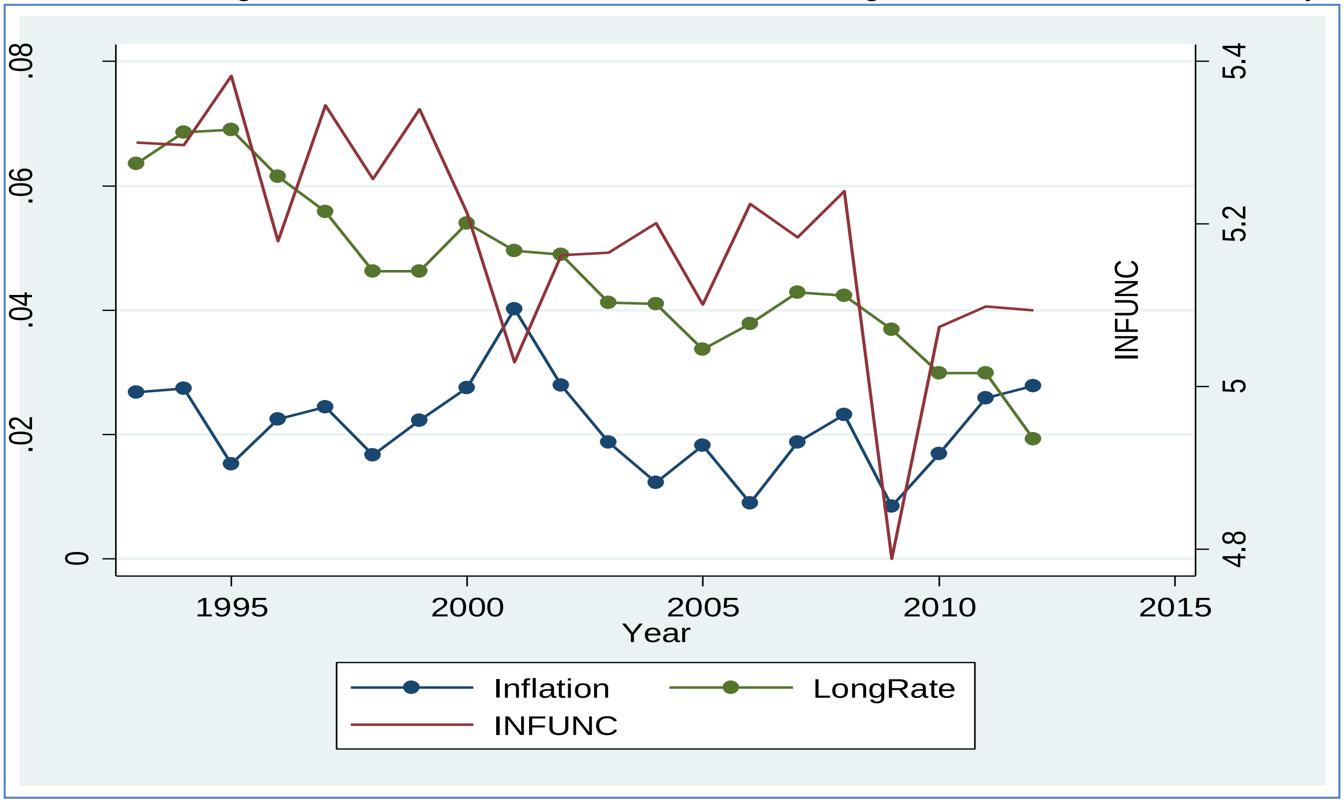
Clearly, there are significant differences in size among firms from each index. AEX firms are proven to be the largest firms in the sample and the biggest users of long-term debt. Conversely, AScX firms are the smallest firms in the sample and have the highest level of short-term debt. This is, again, consistent with Titman and Wessels (1988). It is very possible that for AEX firms, inflation uncertainty is expected to influence long-term leverage more. While for AScX firms, although the effect may not be as large as on long-term leverage, short-term leverage is also expected to be affected by inflation uncertainty.

Since bigger firms have more tangible assets than smaller firms, they are expected to experience the interaction effect between tangibility and inflation uncertainty in lowering long-term leverage level. Thus, AEX firms are expected to sustain either "strenghtening operating leverage effect" or "collateralization effect" for their long-term leverage more compared to AMX and AScX firms. While for AScX firms, both effect are more relevant to increase or decrease in short-term leverage.

In terms of market valuation there are significant differences between market-to-book ratio of AEX index firms and firms from the other two indices. This suggests that AEX firms are valued more by investors compared to the other two indices. It makes sense since AEX index is composed of top 25 Dutch firms based on their market capitalization. This suggests that AEX index is more liquid in terms of trading activities.

Figure 3 The Netherlands Inflation and Inflation Uncertainty

This graph illustrates the movemenr of inflation rate, inflation uncertainty, and long-term nominal interest rates in The Netherlands during the estimation period (1993-2012). As explained in Section III, inflation uncertainty is represented as conditional volatility of inflation. The blue connected-line is the actual yearly inflation rate, calculated from percentage change of yearly consumer price index. The green connected-line represents long-term nominal interest rates. The solid line represents inflation uncertainty level. The y-axis on the left is appointed for inflation and long-term nominal interest rates measure, while on the right side measures inflation uncertainty.



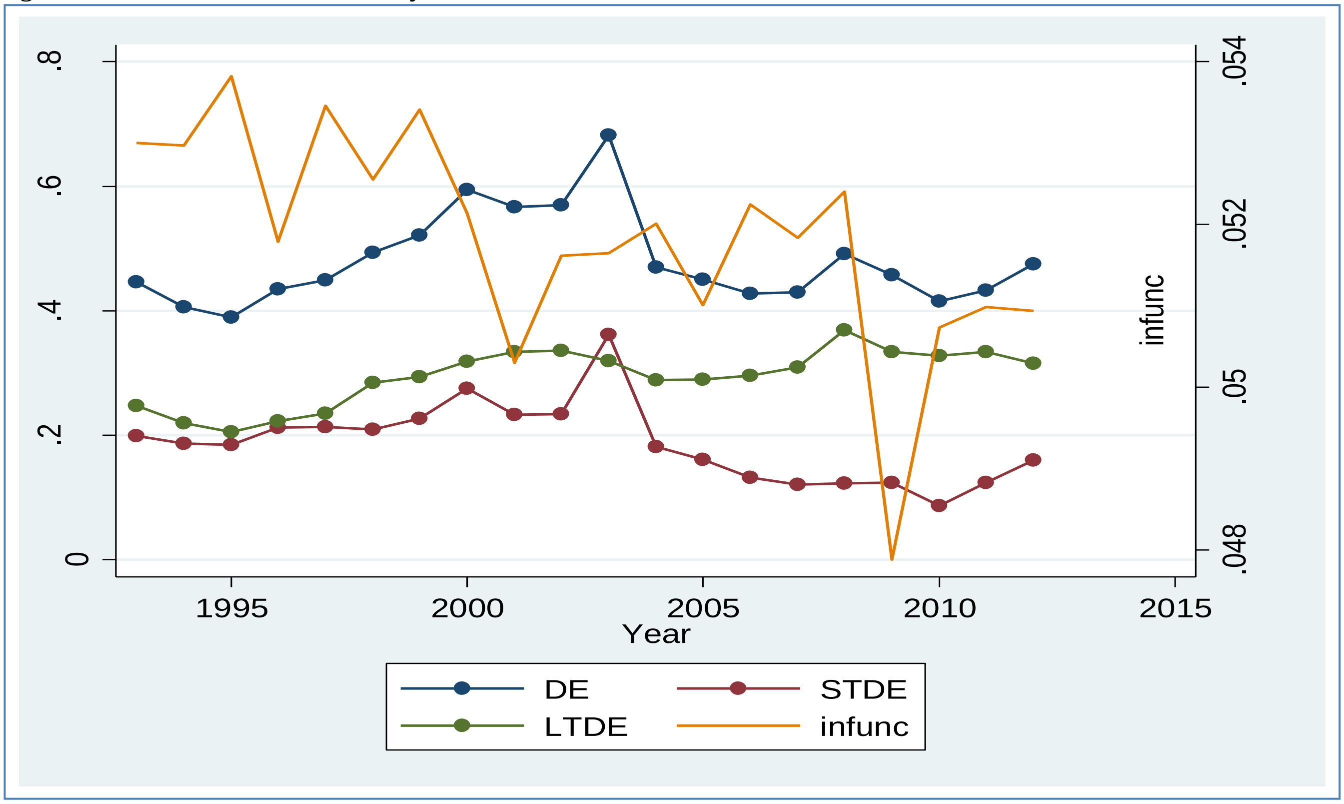
c. Graph/Trend Analysis

Figure 3 illustrates the trend of inflation and inflation uncertainty in the Netherlands. Inflation rate moves together with inflation uncertainty during 1993-2012, align with Friedman-Ball hypothesis which explains that inflation and its uncertainty have positive relationship. This is because of higher inflation rate leads to increasing uncertainty in monetary policy stance, thus raises inflation uncertainty.

However, there was an anomaly in around year 2000-2002, when inflation peaked at 4% while inflation uncertainty was surprisingly dropped. This is the period when European Union entered recession period following tech crash in United States. Many European firms which profits made in United States Dollars hurt as the exchange rate was unfavorable. Throughout the 2000-2001, Euro currency continued to weaken as inflation struck. Moreover, during recession at the year 2008-2010, Europe economy slowed down as shown by lower inflation level. Inflation uncertainty was also lower at these periods.

Figure 4 Average Leverage Levels and Inflation Uncertainty in The Netherlands

The graph illustrates the trend of average leverage level of Dutch firms and inflation uncertainty. Blue connected-line corresponds to average total debt-to-equity ratio; red connected-line represents average short-term debt-to-equity ratio; green connected-line symbolizes average long-term debt-to-equity ratio. The orange solid line represents inflation uncertainty. The y-axis on the left is appointed to leverage levels measurement while on the right serves for inflation uncertainty measurement.



In addition, long-term nominal interest rate movement seems to align with inflation rates and inflation uncertainty. This is consistent with Fisher equation which states nominal interest rate is equal to real interest rate plus inflation rate. Furthermore, since long-term nominal interest rate is used as the proxy of cost of debt, the movement is also in line with Hatzinikolaou, Katsimbris, and Noulas (2002) theory, which proposes that inflation uncertainty increases cost of debt.

Figure 4 displays the trend of average debt levels and inflation uncertainty. The leverage levels exhibit a relatively stable trend throughout the estimation period (1993-2012). At a glance, total debt-to-equity ratio movement seems to be more in line with short-term debt-to-equity ratio rather than with long-term debt-to-equity ratio. This indicates that firms from the sample have substantial amount of short-term leverage, as mentioned in the descriptive statistics analysis. The inflation uncertainty movement seems not to be consistent with debt levels, although there are slight signs indicating inverse relationship between both. For example, at approximately year 2004, where there is a sharp spike in total debt-to-equity ratio and inflation uncertainty were slightly declined. This is probably because of inflation uncertainty does not affect leverage levels directly. It lowers leverage through increase in cost

Table 6 Correlation Matrix

This table presents correlation between variables. DE is total debt-to-equity ratio. STDE is short-term debt-to-equity ratio. LTDE is long-term debt-to-equity ratio. INFUNC is inflation uncertainty. FATA is the ratio of fixed assets to total assets. LRATE is long-term nominal interest rate. MTB is the ratio of market value of assets to book value of assets. SIZE is firm size, defined as natural logarithm of firm's total assets (book value). Numbers in parentheses are the *p*-values. *, **, *** denote significance at 10%, 5%, and 1% level.

	DE	STDE	LTDE	INFUNC	FATA	LRATE	MTB	SIZE
DE	1.0000							
STDE	0.9084*** (0.0000)	1.0000						
LTDE	0.4095*** (0.0000)	-0.0029 (0.9373)	1.0000					
INFUNC	-0.0186 (0.6138)	0.0401 (0.2764)	-0.1373*** (0.0002)	1.0000				
FATA	-0.0758** (0.0393)	-0.1182*** (0.0013)	0.0751** (0.0411)	0.0520 (0.1576)	1.0000			
LRATE	-0.0145 (0.6942)	0.0567 (0.1234)	-0.1679*** (0.0000)	0.5875*** (0.0000)	0.0846** (0.0214)	1.0000		
MTB	0.0713* (0.0524)	-0.0306 (0.4065)	0.2340*** (0.0000)	0.0919** (0.0124)	-0.1144*** (0.0018)	0.0626* (0.0890)	1.0000	
SIZE	-0.0287 (0.4364)	-0.1639*** (0.0000)	0.2914*** (0.0000)	-0.1889*** (0.0000)	0.0798** (0.0299)	-0.2652*** (0.0000)	0.0437 (0.2353)	1.0000

of debt exogenously and escalating earnings volatility endogenously. In addition, leverage levels tend not to change much over a short period of time. This indicates that if inflation uncertainty is significantly influencing leverage levels, the effect may not be economically significant. However, this conjecture is still subject to further econometrical verification. Thus, to examine if inflation uncertainty is related with debt levels by looking at the graph is rather inconclusive.

d. Correlation Analysis

Table 4 presents the correlation matrix to provide indication of regression results. It is shown that inflation uncertainty does not significantly correlate with total debt-to-equity ratio and short-term debt-to-equity ratio. This is probably as a result of short-term leverage is not sensitive to interest rate changes, as supported by insignificant correlation between LRATE and STDE. This result hints at insignificant causality of inflation uncertainty toward short-term leverage. In addition, total leverage level does not strongly correlate with inflation uncertainty and also long-term nominal interest rate. This is due to total leverage is comprised of substantial proportion of short-term leverage. Therefore, I expect that inflation uncertainty and long-term interest rate will have no significant coefficients in the regressions with total debt-to-equity ratio as the dependent variable.

Inflation uncertainty, however, has strong negative correlation with long-term leverage. This is consistent with Hatzinikolaou, Katsimbris, and Noulas (2002) explanation that it causes more volatile operating income then makes tax shields becoming more uncertain. Consequently, this leads to reduced benefits of the use of debt and therefore lowering debt levels. The strong negative correlation between LTDE and LRATE supports the notion that long-term leverage is more sensitive to interest rate changes as it is also used as benchmark for cost of debt. Higher cost of debt leads to lower use of long-term leverage. The strong positive correlation between INFUNC and LRATE emphasizes Hatzinikolaou, Katsimbris, and Noulas (2002) explanation regarding that inflation uncertainty increases cost of debt. Thus, I expect that inflation uncertainty and long-term nominal interest rate have negative and significant coefficients in the regression.

Firm’s tangibility has significant negative correlation with short-term leverage and, therefore, total leverage. This indicates the existence of operating leverage effect in short-term leverage. Conversely, long-term leverage level has a significant positive correlation with firm’s fixed assets, suggesting that collateralization effect exists. This correlation is consistent with the tangibility view of capital structure, which mentions highly tangible firms collateralize their fixed assets to increase their borrowing capacity. However, it contradicts Hatzinikolaou, Katsimbris, and Noulas (2002) explanation arguing that for big listed firms, collateralization is irrelevant. The positive correlation is probably due to size effect since the sample consists of firms with different market capitalization.

Firm’s size is strongly correlates with short-term leverage, long-term leverage, tangibility, and inflation uncertainty. Consistent with Titman and Wessels (1988), the negative correlation between SIZE and STDE and positive correlation between SIZE and LTDE show that the bigger size of a firm the more long-term borrowing capacity it has. Therefore, bigger firms are more capable to raise long-term financing. In addition, significant positive correlation between firm’s size and its tangibility explains that the bigger the size of a firm, the more tangible it is. This correlation is supported by findings in descriptive statistics analysis, which shows that AEX firms are the biggest in terms of size and also most tangible from all firms in the sample.

Finally, firm’s market-to-book ratio has significant positive correlation with long-term leverage, which opposes market timing theory by Baker and Wurgler (2002). This probably due to higher market-to-book ratio is considered as an overvaluation. Firms with high market valuation issue debt-financing for risk-sharing purpose.

e. Regression Analysis

Table 5 summarizes the results from a panel data OLS regression analysis. This preliminary analysis shows that all basic models presented in Section III were initially suffer from heteroskedasticity and autocorrelation problems. Breusch-Pagan test p-values are 0.0000, suggests that error term in the regressions is heteroskedastic. Woolbridge test statistics also indicates that first-order serial correlation exists (p-values = 0.000). Thus, the basic models cannot be considered appropriate. The use of fixed effects specification allows error term to be equal to firm's constants and its time-varying error terms. Therefore, it is very likely that autocorrelation exists among firms. To solve these problems, I cluster standard errors in each firm to generate standard errors that are robust from heteroskedasticity and autocorrelation. In addition, to isolate the effect of each explanatory variable to the dependent variables, I utilize firm fixed effects by including dummy variables from each firm. This also corrects for unobserved heterogeneity among firms, e.g., management characteristics, motivation to reach the optimal capital structure.

Result shows that, after controlling for firm's size, market-to-book ratio and long-term nominal interest rate, inflation uncertainty exerts a strong negative relationship with long-term leverage, as shown by the negative coefficient of $INFUNC_t$ in regression (5) and (6). This is in line with the hypothesis 1 in Section III. However, regressions (1) to (4) show that inflation uncertainty is not significantly related with total debt-to-equity ratio and short-term debt-to-equity ratio. The possible explanation is short-term leverage is not sensitive to changes in cost of debt. Additionally, short-term financing is raised only for short-term purposes, e.g., short-term liquidity fulfillment, working capital financing, etc all of which cash flows are not sensitive to inflation uncertainty and interest rate changes. Whereas, long-term leverage is commonly used for project financing or investments which cash flows are highly influenced by inflation uncertainty.

All regressions show firm's tangibility does not affect the three leverage measures. This contradicts Titman and Wessels (1988) who argue that the use of fixed assets is important to determine financing composition. Moreover, the interaction between inflation uncertainty and firm's tangibility also not related with firm's leverage levels in all maturities. According to these results, the argument stating inflation uncertainty "strengthens operating leverage effect" or creates "collateralization effect" is irrelevant. Therefore, to say such interaction effect does not exist among listed Dutch firms is sufficiently conclusive.

Long-term nominal interest rate has no significant effect at all to all leverage measures. This contradicts hypothesis 4 in Section III and also a noteworthy finding. This is probably due to high correlation between inflation uncertainty and long-term nominal interest rate (58.75%).

Table 7 Panel Data OLS Regression Results for All Firms in The Sample

This table presents estimation results of OLS panel data model. Six regressions are presented to represent each dependent variable and the utilization of firm dummies. Each variable are defined as in Section III. Standard errors are clustered in each firm. All regressions are robust from heteroskedasticity and autocorrelation. The numbers in parentheses are *t*-statistics. *, **, *** denote significance at 10%, 5%, and 1% level respectively.

Dependent Variables	$DE_{i,t}$		$STDE_{i,t}$		$LTDE_{i,t}$	
	without firm dummies (1)	**with firm dummies (2)**	**without firm dummies (3)**	**with firm dummies (4)**	**without firm dummies (5)**	**with firm dummies (6)**
$INFUNC_t$	-0.0158	0.0611	0.1572	0.1936	-0.1730**	-0.1325**
	(-0.07)	(0.27)	(0.69)	(0.88)	(-2.37)	(-2.06)
$FATA_{i,t}$	1.0317	0.6581	2.0228	2.0331	-0.9911	-1.3750
	(-0.34)	(0.25)	(0.68)	(0.82)	(-1.05)	(-1.49)
$(INFUNC * FATA)_{i,t}$	-0.2188	-0.1445	-0.4271	-0.3901	0.2083	0.2455
	(-0.36)	(-0.28)	(-0.71)	(-0.80)	(1.13)	(1.39)
$LONGRATE_t$	-0.1786	4.1541	1.1771	3.2298	-1.3557	0.9243
	(-0.12)	(1.79)	(0.91)	(1.59)	(-1.65)	(-0.92)
$MTB_{i,t-1}$	0.0253	0.0204	-0.0091	-0.0067	0.0345***	0.0271***
	2.18	(1.34)	(-0.66)	(-0.55)	(3.41)	(3.66)
$SIZE_{i,t}$	-0.0074	0.1202***	-0.0301	0.0401	0.0226*	0.0801***
	(-0.37)	(2.68)	(-1.66)	(1.34)	(1.97)	(3.68)
R-Squared	0.0125	0.2656	0.0393	0.2342	0.1820	0.5763
Obs.	740	740	740	740	740	740

In their paper, Hatzinikolaou, Katsimbris, and Noulas (2002) argue that inflation uncertainty increases interest rate risk and therefore leads to increasing cost of debt. The effect seems to be captured by inflation uncertainty in the regressions. Additional checking is needed to verify this matter, i.e., replacing long-term nominal interest rate with long-term real interest rate.

Another interesting finding is that firm's historical market-to-book ratio has strong positive relation with long-term debt-to-equity ratio. Although economically insignificant, this contradicts market timing theory, stating that the higher market value of a firm compared to its book value the higher equity issuance. Possible explanation for this is that higher historical market-to-book value suggests an overvaluation, therefore risk-sharing with debtholders is needed[4]. However, to examine this matter in a more comprehensive extent, one needs a deep understanding of Dutch stock markets, i.e., how are the behaviors of listed Dutch firms in raising equities, what factors that affect their decisions in issuing equities, transaction costs, etc.

Finally, firm's size is found to have strong positive relationship with long-term leverage as well as total leverage as shown in regression (2), (5), and (6). This is in line with hypothesis 6 in Section III and also consistent with Titman and Wessels (1988). As aforementioned in previous section, firm's size is included in the regressions to control size effect because the sample consists of firms with different sizes. Empirical results show that the bigger the firm size the more capable a firm to raise long-term financing. Firm's size, however, does not significantly relate with short-term leverage. This probably due to short-term financing does not require certain assets as collateral.

f. Robustness Tests

Regressions analysis in Table 7 has shown that inflation uncertainty has a significant negative relationship with long-term leverage level, after controlling for size effect and nominal cost of debt. Then again, since the sample is composed of large firms and small firms, it is very likely that "size-effect" exists. Large firms use long-term leverage significantly more than small firms. Despite empirical results in Table 5 showing that inflation uncertainty is unrelated to short-term leverage, it is noteworthy to check if the results are different among small firms.

In addition, long-term nominal interest rate as cost of debt seems less appropriate as a proxy for cost of debt. According to Fisher equation, nominal interest rate equals to real interest rate plus inflation rate. Therefore, it is reasonable that nominal interest rate is insignificantly related to leverage, as the effect is probably captured by inflation uncertainty. I am interested to check if the results are different by using long-term real interest rate (defined as nominal long-term interest rate minus inflation rate) as proxy of cost of debt, whether on big firms or small firms.

[4] See Levy and Hennessy (2007)

Table 8 Regressions for Robustness Tests

This table presents the additional regression results for robustness tests. The variables are similar with the regressions in Table 7 except the absence SIZE and the inclusion of LONGREAL. SIZE is excluded to see if size-effect exists. LONGREAL is defined as long-term real interest rate. This variable replaces LONGRATE in the previous regression. Another difference is the sample is also divided into two: Large Firms, which are defined as firms with average size is larger than the median of size; and Small Firms, which are defined as firms with average size smaller than the median of size. The firm which size is exactly equal with the median of size is included in the Large Firms sample. Each variable, except LONGREAL, is defined as in Section III. Standard errors are clustered in each firm. All regressions are robust from heteroskedasticity and autocorrelation. The numbers in parentheses are *t*-statistics. *, **, *** denote significance at 10%, 5%, and 1% level respectively.

	Large Firms (19 Firms)				**Small firms (18 Firms)**			
Dependent Variables	$STDE_{i,t}$		$LTDE_{i,t}$		$STDE_{i,t}$		$LTDE_{i,t}$	
	without firm dummies (1)	**with firm dummies (2)**	**without firm dummies (3)**	**with firm dummies (4)**	**without firm dummies (5)**	**with firm dummies (6)**	**without firm dummies (7)**	**with firm dummies (8)**
$INFUNC_t$	0,0585	0,1057	-0,2472**	-0,2546***	0,7363	0,4384	-0,2355*	-0,0978
	(0,95)	(1,98)	(-2,44)	(-2,76)	(1,10)	(0,76)	(-1,82)	(-0,73)
$FATA_{i,t}$	-0,8298	0,0099	-1,0539	-1,3149	9,7118	5,3954	-2,1491	-1,3123
	(-1,34)	(0,01)	(-0,87)	(-1,08)	(1,05)	(0,76)	(-0,98)	(-0,53)
$(INFUNC * FATA)_{i,t}$	0,1474	-0,0018	0,2093	0,2335	-1,9581	-1,0238	0,4566	0,2053
	(1,24)	(-0,01)	(0,88)	(1,01)	(-1,06)	(-0,72)	(1,07)	(0,43)
$LONGREAL_t$	-1,0381	-1,0178	-2,0059**	-2,0232**	3,3521	1,6547	-1,6793	-0,6704
	(-1,01)	(-0,98)	(-2,29)	(-2,32)	(1,34)	(0,70)	(-1,63)	(-0,74)
$MTB_{i,t-1}$	0,001	0,0039	0,0321**	0,0313***	-0,0196	-0,0236	0,0338**	0,0202
	(0,10)	(0,46)	(2,31)	(3,29)	(-0,51)	(-0,61)	(2,56)	(1,32)
R-Squared	0,0264	0,2186	0,1264	0,5548	0,0316	0,2179	0,1266	0,4783
Obs.	380	380	380	380	360	360	360	360

Table 8 reports the regressions to test the robustness of the previous regression results. The sample is divided into two[5]. Namely large firms, which are defined as firms with average size is larger than the median of firm's size; and small firms, which are defined as firms with average size is smaller than the median of size. For simplicity, the firm which average size is exactly equal to the median is included to the large firms sample. Additional modification made is the inclusion of $LONGREAL_t$ which is defined as long-term real interest rate to replace long-term nominal interest rate. This variable is included to test if real interest rate performs better as a proxy for cost of debt.

Results from Table 8 shows that inflation uncertainty has strong negative relationship with long-term leverage, as shown by significant negative coefficients in Regression (3) and (4). However, it is not consistently related long-term leverage in small firms. Regression (7) points out that inflation uncertainty has significant negative relationship with small firms long-term leverage. Yet, after including firm dummy variables the effect does not persist, as shown in Regression (8). This indicates that for small firms, macroeconomic factors are not relevant for capital structure decisions.

Long-term real interest rate performs better as a proxy of cost of debt compared to nominal interest rate. Regression (3) and (4) prove that real cost of debt is negatively related to long-term leverage. But then again, it only applies for large firms. In addition, this variable does not influence leverage in small firms. This is probably due to small firms have a substantial amount of short-term leverage which is not sensitive to long-term real interest rate.

Finally, historical market-to-book ratio is still strongly influencing long-term leverage of large firms, but not for small firms. This indicates that for large firms, risk-sharing with debtholders is needed in the case of market overvaluation. Moreover, no evidence is found regarding interaction between firm's tangibility and inflation uncertainty.

V. Conclusion

Existing studies about capital structure have been mostly evolved around firm-specific factors. Some studies also examine that macroeconomic variables relate with capital structure decisions. As one of many macroeconomic indicators, inflation uncertainty is considered relevant to economic conditions in United States and Europe during the past few years. Both continents just endured a difficult economic times, causing uncertainty in macroeconomic conditions. Inflation uncertainty is found to be high during high inflation times. To observe if it is affecting capital structure decision and also to examine if it interacts with firm-specific characteristics is the primary objectives of this research. Covering two dimensions (time-varying dimensions of inflation uncertainty and firm-

[5] It is also possible to run three different regressions for each index. However, since AScX index consists of only 9 firms, the regression results will lack degrees of freedom. A fairly large number of observation (>300) is needed in order to have sufficient degrees of freedom.

specific dimensions of tangibility) related with capital structure decision, this research aspires to fill the gap in the existing literature about capital structure and macroeconomic variables.

Using the pooled sample of listed Dutch firms from Euronext Amsterdam during the period of 1993-2012, I find that inflation uncertainty exhibits a strong negative relationship with long-term debt-to-equity ratio. However, this result is only robust for large firms. This result is consistent with Hatzinikolaou, Katsimbris, and Noulas' (2002) conclusion. Inflation uncertainty reduces leverage exogenously. It increases business risk, which refers to more volatile operating income, causing the tax-shields to become more uncertain. Consequently, reduces the use of debt. Nonetheless, inflation uncertainty is not significantly related to short-term leverage. This is due to sensitivity of short-term financing with inflation uncertainty and interest rate change is lower than long-term financing.

Furthermore, no evidence is found regarding the interaction effect between firm's tangibility and inflation uncertainty. It creates neither "operating leverage effect" nor "collateralization effect". Therefore, to conclude that such interaction effect does not exist among Dutch firms is sufficient. Even so, tangibility itself does not count as an important factor in determining capital structure among Dutch firms. Additionally, interesting finding is that historical market-to-book ratio strongly affects debt levels positively, which is inconsistent with the existing theory. This matter needs further investigation.

My policy conclusion is macroeconomic uncertainty influences balance sheet structure. Study from Bernanke and Gertler (1989) explain that balance sheet shocks may affect the amplitude of investment cycle in a simple neoclassical model. Moreover, policy makers should pay attention that a country's monetary policy tends to be followed by other monetary instruments in the same direction with only rare reversals. For instance, in the US, it is approximately ten times more likely that a rise in interest rate will be followed by another rise in other macroeconomic indicators, rather than a fall, in interest rate. This is important for monetary officials to reduce shocks at firm level and therefore to promote stable monetary environment.

Limitations in this research are probably due to country setting choice. Netherlands' inflation uncertainty has proven to be remarkably stable during 1993-2012, despite the volatility of its inflation rate. Moreover, the selected sample of firms is considered a little bit too "few". Many of listed firms are still young. Additionally, as a part of European Union, The Netherlands economy may be influenced by policies or economic conditions from neighboring countries as well since the country uses the same currency as well as Germany, France.

Future research should select emerging market countries with much more firms to be selected as a sample (e.g., ASEAN countries, Latin America). This will provide us more insights as those countries usually have more volatile macroeconomic conditions. Tangibility issues may be more relevant in those countries, which might as well creates interaction effect between tangibility and inflation uncertainty.

Other recommendation for future research is to further investigate the interaction between macroeconomic variables and other firm-specific characteristics that influence capital structure decisions. It is interesting to observe if, for instance, inflation uncertainty interacts with firm's business risk (measured by its unlevered beta), or with its size, etc.

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