ECON 180

Introduction to Principles of Microeconomics and Financial Project Evaluation

Lecture 32: Capital Cost Allowances

November 25, 2022

Version 1

Required Reading

- Starky, S. (2006). *Capital Cost Allowance* [PB 06-06E]. Retrieved from http://publications.gc.ca/site/eng/9.560783/publication.html
- Recapture [Web Page]. (2021, May 26). Retrieved from https://www.taxtips.ca/glossary/recapture.htm
- Terminal Loss [Web Page]. (2019, March 12). Retrieved from https://www.taxtips.ca/smallbusiness/terminal-loss.htm

Optional Reading: Sources on CCA

- Basic information about capital cost allowance (CCA) [Web Page].(2019). Retrieved from https://www.canada.ca/en/revenue-agency/services/tax/businesses/topics/sole-proprietorships-partnerships/report-business-income-expenses/claiming-capital-cost-allowance/basic-information-about-capital-cost-allowance.html
- Capital Cost Allowance [Web Page]. (2021, May 8). Retrieved from https://www.taxtips.ca/smallbusiness/ccarates.htm
- *Engineering Economics*, 2.7.1, 2.7.2, 2.7.4, 8.5.1, 8.8, 8A
- Classes of depreciable property [Web Page].(2020). Retrieved from https://www.canada.ca/en/revenue-agency/services/tax/businesses/topics/sole-proprietorships-partnerships/report-business-income-expenses/claiming-capital-cost-allowance/classes-depreciable-property.html

Optional Reading: Issues and Case Studies

- Mida, I. & Stewart, K. (1995). The Capital Cost Allowance System. *Canadian Tax Journal, 43*(5), 1245-1264. https://heinonline-org.ezproxy.library.uvic.ca/HOL/Page?lname=Mida&handle=hein.journals/cdntj43&collection=&page=1245&collection=journals
- Schoney, R. A. & Rinholm, R. A. (1989). Capital Cost Allowance and Tax Neutrality: A Case Study of Saskatchewan Farmers' Claims Versus Actual Depreciation. *Canadian Journal of Agricultural Economics*, *37*, 47-62. https://doi-org.ezproxy.library.uvic.ca/10.1111/j.1744-7976.1989.tb03335.x
- Tedds, L. (2015, February 13). Tax Policy that no one will listen to: CCA systems is overly complex and not a political tool [Blog Post]. https://deadfortaxreasons.wordpress.com/2015/02/13/tax-policy-that-no-one-will-listen-to-cca-systems-is-overly-complex-and-not-a-political-tool/

Learning Objectives

- Obtain a basic understanding of the basic concepts behind depreciation.
- Gain familiarity with calculating depreciation using the declining balance method.
- Understand how the Canadian tax code treats depreciable property.
- Be able to conduct a full tax-adjusted present or annual worth evaluation (using, among other tools, the CTF and CSF).
- Be able to calculate maximum CCA deductions and remaining UCC in a given year, making use of the half-year rule when required.
- Be able to calculate the tax impact of asset dispositions or acquisitions, taking terminal loss or recapture into account when appropriate.

Relevant Solved Problems

- From *Engineering Economics,* 6th edition.
- Declining Balance Depreciation: Example 2.10, Review Problem 2.4, Review Problem 8.4, 2.18, 2.19, 2.21, 2.43, 2.44.b, 2.44.c, 2.54, 8.29.d, 8.29.e
- CCA and UCC: **Example 8.5**, Review Problem 8.1, 8.5, 8.7, 8.8, 8.9, 8.13, 8.17, 8.18, 8.20, 8.30
- CTF and CSF: Example 8.6, 8.6, 8.10
- Tax-Adjusted Present Worth (including IRR): Example 8.7, Review Problem 8.3, 8.4, 8.14, 8.15, 8.16, 8.21, 8.22, 8.24, 8.27, 8.28, 8.32, 8.33, 8.35, 8.36, 8.37, 8.38
- Tax-Adjusted Annual Worth (including IRR): Example 8.8, Example 8.9, Review Problem 8.2, 8.19, 8.23, 8.25, 8.26, 8.31, 8.34

Notation Dictionary

(Not provided on quiz/final formula sheet)

- A = Annual Savings
- CCA = Capital Cost Allowance
- CRA = Canada Revenue Agency
- CTF = Capital Tax Factor
- CSF = Capital Salvage Factor
- d = depreciation rate (%/year)

i = interest rate
N = the N'th time period
P = Initial Cost
PW = Present Worth
S = Salvage Value
t = tax rate (%)
UCC = Undepreciated Capital Cost

$f(x)$

Formula Sheet Equations:

- Notation: The orange symbol on a slide indicates a formula sheet formula is introduced there.
- (These will be provided on quizzes and the final.)

- Book Value, Declining-Balance: $\mathrm{BV_{db}(n) = P(1-d)^n}$

- Capital Salvage Factor: $\mathrm{CSF = 1 - \frac{td}{i+d}}$

- Capital Tax Factor: $\mathrm{CTF = 1 - \frac{td\left(1+\frac{i}{2}\right)}{(i+d)(1+i)}}$

ESSENTIALS (19 slides)

So, what about taxes on depreciable property?

- If a firm purchases an asset, that's a capital expense.
- Net income is taxed, so an expense reduces taxes.
- Asset depreciation is an expense →Depreciation reduces taxable income.

- To avoid companies claiming 100% annual depreciation to write off taxes quickly (remember the all-important payback period), the CRA uses declining balance depreciation and sets the depreciation rate, d, by asset category.
- The resulting depreciation expense is called a capital cost allowance (CCA).
- Note: Land is NOT considered a depreciable asset, and has its own tax rules.
- Via the CCA, a firm can eventually claim all of an asset's cost (as it depreciates to zero).
- The government assumes (except in the first year) that an asset loses a constant % of its remaining value each year – that it *depreciates* at a constant rate.

A few CCA rates (Source: CRA)

Class	Rate	Description
1	4%	Most buildings bought after 1987. Non-residential buildings bought by a Canadian taxpayer after March, 2007 and used to make or process goods for sale get an additional 6%, for a total of 10%. For all other eligible non-residential buildings in this class, the rate includes an additional allowance of 2% (total 6%).
8	20%	Property that you use in your business and that is not included in another class. Also included is data network infrastructure equipment and systems software for that equipment acquired before March 23, 2004.
10	30%	General-purpose electronic data-processing equipment (commonly called computer hardware) and systems software for that equipment acquired before March 23, 2004, or after March 22, 2004, and before 2005 if you made an election. Motor vehicles and some passenger vehicles.
10.1	30%	A passenger vehicle not included in Class 10.
43.2	50%	Electrical vehicle charging stations (EVCSs) set up to supply 90 kilowatts and more of continuous power. For property acquired for use after March 21, 2016, that has not been used or acquired for use before March 22, 2016.
54	30%	Zero-emission vehicles acquired after March 18, 2019, that would otherwise be included in Class 10 or 10.1. These vehicles may be eligible for the first-year enhanced CCA deduction with a phase-out period. There is a limit of $55,000 for 2019 on the capital cost for each zero-emission passenger vehicle.

Undepreciated Capital Cost (UCC)

- The Undepreciated Capital Cost (UCC) is that part of the asset's cost that hasn't depreciated away (for tax purposes).
- CCA = d x UCC
- Each year's UCC is diminished by the previous year's claimed CCA.
- Note that the tax benefit is only t x d x UCC, since the CCA is a deduction.
- As an example, take an asset in Class 8, for which d = 0.2, and look at years 4 and 5 of its life…

Year	UCC	CCA
4	100	20
5	80	16

The half-year rule

- Prior to 1981, Canadian companies would try to buy all their depreciable assets as close to the end of the year as possible…
- That way they got to claim a full year's depreciation on a new asset.
- To stop this, the CRA instituted the half-year rule: in the first year of its life, an asset can only claim *half* the usual CCA.
- Let's look at our Class 8 asset again, but suppose we start in Year 1…

Year	UCC	CCA
1	100	10
2	90	18

Year	UCC
1	$\frac{P}{2}$
2	$P - CCA_1$
N > 2	$UCC_{N-1} - CCA_{N-1}$

Disposition

- Often, in the same year, assets are *disposed* of as well as acquired.
- Salvage/Resale/Scrap is an important example.
- For assets *in the same CCA class*…
- $UCC_{opening} + additions - disposals - CCA = UCC_{ending}$
- Don't forget to take the half-year rule into account!
- Consider this example from the text, with d = 0.20.

Year	Purchase	Salvage
2006	10000	
2007	20000	
2011	5000	2000
2012		2000

The evolution of UCC in the text example

Year	Purchases and Dispositions	Base UCC for CCA	CCA	Remaining UCC
2006	10000	5000	1000	9000
2007	20000	19000	3800	25200
2008	0	25200	5040	20160
2009	0	20160	4032	16128
2010	0	16128	3226	12902
2011	3000	14402	2880	13022
2012	-2000	11022	2204	8817
2013	0	8817	1763	7054

This is a great example to study in order to understand how CCA works: this question includes just about EVERYTHING.

- 2006: Only ½ of the $10,000 is used for CCA calculations because of the half-year rule.
- BUT the UCC *account* is increased by the full $10,000
- →Remaining UCC is $10,000 – CCA = $9,000
- 2007: Only ½ of the $20,000 is allowed for CCA calculation, so the UCC for CCA is $9,000 + $10,000.
- BUT Remaining UCC is $9,000 + $20,000 – CCA = $25,200.
- CCA for 2007 is 0.2 x ($9,000 + $10,000) = $3,800
- In 2011, purchases of $5,000 are offset by salvage of $2,000, so the *net* purchase is only $3,000, and this amount is subject to the half-year rule.
- In 2012, a net disposition due to salvage leads to the UCC being reduced… by the full $2,000, since the half-year rule only applies to new purchases.

This is example 8.5 in the recommended text.

Recapture and Terminal Loss

- Since this answers the common questions, ‘What if S > UCC?’ and ‘What happens after the last asset is salvaged?’
- If the proceeds of the disposition of property of a class exceed the UCC balance in the class, that negative balance will be included in income for tax purposes as 'recapture'.
- Any UCC balance remaining after all property of a class is sold can be deducted in computing income for tax purposes as a 'terminal loss'.
- Archived CRA bulletin explaining recapture and terminal loss:
- http://www.cra-arc.gc.ca/E/pub/tp/it478r2/it478r2-e.html

Intuition…

- Suppose you have a bank account, and one day you decide to close down that bank account.
- If you have a positive balance in the account, the bank gives you that money when you close the account.
- If you have a negative balance in the account, the bank will insist you pay up when you close the account.
- It's the same with the UCC account. If, when you sell your last asset in the class, the balance is…
- Positive: the CRA gives you the remaining balance to use as a tax deduction immediately. (Terminal Loss)
- Negative: the CRA will need you to 'pay up', by adding the magnitude of the balance to your taxable income, raising your tax bill. (Recapture)

Issues with CCA Rates and Recapture

- (Tedds, 2015) points out there are cases where CCA rates can be *faster* than use-based depreciation.
- Following Tedds, suppose a tractor is almost 100% depreciated in 2 years, according to the CCA, but in fact has a maximum useful life of 20 years.
- Suppose the truck is sold after, say, 15 years of use.
- Then the UCC falls by the lower of the tractor's sale price or original cost. If this is the last asset in the class, the "account" is closed.
- Negative remaining UCC → recapture → more tax to be paid
- And if CCA depreciation is faster than use-based depreciation, UCC may be low or 0 when the asset is sold → "a large tax bang at the end that could have been avoided. This large tax issue makes owners want more for their business […] and can make negotiation for sale more difficult" (Tedds, 2015)
- This is a long-standing, not just theoretical, issue in Canadian farming: "Saskatchewan farmers […] tended to overdepreciate farm assets, leading to substantial […] tax liabilities. The underlying causes of overdepreciation are rigid and unrealistic capital cost allowance rates." (Schoney & Rinholm, 1989)

Toward a complete tax calculation

- Let's try a "complete tax calculation", or tax-adjusted NPV, for a typical asset (initial cost, some years of income/savings, salvage value).
- Total present worth of such an asset can be divided into:
  - First Cost: -P
  - Annual income or savings: +A x (P/A,i,N)
  - Salvage value: +S x (P/F,i,N)
- →PW = -P + A x (P/A,i,N) + S x (P/F,i,N)

Capital Cost Tax Factors: CTF and CSF

- Summarize the impact of taxes on present worth calculations.
- The present worth of a depreciable asset's first cost, after taxes, is
- P x CTF (CTF = Capital Tax Factor)
- This is less than P, after taking the savings from CCA deductions into account.
- The present worth of *salvage* also needs adjusting: an asset's UCC is reduced by the amount of its sale value, reducing the value of future CCA tax deductions.
- The present worth of salvage F in year N is
- F x CSF x (P/F,i,N) (CSF = Capital Salvage Factor)

The formulas

$$CSF = 1 - \frac{td}{(i+d)}$$

$$CTF = 1 - \frac{td\left(1+\frac{i}{2}\right)}{(i+d)(1+i)}$$

- t = tax rate
- d = CCA rate
- i = *after tax* interest rate

Tax-adjusted present worth calculations

- First cost:

$$-\mathrm{P}\ \mathrm{x}\ \mathrm{CTF}$$

- Annual savings:

$$+\mathrm{A}\ \mathrm{x}\ (\mathrm{P}/\mathrm{A}\,,\mathrm{i},\mathrm{N})\ \mathrm{x}\ (1-\mathrm{t})$$

- Salvage value:

$$+\mathrm{F}\ \mathrm{x}\ (\mathrm{P}/\mathrm{F}\,,\mathrm{i},\mathrm{N})\ \mathrm{x}\ \mathrm{CSF}$$

In a nutshell

- **UCC** can be thought of a pool from which you may draw tax deductions.
- There is a separate UCC pool for each **CRA asset class**.
- **Purchasing** an asset for $P increases the UCC pool by P.
- **Selling** an asset for $S decreases the UCC pool by the lower of S or the purchase price, i.e. by min(S,P).
- Each year, you may claim up to d x UCC as a **tax deduction**, where d is the appropriate CRA depreciation rate for that asset class. This maximum allowed deduction is called the capital cost allowance, or **CCA**.
- The CCA claimed is deducted from the remaining UCC before the start of the following year.
- Since the CCA is a tax *deduction*, not a tax credit, the monetary benefit to the firm from the CCA is only t x CCA, the amount by which taxes are reduced.
- The CCA calculated as above is for a full fiscal year of 365 days. If the fiscal year is less than 365 days, the CCA must be prorated. For example, if the fiscal year is only 200 days long, then in its first year, an asset costing P would only be able to claim a deduction of dP/2 x 200/365. We will ignore pro-rating in this course, but be aware of it. For a worked example, see http://www.allabouttax.ca/articles-tax/76-how-to-calculate-capital-cost-allowance-cca-an-example.html
- There are important exceptions to the above, dealt with in the following two slides.

Exception 1: The Half-Year Rule

- Suppose net purchases, (Purchases – Dispositions), for an asset class in a given year are positive. Call these net purchases, P.
- Your textbook refers to net purchases as 'Purchases and Dispositions'.
- That year, the net purchases are only eligible for half the usual CCA, or dP/2.
- The CCA for the remainder of the UCC is calculated as usual.
- If net purchases are negative, the half-year rule does not apply, and the entire net purchase is treated as a disposition.
- Your textbook and the CRA phrase this 'half-year rule' in a different but equivalent way: they say only half of the asset's purchase price is added to UCC in the first year, while the rest is added the following year but not counted as an acquisition cost.
- Certain asset classes (13,14,23,24,27,34 and more) are exempt from the half-year rule. For details, see http://www.cra-arc.gc.ca/tx/bsnss/tpcs/slprtnr/rprtng/t2125/cl6-eng.html

A simple example

- At the start of fiscal year 2016, your engineering firm has UCC of $10,000 for Class 8. Class 8 has a CCA rate of 20%, and your firm faces an income tax rate of t = 25%. Your firms owns a very large number of Class 8 assets, so we may ignore terminal loss/recapture.
- During fiscal year 2016, your firm purchases a photocopier for $2,000 and sells furniture for $500, that originally cost $1,500. Photocopiers and furniture both fall into Class 8.
- Net purchases are ($2,000 - $500) = $1,500 > 0, so the half-year rule will apply.
- Before deducting the year's CCA claim, UCC remaining at the end of fiscal year 2016 is $10,000 + $2,000 - $500 = $11,500.
- Because of the half-year rule, only half the usual CCA may be claimed on the $1,500 net purchase. The CCA for 2016 is therefore 20% x ($10,000) + 20%/2 x ($1,500) = $2,000 + $150 = $2,150.
- The Class 8 UCC at the start of fiscal year 2017 is therefore $11,500 - $2,150 = $9,350.
- If your firm claims the full CCA, the monetary benefit is equal to $2,150 x 25%, the amount by which taxes are reduced thanks to the $2,150 tax deduction.

Exception 2: Terminal Loss / Recapture

- The year the last asset in a CCA class is sold, the entire remaining UCC is applied as a tax deduction.
- If the remaining UCC is positive, the deduction is a terminal loss. The firm's taxes that year are reduced by t x UCC.
- e.g. UCC at the start of 2016 is $1,000. The last asset in the class is sold later in 2016 for $500. There is a terminal loss of $500, and the firm's taxable income that year falls by $500.
- Another example: http://www.taxtips.ca/smallbusiness/terminal-loss.htm
- If the UCC is negative (because the final asset's sale price was greater than the remaining UCC at that point), the 'deduction' is called recapture, and the firm's tax bill *rises* by t x UCC.
- e.g. UCC at the start of 2016 is $1,000. The last asset in the class is sold later in 2016 for $1,750. There is recapture of $750, and the firm's taxable income that year rises by $750.
- Another example: http://www.taxtips.ca/glossary/recapture.htm
- Note: In the examples above I've implicitly assumed that S < P. According to CRA rules, the *lower* of either the original cost of an asset, or the sales proceeds of an asset net of sales cost are to be subtracted from the UCC. For our purposes, that boils down to min(P,S), where P = initial cost, S = salvage value.

CCA and a complete tax calculation

- Consider an asset purchased for P, which provides annual savings of A from years 1 to N, and is eventually salvaged for S in year N. Assume S < P.
- We want to find the tax-adjusted present value of the investment.
- We've already seen that to adjust A, we need only multiply A by (1 – t), and then find the present value of the annuity. What about P and S?
- After tax, the initial cost is *less* than P, since you're getting tax breaks as a result of the purchase.
- After tax, the benefit from salvage is *less* than S, since disposing of an asset lowers the UCC, reducing the future stream of tax deductions for that asset class.

CTF, CSF and after-tax present worth of P and S

- If recapture and terminal loss are not an issue, then we may summarize the impact of taxes on the present worth of P and S via two multiplicative factors:
- The CTF (Capital Tax Factor) adjusts P for the tax benefits from CCA deductions , assuming your firm keeps the asset forever. The after-tax present worth of P is CTF x P.
- The CSF (Capital Salvage Factor) adjusts S to take into account the reduction in CCA tax deductions. The after-tax present value of S is CSF x S x (P/F,i,N).
- When the last remaining asset in a class is sold, these adjustments are no longer enough, and we must adjust for recapture or terminal loss as described in an earlier slide.

AFTER HOURS

- Declining balance depreciation (2 slides)
- Deriving the CSF & CTF (3 slides)

Reminder: Depreciation

- A lowering of value.
- From the Latin ‘de-pretium’, or de-pricing, de-worth-ing.
- Use-related physical loss (wear & tear)
- Time-related physical loss (corrosion, aging, decomposition)
- Functional loss – inability to satisfy a function due to a change not in the item itself (e.g. changes in pollution legislation or fashion)

$f(x)$

Declining Balance Depreciation

- A constant percentage *d* of the asset's book value will be lost each year. For Canadian taxes, *d* is determined by government: e.g. for tractors, d = 0.30,

- Suppose you buy an asset for $P. What is its book value t years later, according to declining balance depreciation?
- Letting BV = 'Book Value', at time t

$$\mathrm{BV(n)} = \mathrm{P}(1 - \mathrm{d})^{\mathrm{n}}$$

Deriving the CSF (Based on textbook Appendix 8A)

- Suppose you sell an asset for S < P. For convenience, let the year of sale be Year 0. Since this sale reduces UCC by S, let's calculate the present worth of tax benefits from $S of UCC.
- In Year 1, CCA benefits would be t x d x S: t x a tax deduction of d% of S. The present worth is tdS/(1+i)
- In Year 2, CCA benefits would be t x d x (S – dS) = tdS(1 – d). The present worth is tds(1 – d)/$(1+i)^2$.
- Year N CCA benefits: $\frac{tdS(1-d)^{N-1}}{(1+i)^N} = \frac{tdS}{(1+i)}\left(\frac{1-d}{1+i}\right)^{N-1}$
- Since 0<d<1 and i>0, (1 – d)/(1 + i) < 0. This is useful…

Continuing…

- PW (Total Benefits) = $\sum_{n=0}^{\infty} \frac{tdS}{(1+i)} \left(\frac{1-d}{1+i}\right)^n = \frac{tdS}{(1+i)} \sum_{n=0}^{\infty} \left(\frac{1-d}{1+i}\right)^n$
- It's well-known that for q < 1, $\sum_{n=0}^{\infty} q^n = \frac{1}{1-q}$
- Using (1 – d)/(1 + i) as our q and rearranging, we find
- PW (Total Benefits) = $\frac{tdS}{1+i} \frac{1+i}{i+d} = \frac{tdS}{i+d}$
- Salvage value, net of forgone tax benefits, is therefore
- $S - \frac{tdS}{i+d} = S\left(1 - \frac{td}{i+d}\right) \equiv S \times CSF$, q.e.d.
- Note: There's a typo in Appendix 8A. At one point the text writes (1+d) instead of (i+d), but their final values are correct.

What about CTF?

- The half-year rule means we're delaying half of the tax benefits from the initial purchase price P by one year, so the tax benefits from P are (after some massaging):
- PW (Total Benefits) $= \frac{1}{2}\frac{tdP}{i+d} + \frac{1}{2}\frac{tdP}{i+d}(P/F, i, 1) = P\frac{td\left(1+\frac{i}{2}\right)}{(i+d)(1+i)}$
- PW of initial cost, adjusted for tax benefits, is therefore
- $P - P\frac{td\left(1+\frac{i}{2}\right)}{(i+d)(1+i)} = P\left(1 - \frac{td\left(1+\frac{i}{2}\right)}{(i+d)(1+i)}\right) \equiv P \times CTF$, q.e.d.