TRACKING BUSINESS TRENDS – DILEMMAS OF MEASUREMENT

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ABSTRACT

Corporate performance may be tracked using various measures. Our model simulating the behaviour of a simple firm underlines that the choice on measurement unit determines what distortions we will face so based on different measures we may end up identifying completely different cycles. On the top of that, these cycles would radically modify if firms within the given industry would change their strategy towards the same direction or when structural changes happen in the economy. This may end in researchers analyzing non-existing cycle changes.

INTRODUCTION

We may measure corporate performance in various ways. Total sales, operational profit, or after tax profit are used by market analysts to describe a given industry, sum of added value (GDP – gross domestic product) is common measure in macro papers, while at firm level owners may focus on dividends, cash flows, or some profitability ratios, like ROI (return on investment), ROE (return on equity), or CFROE (cash flow return on equity). We may assume that an industry of well performing companies should be doing well at sector level, and an economy consisting of boosting industries ends up with great trends in macro economy. This argumentation may be logical, but is that really true once we use different measures to access performance at each of those levels? Our model shows how measurement results may differ across measures in case of a simple company when controlling for (1) operational and (2) financial leverage, (3) equipment lifetime, (4) demand fluctuations, and (5) inflation.

The main goal of our research is to show how the performance can differ depending on what level we carry out our analysis: on the whole economy level, the industry level or the company level. This is an important question, since in the literature several papers are dealing with the question of performance measurement, but usually the researches focus on one of the levels, and on different indicators, and different analysis methods. For example on the whole economy level related to performance, a key issue is to handle business cycles. The research related to the measurement of business cycles goes back to the late forties. The first notable research was carried out by Burns and Mitchell (1946). This research was followed by several more in this field. The main focus of these research were how to decompose the business cycle component from the empirical datasets, e.g. Baxter and King (1999), Hodrick and Prescott (1997), Darvas and Szapáry (2004), Hassler et al. (1992) or Diebold and Rudebusch (1994). The most commonly used methods based on Baxter and King (1999) are the following: two sided moving average; first-differencing; removal of linear or quadratic trend; application of Hodrick-Prescott (1997) filter; and band-pass filter. The variables that the researches usually use to analyze business cycles, are usually some type of macroeconomic factor, such as GNP (gross national product), fixed investment, employment, etc.

While on industry and company level the performance is measured in various way also empirically and theoretically. For example Capon et al. (1990) are using a meta-analysis method to analyze corporate performance by applying financial and non-financial indicators. They collected the indicators based on the empirical literature of the industry and company level based researches between 1921 and 1987.

Since in our paper we will focus only on financial indicators, we will use those ones, which are usually used in the literature, like the Sales, EBIT or the ROE (Damodaran, 2012).

Besides relying on the financial indicators generally used in the literature, we will also take into account the results of the literature in another aspect as well. Since in previous researches it was found that the effect of inflation is notable regarding the profitability and the value of a company (Dömötör et al., 2013, Radó, 2007). According to this we will use inflation in our models.

The paper will be built up as following: first we will introduce our model, then we show our results in a base scenario, where the demand on the market is stable, and the leverage of the companies is zero as

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well. Then in the following chapters we show how the fluctuation in demand will effect the performance of the company, the industry, and the whole economy. We will also analyze the effect of the different operational and financial leverages, the inflation, and the lifespan of the equipments to the performance. Finally in the last chapter we have our conclusions, and the limitations of our research.

MODEL DESCRIPTION

Our model tracks the performance of one single simplified firm. The company has only one product, which is manufactured using one type of machine. The net working capital of the operation is zero – payables financing inventory and customers completely –, so invested capital (IC) equals to the total value of the equipment.

The sales price (10) and demand quantity (2000 in the first period) is determined by the market forces and cannot be influenced by the firm itself. At the same time, the management will have an exact prediction of the demand at the beginning of each period, so they can purchase exactly the needed amount of machines and will manufacture all products that the market asks for. Though, they may not sell equipment purchased in the previous periods. Capacity only decreases once lifetime of the machine is over.

The firm has variable costs depending on the quantity produced and fixed costs that do not change with the amount produced. A pre-set part (50%) of both cost types is labour expense. Both sales and all types of manufacturing costs grow at the same inflation rate. To allow for comparison we set manufacturing costs always so that during the first period the firm earns an operational profit before depreciation and amortization (EBITDA – earnings before interest taxes depreciation and amortization) of 8000.

There are several kinds of machines available for the production all able to produce the same amount (10 thousand pieces) of product during a period. Those only differ in their useful lifetime (from 1 up to 6 years) and are depreciated linearly. The cost of each machine is calculated so that the yearly cost equivalent for each type would be the same. The price of the machine is indexed to inflation across periods and only whole number of machines can be bought.

At the start of period 1 we always assume that the machines owned are just enough to serve the first period demand and had been purchased in equal quantities during the previous years, so those will need gradual replacement. Given the different lifespans of the equipment when the required product quantity on the market changes the company may have to purchase new machines earlier or accumulate unused capacity depending on the type of machine used.

To calculate operational profit (EBIT – earnings before interest and taxes) manufacturing costs and D&A (depreciation and amortization) is deducted from sales. Then cost of debt (interest) is accounted for, and corporate tax (20%) is deducted to calculate profit after tax (PAT). The interest rate is automatically indexed for inflation. Retained earnings is calculated based on the required growth of equity given product demand of the next year. The difference of PAT and retained earnings is the sum of dividend paid and equity raised or repurchased. This is the cash flow that owners will face (FCFE – free cash flow to equity) and which would determine in the real life the market value of the ownership.

BASE SCENARIO

In the base scenario there is no growth or fluctuation in market demand, no inflation, and we have variable manufacturing costs only (operational leverage=0), operate without debt (financial leverage=0). Due to this, all periods modelled look the same.

Depending on the management choice of machines (financially completely value neutral) we will see different investment need, D&A, EBIT, tax, PAT, and dividend (FCFE). Though, sales and added value (AV = EBIT + D&A + Labour expenses) are the same in any case. As the choice of machine influences the investment need (IC), ROI, ROE and CFROE differ also heavily.

Table 1. Comparison across machine types

Level of analy-sis	Perfor-mance measure	Lifetime of machines		
		1 year	3 years	6 years
Macro	Added value	14 000.00	14 000.00	14 000.00
Industry	Sales	20 000.00	20 000.00	20 000.00
Industry	EBIT	2 990.38	3 409.16	3 920.00
Industry	PAT	2 392.31	2 727.33	3 136.00
Firm	ROI	59.69%	37.13%	27.45%
Firm	ROE	47.75%	29.70%	21.96%

Table 1 illustrates the differences between firms using machines of 1, 3 and 6 years of useful lifetime. We may conclude that while macro analysts would see no difference between the firms, industry analyst would see better performance at firms with machines of longer useful lifetime. At the same time, owners of the firms with shorter lifetime assets would be happier due to higher returns achieved.

Operational leverage would have no effect here, as costs are not changing over time, while financial leverage decreases PAT and boosts ROE (once cost of debt is less than ROI). The effect of inflation may seem neutral for the first look, as both sales price and all types of expenses are inflated by the same percentage. This is indeed true for Sales, Added value, and investment but not for EBIT, PAT, and FCFE (dividend) once the useful lifetime of the machines is longer than 1 year as it is shown in Figure 1.

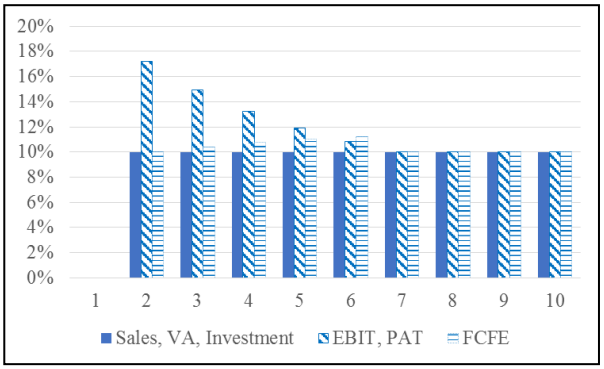

Figure 1. Yearly growth rate at 10% inflation for machines of 6 years lifespan

The reason for this is that D&A is not indexed for inflation, so it takes time that it reflects the growing price level. The lower than realistic D&A increases EBIT and PBT (profit before tax). As PBT is increased so by more than the inflation rate, the real tax burden of the companies grows. As invested capital (and so equity) is not indexed by inflation either, ROI and ROE grow also radically. This phenomenon is also illustrated by Table 2 and 3.

Table 2. Effect of inflation on the first year's numbers (1)

Machine lifetime	**1 year**		
Inflation	**0%**	**10%**	**Change**
Added value	14 000.00	15 400.00	*10.00%*
Sales	20 000.00	22 000.00	*10.00%*
EBIT	2 990.38	3 790.38	*26.75%*
Tax	598.08	758.08	*26.75%*
PAT	2 392.31	3 032.31	*26.75%*
ROI	59.69%	68.78%	*15.23%*
ROE	47.75%	55.03%	*15.23%*
IC	5 009.62	5 009.62	*0.00%*
E	5 009.62	5 009.62	*0.00%*

Table 3. Effect of inflation on the first year's numbers (2)

Machine lifetime	**6 years**		
Inflation	**0%**	**10%**	**Change**
Added value	14 000.00	15 400.00	*10.00%*
Sales	20 000.00	22 000.00	*10.00%*
EBIT	3 920.00	4 720.00	*20.41%*
Tax	784.00	944.00	*20.41%*
PAT	3 136.00	3 776.00	*20.41%*
ROI	27.45%	32.14%	*17.06%*
ROE	21.96%	25.71%	*17.06%*
IC	14 280.00	14 280.00	*0.00%*
E	14 280.00	14 280.00	*0.00%*

This means that depending on the average useful lifetime of machines applied a suddenly appearing inflation may distort statements for several years showing improvement in some of the measures while leaving other unchanged. On the top of all that the exact extend of distortions is also dependent on the type of equipment used by the firm.

INTRODUCING DEMAND FLUCTUATION

To get a more realistic model we assume some fluctuation in demand overtime according to Equation 1. To keep it simple we use a sinus function to achieve cycles between 2 and 3 million pieces per period. Figure 2 and 3 contrast the development of key quantities in case of different machine types. Our equation for demand (Q) is as follows:

$$Q_t = Q_0 + a * (1 + \sin(c * t)) \quad (1)$$

For the sake of example a=500 and c=100 have been chosen as parameter values.

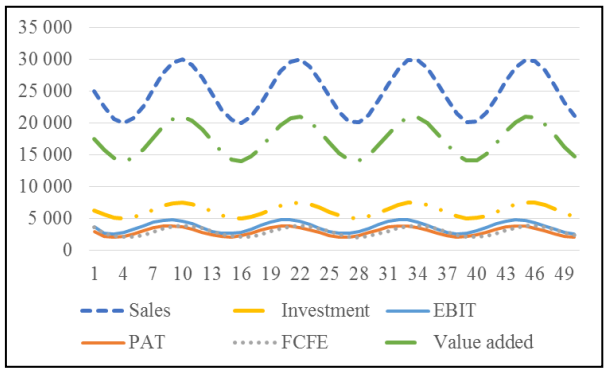

Figure 2: Effect of demand fluctuation – Lifetime of machines: 1 year

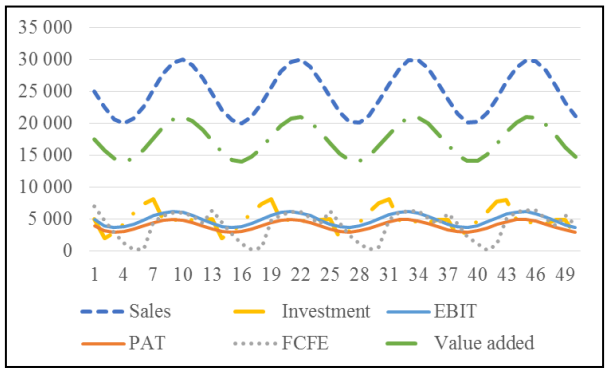

Figure 3: Effect of demand fluctuation – Lifetime of machines: 6 years

Note, that longer lifetime leads to investment and FCFE following new patterns. It is key to see that even during times of increasing output, Sales and added value investment may fall back as current capacity is dependent not only on current investment level, but also on those of the previous 5 years. Due to this fluctuation FCFE may not only grow when performance increases, but also when lower proportion

of current profit is needed to keep production capacity at the required level.

Differences are more dramatic when focusing on financial ratios instead of absolute quantities. As Figure 4 shows that the previously experienced synchrony disappears: in case of using 1-year machines CFROE, ROI, and ROE are unchanged and equal as the firm can adapt to the market fluctuations perfectly. When using equipment with 6-years life time, company will have some unused capacity during some periods, destroying capital efficiency. This means, that the risk of shares will also differ.

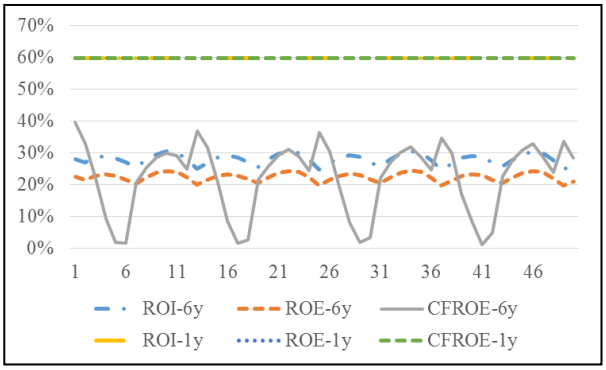

Figure 4: Effect of demand fluctuation – Financial ratios

FLUCTUATION AND LEVERAGE

Now, that manufactured amount changes from period to period, the amount of operational leverage (percentage of fixed costs) plays an important role. Assume that two technologies exist: the one used until now with 6 units of variable cost (VC) per piece and no fixed costs (FC), and another with 4 units of VC and 5000 units of FC. Note, that both of these technologies imply an EBIT of 4960.

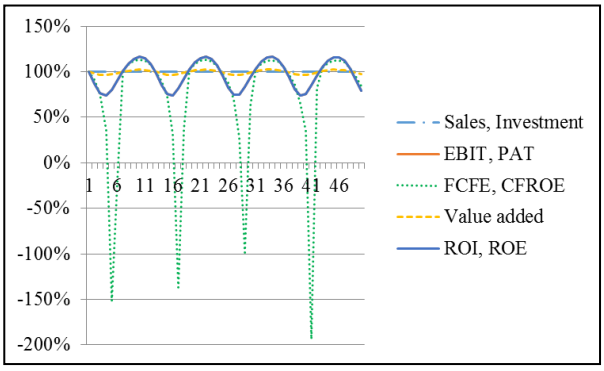

Figure 5: Performance with operational leverage in percentage of that without leverage (machines used for 6 years)

The only two measures that operating leverage does not affect is sales and investment. As fixed cost do not change overtime, more fluctuation is to be seen in all other quantities. Figure 5 offers a comparison between two otherwise identical firms using two different technologies.

Financial leverage (we assumed D/IC=50%. interest=10%) only effects P/L (profit and loss) item below EBIT. PAT is lowered by interest payment, but only hurts FCFE in periods when ROI is lower than cost of debt. In all other periods FCFE is dramatically increased that results in boosted CFROE at any time due to the continuously lower equity requirement as it can be seen in Figure 6. It is also worth noticing that operational leverage increased risk by boosting downside potential, while financial leverage (under the given conditions) added to risk by letting the upside grow.

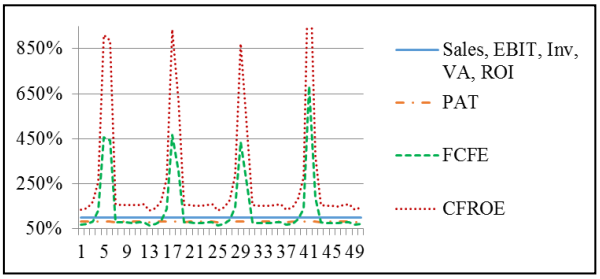

Figure 6: Performance with financial leverage in percentage of that without leverage (machines used for 6 years)

Adding inflation to the fluctuations will also complicate trend analysis. The steady price growth pushes up profits faster than sales or AV due to the lagging historical prices in D&A. As book value of machines (IC) is not indexed by inflation while profit is higher due to the D&A effect. ROI and ROE distortedly shows a better performance. CFROE is more realistic as D&A effect is not hitting it. FCFE shows radical fluctuations as the demand fluctuation requires to buy a huge number of new equipment every twelfth year but as FCFE is growing slower than investment, those years equity needs to be raised to cover extra investment, while the real performance of the firm has not changed at all.

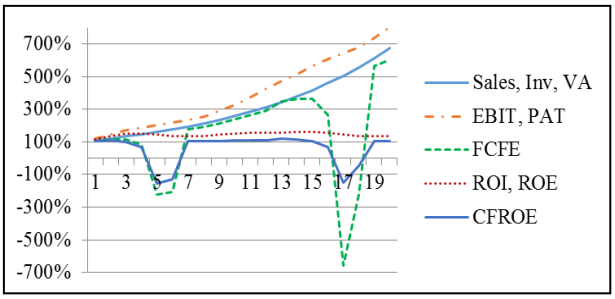

Figure 7: Performance with inflation (10%) in percentage of that without inflation (machines used for 6 years)

As we have seen, once demand is not constant it is not only the useful lifetime of the equipment used but also

operational and financial leverage, and inflation that would modify the measureable performance trends. In the next step we investigate how all these factors together may influence the financial numbers of a firm. Let us compare the development performance measures of two firms facing the same demand trends but using different machines (1 year lifetime against 6 years life time), different technology (VC=6 only and VC=4 and FC=5000), and different financing (D/IC=0 and D/IC=50% interest=10%). For simplicity we assume these firms operate in the same country and face the same inflation (0%). Note that the first firm is identical to what appears on Figure 2.

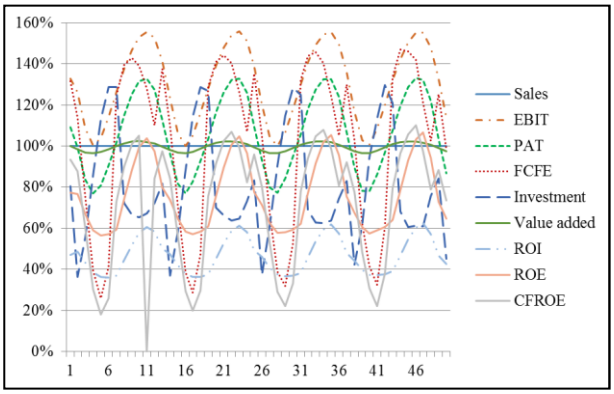

Figure 8: Comparing firms from the same industry of different equipment, technology, and financing (a=500. c=100) (ratio of performance measures)

Figure 8 illustrates the performance measurement problem of a given sector. Though sales trends are just the same (flat line at 100%), all other performance measures would differ across firms due to individual characteristics. It is easy to see that distortions are very different both in size, form, and timing. So when aggregating (summing, averaging) certain performance measures we would end up concluding totally different trends for the whole industry altogether.

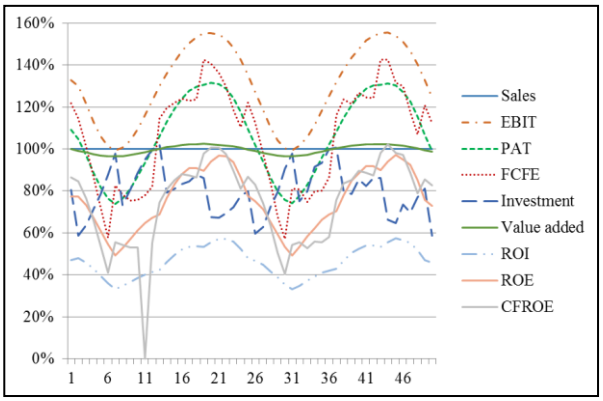

Figure 9: Comparing firms from the same industry of different equipment, technology and financing (a=500. c=50) (ratio of performance measures)

While one might think that careful modelling may help us to get rid of these distortions. Figure 9 and 10 supports that the problem is more complex. Just by increasing the wave length of the demand fluctuation to its twofold or fourfold (slower fluctuation of the same size) leads to a very different set of differences. Distortions in performance measures become more similar as wave length increases. (Endlessly long waves can be very similar to the flat demand we used at the beginning of this paper.)

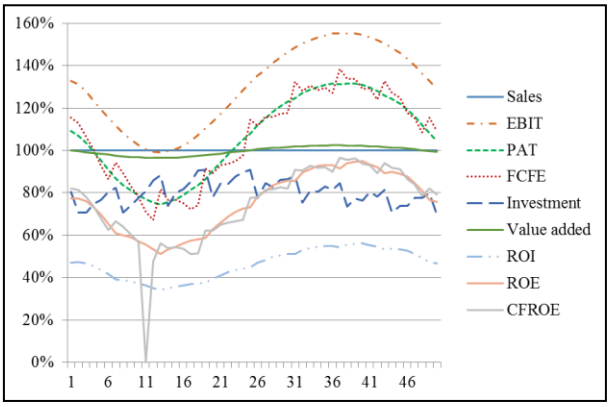

Figure 10: Comparing firms from the same industry of different equipment, technology and financing (a=500. c=25) (ratio of performance measures)

It is important to notice that while in case of the original fluctuation (Figure 8) ROE was able to over perform at peak times of the base model (Figure 2), due to change in the wave length this was not possible anymore. In other words it is also the type of demand fluctuation that determines how successful a given strategy might be on the market.

CONCLUSION

We prepared a simplified financial model of a manufacturing firm and analyzed how the useful lifespan of equipment used (length of replacement cycle), operational and financial leverage are applied (business strategy), and demand fluctuation and inflation (market conditions) would influence performance measures.

Even in case of stable demand the kind of assets used had serious effect on financial performance even though financially all of the alternatives cost the same (equal yearly cost equivalent) – a result quite counterintuitive.

We also saw that appearance of inflation not only increases tax payment in real terms cutting back on the value of the firm but at the same time distorts performance measures to show a contrary trend.

When demand fluctuation was introduced into the model it has become clear that investment may not peak in periods where demand does depending on the length of equipment lifetime and due to that cash flow

to shareholder may also be higher in years with lower demand.

The use of short lifetime equipment seems to protect owners from fluctuations of profitability ratios, while operational and financial leverage increase risk. Though added operational risk shows in increased downside potential while financial leverage (under our assumptions) offered an enhanced upside potential.

When considering inflation a new serious problem was identified: because of demand fluctuations owners were forced to regularly pay in cash to maintain an operation that did not change at all in real terms.

Finally, we compared performance measures of firms with different strategy to figure out that the choice of firms on machines and leverage would have dramatic effect on the performance measures making the original demand trend nearly unrecognizable. Depending on what kind of measure we focus on, the industry cycle would be described completely differently.

This issue becomes particularly important in a transforming economies. Once companies tend to change their strategy (some technologies, machine types, particular leverage level gaining popularity) or the structure of economy is shifted preferring firms with a given strategy, we may measure macro trend changes that are not existing at all.

Unfortunately these distortions are not even stable but rather depend on the speed of market fluctuations. It is not only the size but also the speed of market fluctuations that determine how successful a business strategy would be.

Due to these we have to be very careful when choosing a metric to track financial performance across time of a given industry of firm. Even an unchanged strategy could lead to very wild fluctuations in performance on a relatively stable market when different waves interpolate.

LIMITATIONS

In the real life firms may not be able to precisely predict the quantity to be produced and sold during the next period that may lead to distortions in investments and manufacturing. No matter whether they over or under estimate demand they will have a worse performance than predicted by our model, as both unneeded capacity and market growth potential not completely used causes losses compared to the optimum.

Inflation rates may differ across various types of cost, particularly the increase of wages may be very different to that of the material expenses. This could lead to even more complex distortions.

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