

Accounting in perfect and complete markets (Y3)

3.1 Proper accounting

As previously mentioned, whether accounting is done properly is a matter of judgement and circumstance in the real world. Yet, it is useful to explore a world in which proper accounting is a matter of fact (pun). We now make the simplifying assumption of *perfect and complete markets* in order to demonstrate that it is theoretically possible to construct an effective (and objective) measure of a firm's financial position and performance. However, keep in mind that our ability to demonstrate that a measure with this property exists is dependent on these simplifying assumptions.

3.1 Perfect and complete markets

In this analysis, we assume that everyone agrees about the future cash flows associated with the ownership of any asset. We also assume that every person in the economy faces the same known interest rate. Finally, we assume there is no uncertainty about the cash flows or interest rate, but this assumption is not that important to the basic conclusions.¹

These assumptions are consistent with the idea of perfect and complete markets, which you studied in your microeconomic principles class. Under these assumptions, it has been demonstrated that the *market value* of an asset exists, and it is equal to the present value of the future cash flows that its owner would obtain by having possession of the asset. *Economic income* is then naturally defined as the change in the market value of the asset.

The *accrual accounting system* that produces objective (and correct) measures of value and income is one that assigns assets a value equal to their market value and defines income as the change in market value of assets. We refer to this approach as *economic income accounting*. We next proceed to a numerical example to illustrate these ideas.

3.2 An illustrative example of economic income accounting

To be interesting, we need to expand our setting to one that covers several periods. Assume our firm can purchase a machine that will be used to produce a three-year sequence of cash flows as follows: \$2,600, \$2,400 and \$2,200. For simplicity, we assume that each cash flow will occur at the end of the year. Immediately after the third year the cash in the firm is paid out to its owners.

The market rate of interest is 10%. This means that the price of borrowing and lending for all market participants is 10%. Furthermore, assume that at each point in time, every market participant knows the future cash flows associated with ownership of the asset. These features follow from the perfect and complete markets assumption, and imply that there is market consensus regarding the worth of the asset.

A timeline appears in Figure 1 below.

¹ We could easily incorporate uncertainty if we further assume risk neutrality. In doing so, we could replace what were the certain cash flows with the market's assessment of the *expected* cash flows, and the analysis would change very little.

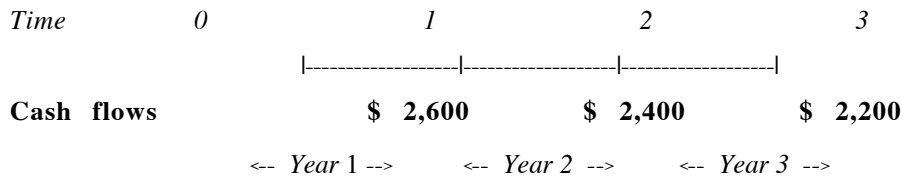


Figure 1: Timeline - Cash flows

Further details are provided below.

	Year 1	Year 2	Year 3
Cash contribution by owner	\$ 6,000	\$ 0	\$ 0
Purchase of machine for cash	6,000	0	0
Cash revenue	5,000	6,000	4,000
Cash expenses	2,400	3,600	1,800
Withdrawal by owner	0	0	7,986

Because we hold onto the machine for more than one accounting period, we now confront the issue of its valuation over time. This situation is similar to that of valuing the inventory at the end of the accounting period, which we encountered in the previous reading.

As mentioned above, one can prove that with our simplifying assumptions about markets, there exists valuation and recognition rules for preparing balance sheets and income statements that effectively measure financial position and performance. To be precise, we seek a way of preparing the financial statements such that *accounting income* is equal to *economic income*. The economic income of an entity is the amount of resources that could be paid out over a period of time such that the entity would be no worse off than at the beginning of the period.

Economic income accounting: At each point in time, each asset is valued at its market value, which in this simple economy is equal to the present value of the future cash flows obtained by its owner. A gain (asset appreciation) or loss (asset depreciation) is recorded, based on whether an asset's value increases or decreases over the reporting period.

Although this approach may look a little abstract, market value and present value approaches are sometimes recommended by (United States) Generally Accepted Accounting Principles. For example, GAAP recommends the use of lower-of-cost-or-market for inventories, fair value for trading securities, and effective interest amortization for bonds and notes.

Given that all participants borrow and lend at the same rate and are aware of the cash flows associated with asset ownership, a simple arbitrage argument implies the market value of the asset is equal to the present value of the future cash flows associated with the asset, which of course is its economic value. No one would be willing to purchase the asset for an amount greater than its known economic value, and no one would be willing to sell it for less. Therefore, in this simple economy equilibrium market values are well defined and equal to the asset's economic (present) value.

Applying this valuation rule to our example, the asset will be valued at Time 0 as follows.

$$6,000 = \frac{2,600}{(1.10)} + \frac{2,400}{(1.10)^2} + \frac{2,200}{(1.10)^3}$$

Notice from the table above that the purchase price (market value) of the machine is \$6,000, which is

identical to the economic value of the asset. This equality simply reflects the perfect and complete markets assumption that, in equilibrium, firms earn zero economic profits. The asset values at Time 1 and 2 are as follows.

$$4,000 = \frac{2,400}{(1.10)} + \frac{2,200}{(1.10)^2} \quad \text{and} \quad 2,000 = \frac{2,200}{(1.10)}$$

One uses these values to make a journal entry to record the depreciation or appreciation on the machine. One decreases or increases the machine's book value and at the same time records a gain or loss. Because the depreciation or appreciation amount is equal to the change in market value, and due to the perfect and complete markets assumption the market value is equal to the economic value, we refer to this approach as *economic depreciation*.² We note in passing that, in practice, accounting depreciation and amortization is generally not based on changes in economic value.³

Below are the journal entries for Year 1.

		Year 1	Year 2	Year 3
Cash contribution by owner	Cash Capital	6,000 6,000		
Cash payment for machine	Machine Cash	6,000 6,000		
Cash sales	Cash Revenue	5,000 5,000	6,000 6,000	4,000 4,000
Cash expenses	Expense Cash	2,400 2,400	3,600 3,600	1,800 1,800
Depreciation of machine	Expense Accumulated depreciation, machine	2,000 2,000	2,000 2,000	2,000 2,000
Closing 1	Revenues Income Summary Expenses	5,000 600 4,400	6,000 400 5,600	4,000 200 3,800
Closing 2	Income Summary Capital	600 600	400 400	200 200
Withdrawal by owner	Capital Cash			7,986 7,986

² Sometimes this approach is referred to as *effective interest depreciation* or *effective interest amortization*.

³ Accountants generally would regard depreciation not as a measure of (change in) value, but as a means of cost allocation:

"Assets are depreciated not on the basis of a decline in their market value, but on the basis of a charge of systematic charges to expense. Depreciation is defined as the accounting process of allocating the cost of intangible assets to expense in a systematic and rational manner to those periods expected to benefit from the use of the asset ... This approach is employed because the value of the asset may fluctuate between the time the asset is purchased and the time it is sold or junked. Attempts to measure these interim value changes have not been well received by accountants because values are difficult to measure objectively." (Kieso and Weygandt, 1998).

We are interested in reporting the firm's financial position at several points in time:

- Time 0 Immediately after the machine is acquired.
- Time 1 At the end of year 1
- Time 2 At the end of year 2
- Time 3 After operating cash flows are received in Year 3 but just before the owner withdraws the cash. (It is more instructive if we construct the last balance sheet just prior to paying the dividend).

Below are the financial statements. Note that the balance sheet and income statement fully articulate. Any change in assets that is not a capital contribution or a return of capital affects net income.⁴

<i>Balance sheets</i>	<u>Time 0</u>	<u>Time 1</u>	<u>Time 2</u>	<u>Time 3</u>
Cash	\$ 0	\$ 2,600	\$ 5,260	\$ 7,986
Long term asset	<u>6,000</u>	<u>4,000</u>	<u>2,000</u>	<u>0</u>
Total assets	<u>\$ 6,000</u>	<u>\$ 6,600</u>	<u>\$ 7,260</u>	<u>\$ 7,986</u>
Capital	<u>\$ 6,000</u>	<u>\$ 6,600</u>	<u>\$ 7,200</u>	<u>\$ 7,986</u>

<i>Income Statements</i>	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>
<u>Revenue:</u>			
Operating revenue	\$5,000	\$6,000	\$4,000
Interest revenue	0	260	526
Operating expense	(2,400)	(3,600)	(1,800)
Depreciation expense	<u>(2,000)</u>	<u>(2,000)</u>	<u>(2,000)</u>
Income	<u>\$600</u>	<u>\$660</u>	<u>\$726</u>

The financial statements are constructed using what we might think of as "savings account accounting." Remember, under our assumptions all assets earn 10%, so each period the cash balance is increased by net cash flows from the asset plus the interest earned during that period on the beginning cash balance. Interest earned in Year 2 is $.10 (2,600) = 260$. In Year 3, interest earned is $.10 (2,600 + 260 + 2,400) = 526$. Net cash inflows from the long term asset and interest earned are recorded as separate revenue items on the income statement.

The technique of economic depreciation is worth revisiting. In Year 1, economic depreciation is $6,000 - 4,000 = 2,000$. Depreciation expense results because some of the future cash flows have been realized, and so are no longer available from ownership of the asset. This suggests another way of arriving at the depreciation number. As time passes: (1) some of the cash flows are converted to cash *on hand*, and (2) interest has been earned on the beginning balance of the long term asset. Thus, depreciation expense can be calculated by netting the interest earned on the beginning of the period asset against the realized cash flow. For example, at the end of Year 1 a cash flow of \$2,600 is received, but we receive interest on the asset whose value was \$6,000 at the start of Year 1. Economic depreciation for Year 1 is thus: $2,600 - .10 (6,000) = 2,000$.

In this example, the sequence of depreciation expense numbers turns out to be equal to those obtained under the often-used straight line depreciation approach, but this is purely a coincidence: the depreciation numbers follow from the movement of the asset's market value through time.

3.3 Cash basis vs. accrual accounting

The economic earnings approach to financial statement preparation, which uses economic depreciation, is one of many ways to implement accrual accounting.⁵ One might ask how would the financial statements appear if we had used *cash accounting*, that is, no accruals. Recall that the only asset appearing on a balance sheet under cash accounting is cash. Below are the *cash basis* financial statements. (In the income calculation for Year 1 the cash payment for the machine is treated as an expense.)

<i>Balance sheets</i>	<u>Time 0</u>	<u>Time 1</u>	<u>Time 2</u>	<u>Time 3</u>
Cash	\$ 0	\$ 2,600	\$ 5,260	\$ 7,986
Capital	\$ 0	\$ 2,600	\$ 5,260	\$ 7,986

<i>Income Statements</i>	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>
<u>Revenue:</u>			
Cash revenue	\$5,000	\$6,000	\$4,000
Interest revenue	0	260	526
Operating expense	(2,400)	(3,600)	(1,800)
Investment expense	(6,000)	0	0
Income	<u>(\$3,400)</u>	<u>\$2,660</u>	<u>\$2,726</u>

We note that total income for the three years under cash basis accounting is $-3,400 + 2,660 + 2,726 = 1,986$. Interestingly, an economic income approach provides total income equal to $600 + 660 + 726 = 1,986$. This points out an important relationship between cash flows and accounting income. No matter how calculated, cash flows and accounting income (as long as clean surplus is followed), are equal in the long run. This suggests that the major concern when it comes to choosing an accounting method is its effect on the *timing* of when values and income numbers are recorded!

3.4 Interpretation of financial statements

Above we have shown that when cash flows and interest rates are known to all market participants there exists a way to do the accounting, which we referred to as *economic income accounting*, that produces accounting income numbers consistent with *economic income* (change in value). However, these assumptions are quite restrictive -- they require that all the market participants already know all the future cash flows. But if the world behaved this way, there would be no need to do accounting!

The point is that accounting takes on a vital role when markets are not well functioning. It is the existence of market imperfections that generates a demand for accounting. Accounting numbers are reported

⁴ This approach is often referred to as *clean surplus accounting*.

⁵ For example, one can use sum-of-the-years digits depreciation or double-declining balance depreciation. Also, recall that the depreciation numbers appear consistent with straight line depreciation, but that is an artifact of the cash flow stream chosen for the example. Different cash flow streams would yield depreciation patterns under economic depreciation.

in a world where the reporter knows more about the value of the assets in place than does the receiver of the report. It is this *asymmetry of information* that creates the need for accounting information to be verifiable or auditable. The usual defense of our accounting system, which generally consists of valuing assets at their historical cost, is that the cost of the asset and the accounting procedures can be verified by a third party, such as an independent auditor. *Conjectures* about future cash flows, which are necessary to use an economic income approach, cannot be verified. Thus, accounting's main purpose is not to measure economic income and value, but to discipline disclosures of forecasts and other non-accounting information about the firm.

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