Determinants and forecasting of corporate profitability

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Abstract

This paper analyzes the key determinants of return on net operating assets (RNOA) and return on equity (ROE). Research in this field normally relies on linear autoregressive distributed lag models (Cheng (2005), Dickinson & Sommers (2011)) without further discussing why this relation should be linear. By relying on neo-classical theory, industrial pricing research and accounting principles I hypothesize how sales and operating cost are determined and use this to hypothesize about the timeseries properties of RNOA and ROE. By using pooled regression I estimate the effects on RNOA and ROE from the determinants of sales and cost. Then I estimate the determinants future predictive effect on RNOA and ROE using a distributed lag model and then an autoregressive distributed lag model to determine the persistence in RNOA and ROE. Thus, the paper can be used by financial analyst and investors in the income forecasting process.

JEL classification: D4, D24, G17, L1, M41
1 Introduction

For decades financial analysts have forecasted firm earnings in order to estimate firm value. This is primarily done by fundamental analysis. Nevertheless several numbers of econometric models have been suggested for forecasting firm earnings. However the explanatory power of these models is low and that is most likely why these models have not been more widely used.

The aim of this paper is threefold. First of all the aim is to explain how much of a firm’s profitability is accounted for by the macroeconomy, the industry, the firm, the management and the accounting methods used by the firm. Second, the purpose of the paper is to identify the determinants of firm profitability and thereby explain which industry-, firm- and management characteristics and accounting methods that influence firm performance and how. The last goal for the paper is to enhance the accuracy of firm profitability forecast.

By using pooled regression I am able to estimate how much of firms profitability that are explained by each of the business environments and the accounting method mentioned above. An by using the same explanatory variables when estimating (autoregressive) distributed lag models the model are able to predict future values of RNOA and ROE.

This paper do not a priori assume that firm profitability should be modelled using an linear autoregressive distributed lag model. Instead in this paper a bottom up approach is used, where separate models for sales and cost with a satisfying explanatory power firstly is fitted. Then these two models are combined and divided by net operating assets (NOA) to get the model for RNOA\(^1\). The paper rely on neo-classical economic theory and on the research field of industrial pricing in creating the sales and cost models. To get the model for ROE a model for net borrowing costs (NBC) is fitted. Then the decomposition of ROE into operating and financing activities is used and RNOA is substituted into this expression.

Since it is the primordial of a variable that goes into the denominator of a return ratio then the denominator value in a forecast model is known if one only want to predict one period ahead. Therefore the primary focus in this paper is to explaining and forecasting the numerator values in return ratios.

The paper contributes to the existing litterature in valuation and strategy by improving the understanding and quantifying the importance of factors (and thereby business enviroments) that determines corporate income. It also contribute to the managerial compensation litterature by quantifying how much managers can influence profitability measure and thereby influence shareholder value.

\(^1\)This approach of course doesn’t assure that the model would have better explanatory power than an linear autoregressive distributed lag model since though I may reduce the unexplained variance of each variable in the total model I then induce other sources of variance due to the covariances of the variables. Nevertheless if the covariances terms are small the explanatory gain exceeds the explanatory loss due to the induce of covariation between the explanatory variables.
This paper is aimed at financial analysts, investors and managers. Financial analysts and investors could use it in relation to valuation and managers could use it in relation to strategy choices, such as determining if the company should enter new or leave old industries and what effect a major employee layoff have on profitability.

Section 2 presents a review of existing literature in this field and identify the gaps in the literature. Section 3 describes the data used in the study together with the variable measurement and the statistical models used. In section 4 the results of the analyses are presented. Section 5 presents the additional analyses. The paper ends with a conclusion in section 6.

2 Litterature review

This section presents a literature review and identify the gap in the existing literature in this field. The literature in this field primary uses panel data either to analyze the time series properties of profitability or just to increase the numbers of observation in relation to just cross-sectional data by pooling the observations.

Earlier studies (Lieberson & O’Connor (1972), Weiner & Mahoney (1981), Dess & Davis (1984), Schmalensee (1985), Cool & Schendel (1988), Roquebert et al. (1996), McGahan & Porter (1997), Adner & Helfat (2003), Short et al. (2007)) segregate the variance in firms performance into macro-, industry-, firm- and management segments. Nevertheless none of the studies take the firms accounting methods into account. Together with this the main part of these studies use multiple linear regression with categorical explanatory variables which in the studies leads to a large amount of unexplained variance in the models for profitability. Short et al. (2007) uses another method for estimating how much of the variability in firm profitability that could be accounted for by each business environment. By using continuous explanatory variables and splitting firm performance into the mean of a higher level business environment there are not any unexplained variance. Such model would look like this:

\[
\pi_F = \pi_A + \frac{\pi_I - \pi_A}{\pi_F - \pi_S}
\]

\(\pi\) could indicate any kind of performance. The footnotes A, I, S denote the mean of all firms, the industry and the strategic group respectively and \(F\) denote the firm.

\(^2\)For a literature review of this kind of research from 2001 and earlier see Bowman & Helfat (2001).

\(^3\)The unexplained variance in the studies is low when they instead use sales or profit as the dependent variable.
The problem with this kind of model is that one can not tell how much of the variance in firms profitability that could be accounted for by the firm, management and accounting methods only how much these things together explain of the variance in firms profitability.

Another problem with both of the two analyze method mentioned above is that they do not explain why one business environment impacts the variability in firms performance more or less than others. These kinds of studies could not therefore be used to explain for example what makes one industry more profitable than another.

Other studies (Dechow et al. (1999), Myers (1999), Cheng (2005), Fairfield et al. (2009), Dickinson & Sommers (2011), and Landström (2011)) focus on the persistence and forecasting of firms profitability by relying on linear autoregressive (distributed lag) models. Cheng (2005) and Dickinson & Sommers (2011) include economic and accounting factors as explanatory variables for the persistence in firms profitability. The explantory power of the models from these studies is however low which suggest that maybe the linear autoregressive distributed lag model is not a good model of the true process for persistence in firms profitability or their models miss important explanatory variables. Fairfield et al. (2009) however show that a simple AR(1) mean-reverting model has a good explanatory power for RNOA but not for ROE. This again suggests that an AR(1) process for ROE might not be a good model. Also such model does not explain what factors that create the mean-reversion.

First of all this study fill in the research gap on firm profitability forecasting by not a priori relying on some kind of linear autoregressive process of firms profitability ratios. Second of all this study also fills in a gap regarding the variance segregation studies by reducing the amount of unexplained variance for the profitability ratios and by including accounting methods as an explanatory variables. However, the independent variables in this study should be classified into a business environment since the statistical models used in this study do not use categorical explanatory variables for each business environment like the earlier variance segregation studies do. The classification of the variables into business environment is done in section 3.3.2.

3 Data and Research Design

This section describes the data, the variable measures and the statistical models used in the study. The statistical models used is deriveded from neo-classical theory, industrial pricing research and accounting principles.

3.1 Data sample

In this study attempts have been made to replicate the data used by Cheng (2005). However this study consist of only 20,042 firm-year observations in relation to the 22,536 firm-year observations used by Cheng (2005).
Observations with available data on all explanatory and independent variables from Compustat North America database are used within the period 1976-1997. Thus the study only look at U.S. and Canadian listed companies. Firms in heavily regulated industries are excluded, such as financial institutions and utilities. This is done by excluding SIC codes in [6000;6999] and [4900;4999]. In order to reduce the impact of extreme observations firms with a book value of equity less than $1 million and firms with an absolute value of ROE greater than 100 percent is excluded. Also all explanatory variables are winzoried at the 1st and 99th percentiles.

3.2 Method

This subsection first hypothesize which factors that determines RNOA. Afterwards the decomposition of ROE in order to analyzies which factors that determines ROE, besides the ones that determines RNOA. The analysis of RNOA is broken down into determinants of sales and costs.

3.2.1 Determinants of Return on net operating assets (RNOA)

Since the return on net operating assets (RNOA) is defined as operating income (OI) divided by net operating assets (NOA) I first estimate a model of OI. This model is estimated by first estimating separate models for sales and operating costs and then linearly combining these two models into one to get a model of OI. Therefore I then focus on the determinants of sales and costs.

3.2.1.1 Sales determinants

Neo-classical microeconomic theory suggest that the quantity demanded by consumers \((q)\) of a good is a function of price \((p)\), price elasticity \((\epsilon)\), income \((GDP)\) and income elasticity \((\zeta)\). The demand function for product \(j\) at time \(t\) could be written as

\[
q_{j,t} = c_{j,t} p_{j,t}^{\epsilon_{j,t}} GDP_t^{\zeta_{j,t}}
\]

where \(c_{j,t}\), \(\epsilon_{j,t}\), \(\zeta_{j,t}\) are parameters that could vary across products. The parameters could also vary through time due to changed consumer behaviour.

If firm \(h\) supply all what is demanded of the firm’s product, the firm’s total sales at time \(t\) could be written as

\[
\text{sales}_{h,t} = \sum_{j=1}^{M} q_{j,t} p_{j,t} = \sum_{j=1}^{M} c_{j,t} p_{j,t}^{\epsilon_{j,t}} GDP_t^{\zeta_{j,t}} p_{j,t} = \sum_{j=1}^{M} c_{j,t} p_{j,t}^{1+\epsilon_{j,t}} GDP_t^{\zeta_{j,t}}
\]

Since a lot of products is not totally identical the parameters that need to be estimated could be as high as three times the number of observations. So even if all

\[4\] The main difference in the data sample between this study and Cheng (2005) is that Cheng excludes observations with an absolute value of abnormal ROE greater than 100 percent.

\[5\] Since \(c_{j,t}\), \(\epsilon_{j,t}\) and \(\zeta_{j,t}\) could vary both through products and time there is three unknown parameters that should be estimated for each observation.
product price data through time is available, the numbers of parameters to be estimated is still a problem. One way to overcome this problem is to use an aggregated measure and instead estimate a firm’s sales as

\[ sales_{h,t} = c_{h,t} p_{h,t}^{1+\epsilon_{h,t}} GDP_t^\zeta \]

but here the problem is that one cannot get price observations since \( p_h \) here denote firm \( h \)'s weighted prices for all their products. Therefore to solve this problem a way forward is to create a model of the firms price level and substitute \( p_h \) with that model.

**Price determinants**

Noble & Gruca (1999) analyzes pricing strategies used in practice in the U.S. and found that more than 50% of their sample of 270 respondents use more than one pricing strategy and that around 50% use a pricing strategy that take the average price set by other firms for a similar product into account, the so-called competitive strategies. Around 56% of the respondents uses a cost-based pricing strategy for price setting. That research therefore suggest that most managers in practice set their prices both relative to others and relative to their cost of producing.

This means that a model of firm price level should incorporate both the cost of producing and prices of competitors within the industry. Therefore the average price of products within an industry could be approximated by the industry's average cost of producing (ACP) times a markup (\( \mu \)). In this paper the model of individual firm sales is therefore a model which is combined of industry sales \( (\text{sales}_I) \) and individual market share of firms \( (\text{ms}) \).

The model for the individual firm \( h \)'s sales which operate in industry \( I \) could be written as:

\[ sales_{h,I,t} = ms_{h,I,t} \cdot \text{sales}_{I,t} = ms_{h,I,t} \cdot c_{I,t} (\mu_{I,t} ACP_{I,t})^{1+\epsilon_{I,t}} GDP_t^\zeta \]

The average cost of producing is equal to the cost of producing \( (CP) \) divided by the quantity supplied. Even if data on how many items of each product a firm produces is available, such data could not be used since the term quantity supplied here refers to the weighted quantity supply where the weight is average cost. Therefore the quantity supplied need to be estimated.

Neo-classical theory suggest that the production of a firm could be described as a function of labor \( (L) \) and capital \( (C) \) suggested by Cobb & Douglas (1928). In this function the term capital refers to machinery, equipment, etc. In other word the term capital refers to items that could not be classified as human capital. The Cobb-Douglas production function could be written as

\[ F(L, C) = \alpha L^\beta C^{1-\beta} \]
Substituting the expressions for average cost into the sales equation leads to the following model for individual firm sales

\[ sales_{h,I,t} = m_{h,I,t} \cdot sales_{I,t} = m_{h,I,t} \cdot c_{I,t} \left( \mu_{I,t} \frac{CP_{I,t}}{\alpha L_{I,t}^{\beta} C_{I,t}^{1-\beta}} \right)^{1+\epsilon_{I,t}} GDP_t^\zeta \]

**Average industry price elasticity determinants**

Pagoulatos & Sorensen (1986) analyze which factors that might be explanatory for the industry price elasticity. They found that product differentiation and barriers to entry and the stage of production significantly influence industry price elasticity. Using multiple linear regression the explanatory power of their model is between 30% and 47% depending on the data they use to estimate the price elasticity. However, they don’t discuss why they use a linear model and therefore in this paper both linear and non-linear models for the relation between average industry price elasticity and its determinants is used.

**Market share determinants**

Since the definition of market share is firm sales divided by industry sales then if one use firm sales as measure of firm size of course firm size would be a good explanatory variable for market share determinants. But since we try to forecast firm sales we would not use firm sales as an explanatory variable for market share. With simply math we get:

\[ m_{sh,I,t} = \frac{q_{h,t} p_{h,t}}{q_{I,t} p_{I,t}} = \frac{q_{h,t}}{q_{I,t}} \cdot \frac{p_{h,t}}{p_{I,t}} \]

This means that a firm’s market share then could be viewed as the firms quantity share of the total industry output times the firms price in relation to the industry average. The firms quantity share of total industry output could again be modelled in the same way as the industry output was modelled:

\[ \frac{q_{h,t}}{q_{I,t}} = \frac{\alpha L_{h,t}^{\beta} C_{h,t}^{1-\beta}}{\alpha L_{I,t}^{\beta} C_{I,t}^{1-\beta}} = \left( \frac{L_{h,t}}{L_{I,t}} \right)^{\beta} \left( \frac{C_{h,t}}{C_{I,t}} \right)^{1-\beta} \]

The firms price in relation to the industry average is expected to depend on factors that normally would justify that a firm could demand a price premium over the price of the average product in the industry. These factors should therefore be a proxy for product differentiation and/or product innovation. Just as with the average industry price elasticity determinants there is no a priori expectation whether the relation between product differentiation and/or product innovation and the firms price in relation to the industry average might be linear or non-linear and therefore both linear and non-linear models for this relation is tested.

**3.2.1.2 Cost determinants**

Since there is two factors or input in the production, labor and capital, these carry on some cost. The cost of production is therefore segregated into laborcost \((LC)\) and
costs of capital \((CC)\). Cost of capital includes depreciation of tangible assets and amortization of intangible assets. Each cost element can be split into the quantity used of the element times the unit price of the element. Labor cost could therefore be split into labor \((L)\) times the unit cost of labor \((w)\). Costs of capital could be split into capital \((C)\) times a capital reduction rate \((\delta)\). Besides these costs there exist direct cost \((DC)\) and other indirect costs \((OIDC)\). The firm’s cost is thereby

\[
\text{cost} = DC + LC + CC + OIDC = DC + wL + \delta C + OIDC
\]

Here the parameter \(w\) could be viewed as the average salary and \(\delta\) as a weighted depreciation/amortization rate. However the capital \((C)\) could be divided into tangible capital \((TC)\) and intangible capital \((ITC)\). Then \(\delta_T\) could be interpreted as the average depreciation rate and \(\delta_{IT}\) as the average amortization rate. An example of direct cost \((DC)\) could be the material cost used in production.

**Capital reduction rate and direct cost**

Since this paper focuses on accounting profitability measures it is expected that the capital reduction rate \((\delta)\) and direct costs \((DC)\) are influenced by accounting choices such as depreciation-method, depreciation-period and inventory valuation method. Together with accounting choice direct cost is also influenced by the bargaining power the firm has against its suppliers. It is expected that if the bargaining power the firm has against its suppliers increases then direct costs decrease. Although bargaining power against suppliers are expected to be negatively related to direct costs there are no a priori expectation regarding whether this relation is linear or non-linear. Therefore the relation is tested with both linear models and non-linear models.

### 3.2.2 Determinants of Return on equity (ROE)

Because of the decomposition of ROE it can be written as a function of RNOA, financial leverage \((FLEV)\) and the net borrowing costs \((NBC)\). Since the values in both the numerator and the denominator of \(FLEV\) is ‘primo’ values this paper do not focus on forecasting \(FLEV\), like the denominators in the return ratios which was mentioned in section 1. Therefore we can use the model for RNOA, then the only thing left to model is the NBC.

#### 3.2.2.1 Net borrowing costs (NBC) determinants

Net borrowing costs \((NBC)\) is defined as net interest\((return)\) \((NFE)\) on net financial obligations \((NFO)\). Therefore a simple model of net borrowing cost is

\[
NBC = \frac{NFE}{NFO} = \frac{\alpha FO - \beta FA}{FO - FA}
\]

Here \(\alpha\) and \(\beta\) denotes the interest\((return)\) on financial obligations and financial assets respectively. If \(\alpha\) is close to \(\beta\) we can estimate NBC as a constant since

\[
NBC = \frac{\alpha FO - \beta FA}{FO - FA} \approx \frac{\beta FO - \beta FA}{FO - FA} = \beta
\]
3.2.3 Determinants of profitability persistence

If one fits a non-timeseries model to some data and want to use that model for forecasting purposes one need to forecast each of the explanatory variables. If one then fits timeseries models for each of the explanatory variables and substitute these timeseries models into the original model then the original model could be turned into a timeseries model directly. The explanatory power of the model then of course highly depend on the explanatory power of the timeseries models for the explanatory variables. Therefore a model that is good for analyzing which factors that explain the value of the dependent variable might be a bad forecasting model if the modelling of the explanatory factors’ time series properties is poor. Nevertheless fitting a non-timeseries model is a good way to start a timeserie analysis since it might catch the relation between the explanatory variables and the dependent variable which normally is not argued by researchers in this field, just assumed in their papers.

The importance of having a good explanatory non-timeseries model before modelling timeseries with explanatory variables can be seen from an example below. If we let $y$ denote operating income, $x$ denote sales and $z$ denotes the costs which is negative we could rewrite operating income as $y_t = x_t + z_t$ where $t$ is an index for time and $f$ and $g$ are functions of time. If AR(1) models is good timeseries models for $x$ and $z$ then we have the following:

\[
y_t = x_t + z_t \tag{1}
\]

\[
x_t = \alpha_1 + \beta_1 x_{t-1} + f(t) + v_t \tag{2}
\]

\[
z_t = \alpha_2 + \beta_2 z_{t-1} + g(t) + \omega_t \tag{3}
\]

Substituting (2) and (3) into equation (1) then yields the model that should be estimated given the above relation between $y$, $x$ and $z$ and the evolution of $x$ and $z$ through time:

\[
y_t = \gamma + \beta_1 y_{t-1} + \beta_2 z_{t-1} + f(t) + g(t) + \varsigma_t \tag{4}
\]

The constants $\alpha_1$ and $\alpha_2$ is transformed into another constant $\gamma$ and the error terms $v_t$ and $\omega_t$ is transformed into one error term $\varsigma_t$. If one want the model to incorporate the timeseries properties of $y$ then equivalent models of the one above could be fitted by reparametrising the model:

\[
y_t = \gamma + \beta_1 (x_{t-1} + z_{t-1}) + (\beta_2 - \beta_1) z_{t-1} + f(t) + g(t) + \varsigma_t \\
= \gamma + \beta_1 y_{t-1} + (\beta_2 - \beta_1) z_{t-1} + f(t) + g(t) + \varsigma_t \\
= \gamma + \left( \beta_1 + (\beta_2 - \beta_1) \frac{z_{t-1}}{x_{t-1} + z_{t-1}} \right) y_{t-1} + f(t) + g(t) + \varsigma_t \\
= \gamma + \left( \beta_1 + (\beta_2 - \beta_1) \left( 1 + \left( \frac{x_{t-1} + z_{t-1}}{x_{t-1}} \right)^{-1} \right) \right) y_{t-1} + f(t) + g(t) + \varsigma_t
\]
The functions $f$ and $g$ capture the long-run trends of $x$ and $z$ respectively. If we look at economic timeseries they often have an exponential long-run growth trend. Therefore, if we let $s_t$ denote the exponential detrended timeseries of $p_t$ we have

$$s_t = p_t - e^{\lambda + \psi t}$$

where the long-run trend is estimated by the following log-linear regression

$$\ln(p_t) = \lambda + \psi t$$

If we use an AR(1) model on the detrended timeserie $s_t$ this is equal to the following AR(1) model for the original timeserie $p_t$

$$s_t = \gamma + \theta s_{t-1} + \epsilon_t$$

$$p_t - e^{\lambda + \psi t} = \gamma + \theta \left( p_{t-1} - e^{\lambda + \psi(t-1)} \right) + \epsilon_t$$

$$p_t = \gamma + \theta p_{t-1} - \theta e^{\lambda + \psi t} e^{-\psi} + e^{\lambda + \psi t} + \epsilon_t$$

$$p_t = \gamma + \theta p_{t-1} + \left( 1 - \theta e^{-\psi} \right) e^{\lambda + \psi t} + \epsilon_t$$

We can then see that the trend function is equal to $j(t)$.

In appendix A it is mentioned that when we look at a ratio which has a divisive relation then a timeseries model is not linear but converges to a linear model. If we assume that the timeseries RNOA has converged we can see that we could model the timeseries properties of RNOA in the following way:

$$RNOA_t = \gamma + \frac{1}{1 + \psi_{NOA}} \left( \rho + \beta PM_{t-1} \right) RNOA_{t-1} + \epsilon_t$$
where $PM$ and $\psi_{NOA}$ denote the profit margin and the long-run growth rate of net operating assets. We could then of course go a step further to analyze what drives the persistence in profit margin.

### 3.3 Variable measures and their business environment

In this subsection the measurement of the variables are presented. Also, these variables are classified into business environments in order to explain how much of the individual firm profitability that is accounted for by each business environment.

#### 3.3.1 Variable measures

In this paper GDP ($GDP$) is measured by the U.S. real GDP. As a proxy for labor ($L$) and capital ($C$) the numbers of fulltime employees ($FTE$) and the operating assets is used respectively. As a proxy for the cost of producing ($CP$) the accounting measure cost of goods sold ($COGS$) is used.

The industries are classified by three-digit SIC Codes and industry variables indexed with an $I$ is calculated by the sum of all firms in that industry.

When Pagoulatos & Sorensen (1986) estimate the product differentiation effect on the industry demand elasticity they use the total number of brands within an industry, advertising intensity measured by advertising expenditures to domestic sales and brand turnover which they measure as R&D expenditures to domestic sales. As measures for barriers to entry they use the four firm industry concentration, capital requirement and the effective tariff rate. The stage of production of the industry they measure as the percentage of the industry output which is sold to final consumers.

They found that all these proxies except the total number of brands all significantly influence industry price elasticity. As expected, they found that the product differentiation measures and barriers to entry proxies to be negatively related to industry price elasticity. The stage of production measure they found to be positively related since intermediate goods are used as complementarities with other input goods which means that the price elasticity of goods that are not sold to final consumers are expected to be lower than those sold to final consumers.

Advertising expenditures to sales is used as proxy for product differentiation and

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6However the four firm industry concentration is positively related to industry price elasticity. Researcher agree that it is the possibility of collusion between firms that creates a cooperative advantage which can lead into increased firm profitability in terms of higher prices without losing customers for example. In other words collusion would decrease price elasticity. However if price elasticity is not constant and instead a positive function of price, firms could increase the price so much after a collusion that price elasticity actually increases. Therefore researcher does not agree on the relation between industry concentration and industry price elasticity. Likewise the objective of collusion is to create a more monopolistic market in order to increase profitability. A less concentrated industry could be said to be more monopolistic. However if collusion surely increases with industry concentration the impact of industry concentration on profitability is ambiguous.
R&D expenditures to sales is used as a proxy for product innovation, like Cheng (2005) do.

As measures of other indirect costs \((OIDC)\) advertising and R&D expenditures are used\(^7\).

A firm could bargain with its suppliers regarding the price, the payment/financing terms and the quality. Dickinson & Sommers (2011) uses two measures of bargaining power against suppliers (BPS). The first is the operating liability leverage. If companies only bargaining with their suppliers regarding the payment/financing terms the price would not be affected. However it is assumed that the buying firms bargain both in terms of lower price and better payment/financing terms. Since higher operating liability leverage indicates better payment/financing terms for the buying firm this measure is expected to be negatively related to the price the buying firms pay. Therefore it is expected that operating liability leverage is negatively related to material cost. The second proxy for BPS used by Dickinson & Sommers (2011) is inventory turnover which they measure as cost of goods sold divided by inventory\(^8\). Inventory turnover is positively related to the number of transaction a firm makes with its suppliers. Since the supplier wants to minimize the number of transactions, this measure is expected to be negatively related to material costs. Another way to measure the BPS is to calculate how much of the supplier firms revenue that comes from the buying company. This measure is, like the other two measures, expected to be negatively related to material costs. Data on how a firms total revenue is distributed amongst all their costumers are not available to outsiders and therefore this measure is not directly observable but can be estimated via the buying firms revenue and in-/output tables (See the deviation of the estimate in appendix B).

All these three proxy measures for BPS are used in this study.

### 3.3.2 Classification of business enviroment factors

The only variable in the model that could be classified as a macroenvironment variable is GDP. The industry mark-up \((\mu_I)\), the industry average cost \((AC_I)\) and the industry constant \((c_I)\) may be viewed as the industrys accountability in the indiviual firm profitability. The market share \((ms)\) and all the cost element is firm specific factors. It could be argued that the industry has some kind of influence over the cost since the industry set the frames of the cost level. Therefore it make sense to split the cost function into the mean cost of the industry and the firm deviation from this mean. However this is not done in this study. Adner & Helfat (2003) argue that decisions such as downsizing, cost cutting, layoffs, financial and organizational restructuring come from management. Therefore variables such as the average number of fulltime employees \((L)\), financial leverage \((FLEV)\) and to some extent the average salary\(^9\) per employee could be influenced by the management. The capital

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\(^7\)R&D expenditures does not include engineering expense.

\(^8\)Dickinson & Sommers (2011) however uses the inverse turnover due to small or missing values problems of inventory.

\(^9\)Due to labor union wages can not be completely determined by the management of a firm.
reduction rate ($\delta$) is a function of accounting choices alone. The matrial cost ($DC$) is however a function of firm factors such as the bargaining power against suppliers ($BPS$) and the inventory valuation method and therefore ($DC$) is a function of both firm factors and accounting choice factors.

4 Results

5 Additional analyses

6 Conclusion
References


A From non-timeseries model with non-linear relation to timeseries model

Given a divisive relation\(^{10}\) between \(y, x\) and \(z\) and the evolution of \(x\) and \(z\) through time we have:

\[
y_t = \frac{x_t}{z_t}
\]

\[
x_t = \alpha_1 + \beta_1 x_{t-1} + f(t) + \nu_t
\]

\[
z_t = \alpha_2 + \beta_2 z_{t-1} + g(t) + \omega_t
\]

Again we can rewrite this to include terms of \(y_{t-1}^\text{.}:

\[
y_t = \frac{\alpha_1 + \beta_1 x_{t-1} + f(t) + \nu_t}{\alpha_2 + \beta_2 z_{t-1} + g(t) + \omega_t}
\]

\[
= \frac{z_{t-1}}{\alpha_2 + \beta_2 z_{t-1} + g(t) + \omega_t}
\]

\[
= \frac{z_{t-1}}{\alpha_1 + \beta_1 x_{t-1} + f(t) + \nu_t}
\]

\[
= \frac{z_{t-1}}{\alpha_2 + g(t) + \omega_t}
\]

\[
= \frac{z_{t-1}}{\beta_2 + \omega_t}
\]

\[
= \frac{z_{t-1}}{\beta_1 y_{t-1} + \frac{\alpha_1 + f(t)}{z_{t-1}} + \frac{\nu_t}{z_{t-1}}}
\]

If we just look at the \(y_t\) in the long-run \((t \to \infty)\) we get that

\[
y_t = \frac{x_t}{z_t} = \frac{z_{t-1}}{z_t} \frac{x_t}{z_t} = \frac{z_{t-1}}{z_t} \frac{x_{t-1}}{z_{t-1}} = \frac{x_{t-1}}{z_{t-1}} \alpha_1 + \beta_1 x_{t-1} + f(t) + \nu_t
\]

\[
= \frac{z_{t-1}}{z_t} \left( \beta_1 y_{t-1} + \frac{\alpha_1 + f(t) + \nu_t}{z_{t-1}} \right)
\]

\[
= \frac{z_{t-1}}{z_t} \left( \beta_1 y_{t-1} + \frac{f(t)}{z_{t-1}} + \frac{\alpha_1 + \nu_t}{z_{t-1}} \right)
\]

By using limiting value calculation rules we get

\[
\lim_{t \to \infty} y_t = \left( \lim_{t \to \infty} \frac{z_{t-1}}{z_t} \right) \left( \beta_1 y_{t-1} + \lim_{t \to \infty} \frac{f(t)}{z_{t-1}} + \lim_{t \to \infty} \frac{\alpha_1 + \nu_t}{z_{t-1}} \right)
\]

If we let \(\psi_x\) and \(\psi_z\) denote the long-run trend in \(x\) and \(z\) respectively we have that

\[
A = \frac{1}{1 + \psi_x}\]

Since \(\lim_{t \to \infty} z_{t-1} = \infty\) this means that \(C = 0\). The numerator and the

\(^{10}\)An example of this could be that \(y\) denote profitmargin and \(x\) denotes operating income and \(z\) sales.
denominator in $B$ both go to infinity when $t$ goes to infinity. From equation (5) we can see the expression of the trend function and by using L’Hôpital’s rule we get

$$B = \lim_{t \to \infty} \frac{\frac{\partial f(t)}{\partial t}}{\frac{\partial g(t)}{\partial t}} = \frac{\psi_x \left(1 - \theta_x e^{-\psi_x}\right) e^{\lambda_x + \psi_x t}}{\psi_z \left(1 - \theta_z e^{-\psi_z}\right) e^{\lambda_z + \psi_z t}}$$

$$= \frac{\psi_x \left(1 - \theta_x e^{-\psi_x}\right) e^{\lambda_x - \lambda_z + (\psi_x - \psi_z)t}}{\psi_z \left(1 - \theta_z e^{-\psi_z}\right)}$$

From this we can see that if $y_t$ should converge $\psi_z \geq \psi_x$. Therefore if we assume that $\psi_z > \psi_x$ we have

$$\lim_{t \to \infty} y_t = \frac{1}{1 + \psi_z} \beta_1 y_{t-1}$$

and by assuming $\psi_z = \psi_x = \psi$ we have

$$\lim_{t \to \infty} y_t = \frac{1}{1 + \psi} \left(\beta_1 y_{t-1} + \frac{\left(1 - \theta_x e^{-\psi}\right)}{(1 - \theta_z e^{-\psi})} e^{\lambda_x - \lambda_z}\right)$$

### B Suppliers bargaining power

$$BPS_{ih,jk} = \frac{rev_{ih,jk}}{rev_{ih} \cdot rev_{jk}}$$

We let $BP_{ih,jk}$ denote the bargaining power firm $h$ that operates in industry $i$ has against firm $k$ that produces input $j$. We let $BP_{ih,jk}$ be measured by the share of firm $k$’s total revenue that is accounted for by firm $h$. Therefore $BP_{ih,jk} \in [0; 1]$ and when $BP_{ih,jk}$ increases the bargaining power will also increase.

Let $rev_{ih,jk}$ describe the consumption of input $j$, firm $h$ in industry $i$ buys from firm $k$. The input, $j$, is although an industryinput. This means that $j$ more precisely describe all the input that firm $h$ buys from company $k$ which is a company that supplies products and/or services from industry $j$. If we then let $rev_{jk}$ denote the revenue that firm $k$ that operates in industry $j$ generates then the bargaining power $BP_{ih,jk}$ would be:

$$BPS_{ih,jk} = \frac{rev_{ih,jk}}{rev_{jk}}$$

It is assumed that firm $h$, that operates in industry $i$, buys $j$-inputs from all companies that operates in industry $j$, where the share that firm $h$ buys from firm $k$ is equal to firm $k$’s marketshare in industry $j$. This share is described by $MS_{jk}$. Therefore
$rev_{h,j,k}$ would be equal to firm $h$’s demand for input $j$, $rev_{i,h,j}$, times $MS_{j,k}$. If we let $Irev_j$ denote industry $j$’s revenue, we got:

$$rev_{i,h,j} = rev_{i,h,j} \cdot MS_{j,k} = rev_{i,h,j} \frac{rev_{j,k}}{Irev_j}$$

This means that

$$BPS_{i,h,j,k} = \frac{rev_{i,h,j} \frac{rev_{j,k}}{Irev_j}}{rev_{j,k}} = \frac{rev_{i,h,j}}{Irev_j}$$

where $rev_{i,h,j} = \frac{rev_{i,h} Ireq_{i,j}}{Irev_i}$. Here $rev_{i,h}$ simply denotes the revenue of firm $h$ that operates in industry $i$ and $Ireq_{i,j}$ denotes the requirement of inputs from industry $j$ that industry $i$ needs to make one unit of revenue.

It can be seen from the expression above that $BP_{i,h,j,k}$ doesn’t depend on the revenue of firm $k$. Therefore firm $h$ has the same bargaining power against all the firms that produces industry $j$-inputs. Therefore firm $h$’s total bargaining power over its suppliers is equal to the share of requirement for the input over the total requirements for inputs.

$$BPS_{i,h} = \sum_{j=1}^{N} \frac{Ireq_{i,j}}{Irev_i} BP_{i,h,j}$$

We let all firms in industry $i$ have the same relative input requirement from the other industries. This means that firm $h$’s total bargaining power over the suppliers therefore is:

$$BPS_{i,h} = \sum_{j=1}^{N} \frac{Ireq_{i,j}}{Irev_i} BP_{i,h,j}$$

where $N$ denotes the number of industries. Putting all this together we got

$$BPS_{i,h} = \sum_{j=1}^{N} \frac{Ireq_{i,j} rev_{i,h} Ireq_{i,j}}{Irev_i Irev_j} = \sum_{j=1}^{N} \left( \frac{Ireq_{i,j}}{Irev_i} \right)^2 \frac{1}{Irev_j} = \frac{rev_{i,h} \sum_{j=1}^{N} \left( \frac{Ireq_{i,j}}{Irev_i} \right)^2 \frac{1}{Irev_j}}{Irev_j}$$

This means that a company’s bargaining power against firms that produces input $j$ depends on the company’s revenue and the input requirement of input $j$ and the industry-revenue in industry $i$ and $j$ respectively.