Technical Note

Cash Flow and the Consistency Principle in Working Capital Management Calculations

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Abstract

The consistency principle when estimating cash flows states that the net present value of the discounted cash flow should be the same, even when using different estimation methods and techniques.

However, the estimation is not straightforward when estimating nominal and real net change in working capital. A case experiment with 62 students was conducted, the results suggesting that they struggle with the consistency principle when estimating net changes in working capital as part of cash flow analysis.

This technical note proposes solutions to this challenge. The value from this technical note is to ensure correct estimation in net working capital cash flow changes, which contributes to providing an adequate level of liquidity, and gives a sound judgement in business project analysis and estimation of a firm's value.

Keywords

Management Accounting
Consistency Principle
Investment Analysis
Net Present Value
Nominal and Real Cash Flow
Working Capital

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Introduction

This technical note is about the consistency principle in calculating present value of changes in working capital as part of cash flow analysis. This principle is normally elaborated in corporate finance and financial management textbooks, but often left out or marginalized in accounting textbooks (see, for instance, two accounting textbooks with widespread usage: US-based Horngren *et al.* 2009, and UK-based Drury, 2015). Although it may be taken for granted that students know how to perform such calculations, our experience from teaching and grading exams shows that students struggle to grasp the consistency principle. This may at least partially be explained by the fact that the consistency principle is often marginalized in the curriculum, especially for those majoring in management accounting.

Our motivation for this technical note is to provide a quick introduction to this problem and illustrate with a real-life case how to overcome it. This may be used for shorter lecture sessions in accounting courses, where the theme may be project investment analysis, and, as part of this, a focus on the more troublesome area of the consistency principle as part of cash flow analysis.

In general, the use of the discounted cash flow method is described by Johnson and Kaplan (1987) as the main innovation in management accounting practice during the past 60 years. Wouters (2008) argues that cash flow should be the central theme in introductory courses in managerial and financial accounting as it is fundamental for investment projects or firm valuations. The practical value from correct cash flow estimations may be summarized as ensuring sufficient level of liquidity to pay short-term debt and operational expenses, accepting the good projects and avoiding the bad ones, and estimating more correctly a firm value.

One important aspect of cash flow analysis is working capital (WC). This has been previously identified as a difficult area in *teaching (Collins, 1985). From the financial* statement analysis, students learn that positive WC is good, which is opposed to the cash flow statements, where an increase in WC leads to

reduced cash flow. Petro and Gean (2014) argue that cash flow statement analysis is the most difficult of the three financial statements in a financial report.

To calculate the net change in WC, one must be sure to maintain the consistency principle, which implies that changes in the need for WC should affect the net present value of the discounted cash flow equally.

The remainder of the technical note is as follows. First, we describe the method and the case used in the experiment. The second section describes the results and common mistakes made, before the third section illustrates how to calculate correctly net real changes in WC. The technical note ends with some concluding remarks.

Method

In order to reject or confirm our preconception of the consistency principle as difficult to comprehend among students, we conducted a case experiment among two different management accounting classes in the third year of their Bachelor degree within business and administration at BI Norwegian Business School, Campus Trondheim and The Norwegian University of Science and Technology Business School (NTNU). Among the high schools and universities offering a Bachelor degree in business and administration in Norway, NTNU has the second highest admission requirements in terms of previous grades from upper secondary schools. BI Norwegian Business School is one of 75 business schools in the world that have a "triple crown" accreditation, which, among others, indicates that their teaching and research within business management and accounting is conducted at a high level.

Therefore, the students may be considered above average within their discipline, and conducting this experiment in their third year ensures that they have met cash flow analysis in previous accounting and finance courses.

The participants recruited for this experiment are majoring in management accounting. There is only one class at each school with this major. The experiment was conducted at the same time and place in the classes on the different school campuses, but one day at NTNU and another day at BI Norwegian Business School. In total, 62 students participated and handed in their case solutions, which is equal to approximately one of four students from this major specialization.[1]

An oral presentation of the study was given before signing the consent form. Then the case was handed out, with no collaboration or PCs allowed—only the aid of an exam-defined calculator. The answers were written in pen or pencil on paper, and 20 minutes was assigned to complete the case (see Appendix A for the case text and questions).

The case was based on a real company (Jacobsen & Svart AS) and their difficulties in estimating adequate levels of working capital. In real life, other aspects of cash flow analysis may also be difficult to estimate (for instance, nominal and real deprecation rates), but this falls outside the scope of this technical note. The values used are hypothetical for this company.

The Case: Jacobsen & Svart AS

Jacobsen & Svart AS is a niche coffee roaster. Until now it has focused only on coffee roasting, delivering high-end coffee mostly to restaurants and hotels.

The company's dedication to coffee has not gone unrecognized among customers, and it is about to expand by opening its own café for regular customers. Starting up an independent café requires a lot of assets, such as location, furniture, espresso machine, coffee beans, etc.

Although the consistency principle holds the same logic when looking at the total cash flow, we only look at the treatment of working capital for the sake of simplicity, with a

[1] Attending lectures is voluntarily, and the participation rate may be considered stochastic. If there is a self-selection bias, then this should be in a positive direction, with academically stronger students showing up at school and having interest in participating in the study.

special emphasis on inventories.[2]

Jacobsen & Svart AS is struggling to estimate its working capital need. The level of inventory must be balanced between the conflicting views of having sufficient inventory and not tying up too much capital (Randall and Farris, 2009). For instance, higher levels of inventory may facilitate increased sales and reduce transaction costs associated with smaller and more frequent procurements (Petersen and Rajan, 1997).

However, this must be weighed against stacking up too much inventory. Higher inventory levels run the chance of not being sold and going beyond the expiration date, and may too increase operational costs associated with storing and handling (Kim and Chung, 1990). There is also an opportunity cost associated with capital tied up in the working capital. At the other end of the continuum, we find the strategy of building down inventory to an operational minimum. This will accommodate much of the above-mentioned drawbacks with high levels of inventory, but comes with a cost as well. The risk of stock-outs increases, and firms may miss opportunities for volume discounts.

Jacobsen & Svart AS has done some preliminary analysis of a target inventory level, and even though there may be nominal changes over time, the real value of the inventory should be the same, providing sufficient inventory.[3] Since it is opening up a new café, the longevity of the business is highly unsure: thus, we are looking at this as an investment project, running initially for a three-year period. Moving forward, this note will use fictitious numbers for better illustrative purposes.

Assume that Jacobsen & Svart AS has in its preliminary analysis the following information:

1. The need for working capital is $210.000 at period 0.
2. The inflation rate is estimated to be 2,5%[4].
3. By using the WACC formula, the nominal weighted average cost of capital is estimated to be 10,7%, and by applying the Fisher principle, this equals to a weighted average real cost of capital of 8%.
4. The working capital will be released in its totality after the project ends.
5. The working capital is estimated on the basis of next year's sales.

The participants were given a shorter version of this case text with two tasks (Appendix A):

a) Estimate the present value of nominal changes in working capital.
b) Estimate the present value of real changes in working capital.

Results

Not everyone completed the two tasks (some left the question blank with no calculations). Those who did not answer were removed from further analysis of the results.[5]

To calculate changes in working capital was deemed a challenging task for the participants in the study, whether it was nominal or real net change in WC.

Approximately one in five managed to calculate correctly the nominal change in WC. This is surprising, as this is taught in introductory courses in management accounting and finance and should be common knowledge.[6]

The participants with a correct solution had a net nominal change of WC as illustrated below in Table 1.

[2] The total case would include other aspects such as revenues and operating costs, opportunity costs, sunk costs, as well as cash flow to equity.

[3] Nominal numbers: Today's commodity prices. Real numbers: A commodity's price adjusted for inflation. Expresses real purchasing power. We are bridging the gap by applying the Fisher principle: $r_n = r_r+j+(j\times r_r)$ or $r_r = (r_n-j)/(1+j)$, where r_n = nominal interest rate, r_r = real interest rate, j = inflation rate.

[4] The inflation rate equals the central bank of Norway's inflation target.

[5] See Appendix B for further description of the sample.

[6] It seems that what is taught and supposed to be known before an exam is easily forgotten afterwards.

Table 1: Net Nominal Cash Flow Effect from Changes in Working Capital.

Period	**0**	**1**	**2**	**3**
Opening WC	$ -	$ -210,000	$ -215,250	$ -220,631
WC Requirement (nominal)	$ -210,000	$ -5,250	$ -5,381	$ 220,631
Closing WC	$ -210,000	$ -215,250	$ -220,631	$ -
PV	**$ -56,495**			
IRR	**0.00 %**			
Assumptions:				
Nominal cost of capital	10.70 %			
Inflation rate	2.50 %			

Those with correct solution of net nominal changes seem to understand that Jacobsen & Svart AS needs to have inventories when starting up its café. Before it opens the doors to the café, it needs to have sufficient inventories of coffee beans, milk, napkins, etc. This is the logic behind inserting the need for working capital to period 0.

However, the consistency principle states that the real changes should give the same present value as nominal changes if calculated correctly. The reason for making such calculations may stem from Jacobsen & Svart AS now being unsure if its volume of inventory will actually increase during the different periods. It does not want to build up more inventory than necessary, and would like to make an analysis of real changes in working capital just to verify that the present value is the same. The second question asked the students to calculate this real change in WC. The results were even worse than when asked to calculate nominal change in WC. None of the participants was able to calculate the correct solution. Also, fewer participants tried to answer this question than attempted the first task.

Among the suggested solutions, we noticed that one mistake was especially frequent. Approximately one in five made a mistake with the requirements of WC being zero in periods 1 and 2. The (wrong) solution they suggested is illustrated in Table 2.

Table 2: Net Real Cash Flow Effect from Changes in Working Capital (Wrong)

Period	**0**	**1**	**2**	**3**
Opening WC	$ -	$ -210,000	$ -210,000	$ -210,000
WC Requirement (real)	$ -210,000	$ -	$ -	$ 210,000
Closing WC	$ -210,000	$ -210,000	$ -210,000	$ -
PV	**$ -43,295**			
IRR	**0.00 %**			
Assumptions:				
Real cost of capital	8.00 %			
Inflation rate	2.50 %			

It is understandable why students make this error, as the intuitive appeal is easy. When the real cash flow is constant over time, the net changes in WC requirement will only occur in period 0 and at the project end (period 3). However, this logic is wrong, as the present value has now changed. In the following discussion, two different techniques are used to overcome this challenge which may enable students to make the right transition from nominal to real changes in WC.

Discussion

The first technique is the common method explained in financial management textbooks, calculating the nominal change first and then deflating the cash flow. The second technique is less common, and illustrates how you may directly calculate the real change without going through the nominal change.

Technique 1: Deflating Nominal Net Change in Working Capital

One way is to calculate the nominal change first and then deflate the cash flow. This is illustrated below in Table 3 with the nominal cash flow first and then the real cash flow.

Table 3: Net Cash Flow Effect from Changes in Working Capital on Nominal Total Cash Flow

Period	**0**	**1**	**2**	**3**
Opening WC	$ -	$ 210,000	$ 215,250	$ 220,631
WC Requirement (nominal)	$ -210 000	$ -5 250	$ -5 381	$ 220 631
Closing WC	$ 210,000	$ 215,250	$ 220,631	$ -
Discounting (inflation)	1.00	0.98	0.95	0.93
Real cash flows	**$ -210,000**	**$ -5,122**	**$ -5,122**	**$ 204,878**
Discounting (Real Interest)	1.00	0.93	0.86	0.79
DCF	$ -210,000	$ -4,743	$ -4,391	$ 162,639
PV	**$ -56,495**			
IRR	**-2.44 %**			
Assumptions:				
Real cost of capital	8.00 %			
Inflation rate	2.50 %			

What we can see is that the present value is now the same as in the nominal change, and this is at the heart of the matter: using nominal or real numbers yields the same present value because *the actual volume in WC has not changed* (for instance, the level of inventory).

In other words, Jacobsen & Svart AS has not tied up more or less capital per se by stocking up coffee beans in its inventories, even though it seems so when using nominal numbers.

It should be noted that the internal rate of return (IRR) is not 0 per cent, as one should expect from Table 1.

Even though this is beyond the scope of this technical note, it shows how IRR may be a fallacious argument in decision-making processes among mutually exclusive investment projects.

Technique 2: Quasi-Real Net Change in Working Capital

The second method is to deflate the opening balance of working capital in period 1, as we are assuming that the real value of working capital will be reduced during the year due to inflation. This is illustrated in Table 4.

We can see the change: we are directly estimating the real change in working capital (highlighted in bold), as opposed to estimations in Table 3.

The logic here may not be as straightforward, as this technique means deflating a real net change in working capital. The reason is that the working capital received at the end of year 0 is both nominal and real in a sense, and if interpreted as nominal, the real value at the beginning of the year is then obtained by deflating this working capital. The real value is then $204,878 in each year.

Table 4: Net Cash Flow Effect from Changes in Working Capital on Real Total Cash Flow.

Period	**0**	**1**	**2**	**3**
Opening WC	$ -	$ 204,878	$ 204,878	$ 204,878
WC Requirement (nominal)	$ -210,000	$ -5,122	$ -5,122	$ 204,878
Closing WC	$ 210,000	$ 210,000	$ 210,000	$ -
Discounting (inflation)	1.00	0.98	0.98	0.98
PV	**$ -56,495**			
IRR	**-2.44 %**			
Assumptions:				
Real cost of capital	8.00 %			
Inflation rate	2.50 %			

It may also be remarked that there is a third way around the problem, namely calculating WC as a certain percentage of the present year's sales. The technical estimations for this approach are not included in this technical note, as there are some logical disadvantages to using this technique.

The reason is that the first WC will occur first at period 1 and not period 0, as when we are assuming WC based on the forthcoming year's sales. It does not make any sense for a café such as Jacobsen & Svart AS to receive its inventories at the end of period 1, as it needs supplies before the opening day in order to make coffee sales from day one: otherwise, it will open up and then wait for the supplies to arrive during the year, since WC is based on the present year's sales, which also creates a circular argument since we need the inventory in the first place to create sales at all.[7]

Although the estimation itself is not problematic from a technical point of view, the confusion of practical implications may overshadow the teaching effect.

Concluding Remarks

This technical note has contributed with a quick introduction to the consistency principle connected to a real-life case, and then illustrated how to maintain such consistency by using the case as an example. This case study focuses on the point that inflation may give the illusion of volume changing inventories, which is especially relevant for firms selling goods and holding inventories.

Our results indicate that many students struggle with working capital in cash flow analysis. This is the same whether they are asked about nominal or real changes in WC.

The wrong technique when estimating net real change of WC may be used in lectures, as this technique seem to be intuitively appealing among students. Then, one of the correct techniques may be chosen to illustrate how to be consistent.

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[7] E-commerce may, though, be an example where WC calculated from present year's sales is relevant.

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Appendix A

The Case: Jacobsen & Svart AS

Jacobsen & Svart AS is a niche coffee roaster. Until now, it has focused only on coffee roasting, delivering high-end coffee mostly to restaurants and hotels. Its dedication to coffee has not gone unrecognized among customers, and it is about to expand by opening up its own café for regular customers. Starting up an independent café requires a lot of assets, such as location, furniture, espresso machine, coffee beans, etc.

Jacobsen & Svart AS is struggling to estimate its working capital need. The level of inventory must be balanced between the conflicting views of having sufficient inventory and not tying up too much capital. Jacobsen & Svart AS has made some preliminary analysis of a target inventory level, and even though there may be nominal changes over time, the real value of the inventory should be the same, providing sufficient inventory. Since it is opening up a new café, the longevity of the business is highly unsure; thus we are looking at this as an investment project, running initially for a three-year period.

Assume that Jacobsen & Svart AS has in its preliminary analysis the following information:

- The need for working capital is NOK 210.000 at period 0.
- The inflation rate is estimated to be 2.5%.
- By using the WACC formula, the nominal weighted average cost of capital is estimated to be 10.7%; by applying the Fisher principle, this equals to a weighted average real cost of capital of 8%.
- The working capital will be released in its totality after the project ends

Based on the information above, answer the following questions

Estimate the present value of the nominal changes in need of working capital over the entire project period (fill in the total present value in the box).

Estimate the present value of the real changes in need of working capital over the entire project period (fill in the total present value in the box).

In your answer to these two questions, clearly illustrate the changes in opening and closing balance during the periods. Make all assumptions explicit in your answer if necessary.

Appendix B

Sample Description

	Class size (total)	Participants in given case	Participants who handed in case solutions	% Participation and handed in case solutions	Participants that answered question 1	% Correct on question 1	Participants that answered question 2	% Correct on question 2	Participants that answered both question 1 and 2
BI	50	14	8	20%	8	25%	8	0%	8
NTNU	200	80	54	25%	48	19%	41	0%	41
Total	**250**	**94**	**62**	**25%**	**56**	**19%**	**49**	**0%**	**49**