

## Engineering Economics

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## Introduction

Why should an engineer care about economics?

What economic principles should an engineer know?

How does economics affect engineering decisions?

How does engineering affect the economy?

## Why should an Engineer care about Economics?

- Economics is the fundamental theory of business.
- Business decisions based on economic principles determine the success or failure of engineering projects.
- The best technology may not be the most profitable one.

## What Economic Principles should an Engineer know?

- Scarce resources have alternative uses, and thus opportunity costs.
- Good decisions are ones in which benefits exceed opportunity costs *on the margin*; sunk costs are irrelevant, and fixed costs are irrelevant in the short-run.
- The more you do something, the lower the marginal benefits and the higher the marginal costs.

## Wait, there's more...

- Demand (and Supply) is fundamental.
- Market structure, competition and information all *matter*, and they will all change over time.
- There are tradeoffs between risk, return, and incentives.

## Opportunity Cost Examples

Should your firm...

- Install a new precision tool that will improve product quality?
- Make a particular, apparently profitable investment?
- Develop a new product?

## Include all marginal costs and benefits

- Costs include the value of foregone activities, but not costs already sunk.
- Finance costs include interest, depreciation, and a risk premium.
- Don't forget the *money value of time!*
- Include nonpecuniary costs and benefits, if possible and relevant.

## Example 1

Jane, Paul, George, and Mandy, four high school seniors who have taken your class, are now inspired not only to attend UNR and become software engineers, but also to found their own company beginning the summer after they graduate.

Working in a spare room in George's house, they plan to call their firm **Macro-Hard**

They want to develop extremely challenging computer games for their classmates bored with the same old stuff.

## What will it cost them?

- The wages they could've earned over the summer with their labor.
- The costs of computer equipment, software licenses, a business licence, et cetera.
- The costs of any consultants and other help they hire.
- The costs of diskettes and packaging.
- The costs of financing their expenditures, including lost interest on their savings and a fair return that makes up for the risk that they may lose their shirts.

## Their Sunk Costs...

...include computers and developmental software, since once purchased the money put into them cannot really be recovered. They are relevant before you spend the money on them, but not after.

## Remember the opportunity cost of their time!

The wage rate for labor is its next best alternative, and that includes the labor of the owners. Minimum wages are appropriate if all the owners could do is flip burgers, but if they are any good at writing computer games they could potentially get a job doing it for somebody else at a good wage, so factor this in.

## The Time Value of Money

Present Value = Future Value /  $(1+r)^n$

Net Present Value = sum of present values for all current and future cash flows.

## Let's work through the Handout

- Macro-Hard
- Net Present Value
- Homework

## What will the market be like?

A competitive market or more monopolistic?  
It depends on substitute availability.

Is product truly unique? If not, you will have to price what the competition is charging; if yes, then you can charge a higher price, but it will cost you some customers.

**If**

the market is still profitable, expect other firms to enter in the future, and the market price to fall over time.

Expect your market to take some time to develop.

- But be prepared if it takes off quickly. It all depends on the perceived quality of product and the rate at which that information travels.
- *As much as possible, put hard numbers to your problem.*

## Another Example...

Which technology should your firm choose?

- “Efficient” technologies are not always the most modern.
- “Appropriate” technologies are not always the most hi-tech.

*See the Macro-Hard example #2*

## And Another...

How much should your firm produce?

- You need to know your marginal costs.
- You also need to know marginal benefits, with means you need to know something about your demand curve.

*See the Macro-Hard example #3*

## What Affects Demand?

Price

Prices of substitutes or complements

The number of customers, their preferences and income

Information and expectations

## Market Development

- Create a product that that customers want, that fulfills a perceived need.
- Educate potential customers about product's potential.
- Set the right price.

*The saying that "Nobody ever went broke by underestimating the intelligence of their customers" is funny, but wrong.*

## Market Structure

- Monopoly Power allows firms some (but not total) control over prices.
- Competition drives prices down to marginal costs, bankrupts marginal firms, and drives economic profits to zero for the rest.
- Other firms enter profitable markets, and make them more competitive over time.

## Types of Markets

perfect competition - monopolistic  
competition - oligopoly - duopoly -  
monopoly

- In intermediate markets, firms compete strategically to reduce competitive behavior from others in their industry.

## What if Macro-Hard gains a monopoly?

- *Patents, copyrights, and the protection of intellectual property*
- *Monopoly pricing*

## Will Microsoft crush Macro-Hard?

- *Strategic interaction of firms*
- *Government intervention into competitive practices*

## Capital Markets

bank loans, stock, bonds, or venture capital

- financial intermediaries vs. direct financing
- debt vs. equity
- risk vs. return
- information and incentive problems (adverse selection and moral hazard)

## Are there alternative financing methods for Macro-Hard?

- *Banks vs. venture capital*
- *Risk and return for bonds vs. stocks*
- *Incentive problems*
- *Information problems*

## Property Rights

Possible solution to the incentive problem

- Right to residual income
- Right of Control
- Right to Transfer

An incentive to use resources efficiently so as to maximize their market value.

## Signaling

Possible solution to an information problem

What does he know that he is not saying?

Can we tell what he knows by what he does?

If he believes in his idea, why does he not appear to be willing to risk anything?

## Types of Firms

- Sole proprietorships - no limit to legal liability for debts, simple taxation.
- Partnerships - multiple owners, difficulty in defining rights and responsibilities.
- Corporations - well-defined rights for shareholders, limit to legal liability, complex double taxation.

## Should Macro-Hard incorporate?

- *Calculate tax treatment*
- *Consider legal liability issues*
- *Consider problems of managing partnerships*

## Entrepreneurship

- The engine that makes capitalism work.
- Requires a willingness to incur risk.

## How does Engineering affect the Economy?

- In developed market economies, 75% of real per-capita economic growth comes from technological progress and human capital development, and the other 25% comes from investment in productive physical assets.
- Innovation Cycles and Creative Destruction.

## Labor Markets

- The effect of international trade on the wages of skilled vs. unskilled labor.
- The effect of technological progress on the demand for engineers, those who understand how to manage them, and those who can use what they create.

## MHV Example

(Mitchell Hovercraft Vehicles) at:  
*<http://www.unr.edu/business/econ/MHV>*.

Examples and explanations suitable for  
high-school students.

Under construction, but worth visiting  
now.

## Thanks

for your attention and interest!