Lecture 30
MACRS Depreciation

In order to prevent accounting anarchy, Congress, in the 1986 Tax Reform Act, reduced the number of depreciation methods that companies could use for tax purposes and strictly defined the allowable recovery periods for different classes of asset. This system goes by the name of ***Modified Accelerated Cost Recovery System*** or MACRS.

The MACRS makes two depreciation systems available: GDS (General Depreciation System) and ADS (Alternative Depreciation System).

Property that is used predominantly outside the US or less than 50% for business purposes must be depreciated using the ADS. Everything else is depreciated using the GDS, so that's the method we're going to concentrate on in this class.

Three depreciation methods are incorporated into GDS: straight-line, 150% declining-balance switching to straight-line, and double-declining-balance switching to straight-line. The method used depends on the type of asset and the recovery period.

For ***real property*** (i.e., buildings) MACRS requires you to use the straight-line method with a recovery period of n = 39 years. ***MACRS always assumes a salvage value of zero***, so the annual depreciation amount is just

$$D_t = \frac{B}{39}$$

For ***personal property*** (i.e., equipment) MACRS specifies recovery periods of 3, 5, 7, 10, 15, and 20 years depending on the type of asset that is being depreciated. Table 12.4 in the textbook provides some examples.

If the recovery period is 10 years or less, you must use double-declining-balance switching to straight-line. For recovery periods of 15 or 20 years, you must use 150% declining-balance switching to straight-line. In both cases, you must use ***a salvage value of zero***.

With a salvage value of zero, the depreciation amounts are functions only of the basis and the recovery period. This lets you calculate each year's depreciation amount as a percentage of the basis alone (since you always aim for zero once you switch to straight-line):

$$D_t = d_t B$$

Values of d_t are tabulated for each of the available recovery periods in Table 12.2.

Remember: the depreciation rate d_t is applied to the ***basis*** not the current book value.

If you look closely at Table 12.2, you'll notice that the number of rows is always one greater than the recovery period.

Under MACRS, it is assumed that all assets are ***placed in service*** and ***removed from service*** mid-year, so the recovery period actually spans n+1 tax years. During the first and last half-years, you can only write off half as much as you normally would because the asset is assumed to be used to generate revenue for just half the year.

So, for example, the MACRS depreciation schedule for an asset with a 3-year recovery period uses double-declining-balance-switching-to-straight-line depreciation. From our last lecture we know that, for the double-declining-balance method, the depreciation rate is

$$d = (2)\frac{100\%}{3} = 66.67\%$$

Ordinarily, the depreciation amount for the first year of a 3-year recovery period would be

$$D_1 = d \cdot BV_0 = 0.6667\,BV_0 = 0.6667\,B$$

However, since you're only allowed to claim half the depreciation amount in the first year, the actual depreciation for the first year is

$$D_1 = \frac{1}{2}\,d \cdot BV_0 = 0.3333\,BV_0 = 0.3333\,B$$

Subtracting this from BV_0, the book value of the asset after the first tax year is

$$BV_1 = BV_0 - D_1 = B - 0.3333\,B = 0.6667\,B$$

During the second and third years, you're allowed to claim the full depreciation amount:

$$D_2 = d \cdot BV_1 = 0.6667(0.6667\,B) = 0.4445\,B$$
$$BV_2 = BV_1 - D_2 = 0.6667\,B - 0.4445\,B = 0.2222\,B$$

$$D_3 = d \cdot BV_2 = 0.6667(0.2222\,B) = 0.1481\,B$$
$$BV_3 = BV_2 - D_3 = 0.2222\,B - 0.1481\,B = 0.0741\,B$$

During the fourth tax year, the DDB depreciation amount is less than the straight-line amount, so we switch to the straight-line amount:

$$D_t = \frac{BV_{remaining} - S}{n_{remaining}}$$

Since there's only half a year left in the 3-year recovery period and the salvage value is zero

$$D_4 = \frac{BV_{remaining} - S}{n_{remaining}} = \frac{BV_3 - 0}{0.5} = \frac{0.0741B}{0.5} = 0.1482B$$

But we're only allowed to take half the depreciation in the final period, so we actually use

$$D_4 = \frac{1}{2}(0.1482)B = 0.0741B$$

Subtracting this from BV_3, the book value after the fourth and final tax year is

$$BV_4 = BV_3 - D_4 = 0.0741B - 0.0741B = 0$$

Since the calculated book value is zero at the end of the recovery period, we know we did the calculations correctly, because MACRS always assumes a salvage value of zero.

If we compare the values above to those in Table 12.2, we see that they're exactly the same:

$$D_1 = d_1 \cdot B = 0.3333B$$

$$D_2 = d_2 \cdot B = 0.4445B$$

$$D_3 = d_3 \cdot B = 0.1481B$$

$$D_4 = d_4 \cdot B = 0.0741B$$

By using a salvage value of zero, the depreciation amounts are simply some fraction of the initial basis, B. This makes it easy to calculate depreciation amounts and book values, even if you don't know the underlying method. Let's see how this works for our Ferryman Example:

Ferryman Example 4

In 2004, Ferryman Company, a titanium producer in Pennsylvania, expanded its operations with the purchase of a $10 million rolling mill. Assume the new mill was fired up at the start of 2005 and runs at its peak capacity of 4 million pounds of output per year for 10 years. Assume that each pound of output generates $9.00 in revenues while costing $4.00 to produce. Assume that O&M costs are $10 million in 2005 and grow by $1 million per year after that. At the end of 10 years the mill will be sold for scrap for $500,000. Calculate the depreciation amount they can claim for 2007 and the book value at the end of 2007 using the MACRS with a 10-year recovery period.

For the purpose of this example, we'll assume the entire mill can be depreciated as a single object. In reality, every piece of equipment in the mill could have a different recovery period and equipment that had to be replaced would initiate a new recovery period for the replacement.

Since the mill was ***placed into service*** ("fired up") at the start of 2005, then 2005 is Year 1 in the MACRS and 2007 is Year 3.

From Table 12.2, for n = 10 and *Year* = 3, the depreciation rate d_t is 14.40% so

$$D_3 = d_3 \cdot B = 0.1440(\$10^M) = \$1.44^M$$

To calculate the book value at the end of Year 3, we have to subtract from the first cost everything that was written off in Years 1, 2, and 3. We can do that by simply subtracting all of the d_t values in the table from 1.0 and multiplying the result by the first cost:

$$BV_3 = B - \sum_{t=1}^{3} D_t = B - \sum_{t=1}^{3} d_t \cdot B = B\left(1 - \sum_{t=1}^{3} d_t\right) = \$10^M\left(1.000 - 0.100 - 0.180 - 0.144\right) = \$5.76^M$$

Note that this book value is larger than the one we calculated last time ($5,120,000) using DDB depreciation. That's because, under MACRS, we were only allowed to write off half a year's worth of depreciation in 2005, but we were able to write off a full year's worth ($2,000,000) in the earlier DDB example.

Let's say we wanted to know the book value at the end of 2011 (Year 7), instead. We could calculate it just as we did for Year 3:

$$BV_7 = \$10^M\left(1.000 - 0.100 - 0.180 - 0.144 - 0.1152 - 0.0922 - 0.0737 - 0.0655\right) = \$2.294^M$$

That's a lot of work! Remember, though, that the book value at any point in time is equal to the portion of the initial cost not yet written off. Therefore, it would be easier to just add all of the percentages we haven't yet used rather than subtract the ones we have used:

$$BV_7 = \sum_{t=8}^{11} D_t = B\left(1 - \sum_{t=8}^{11} d_t\right) = \$10^M\left(0.0655 + 0.0656 + 0.0655 + 0.0328\right) = \$2.294^M$$

This is quite a bit quicker than subtracting the first seven percentages from 100% to get the same answer!