

Intermediate Microeconomics: Chapter 2

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Chapter 2: Budget Constraint

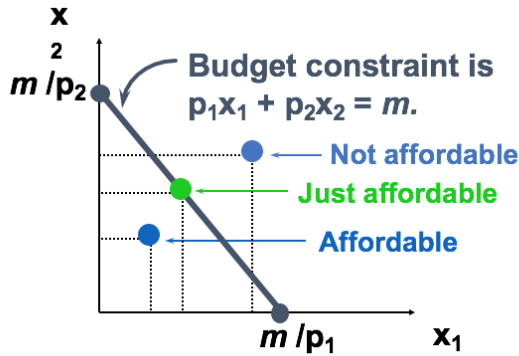
READ SECTIONS 2.0 TO 2.7. Ensure that you can draw a budget line for two goods, interpret it, and understand what happens when prices change. Make sure you can write a budget constraint for any given problem, and mathematically compute/identify the slope of the budget line. Most importantly, make sure you understand the *idea* of a budget line. Be able to think of a numeraire in reality.

Consumption The first thing we want to define is a consumption bundle. We specify some set of goods that the consumer can choose from. Let's call them good 1 and good 2. The quantity of good 1 consumed is defined as x_1 . The quantity of good 2 consumed is defined as x_2 . The consumption bundle is a vector denoting these two quantities: (x_1, x_2) .¹ Obviously every good must have a price, so let's call those p_1 and p_2 . Given that you're consuming (x_1, x_2) at prices (p_1, p_2) , how much money are you spending? Obviously $p_1x_1 + p_2x_2$. The main principle of this entire lecture is that **you cannot spend more than your income**. This gives the simple budget constraint $p_1x_1 + p_2x_2 \leq m$, where m is your income. If you spend all, then consumption is equal to m . Obviously, you can spend this money a bunch of different ways while satisfying the equality constraint. You can buy 10 pens and 3 pencils or you can buy 3 pencils and 10 pens if they both cost the same.²

Let's see if we can draw a line representing all the different ways you can spend all your money on different quantity combinations of good 1 and good 2. We're going to create a graph with x_1 on the x-axis and x_2 on the y-axis. Let's begin with the extremes. If you spend all your money on x_1 , then how many units of x_1 can you actually buy? Well, m/p_1 units of x_1 , and you get zero units of x_2 . Similarly, if you spend all your money on x_2 , then you get m/p_2 units of x_2 and no units of x_1 . This gives us the points where the budget line cuts the two axes. If we simply join these two points with a straight line, we get a budget constraint or budget line.

¹ This is the correct terminology. The names are good 1 and good 2; the quantities are x_1 and x_2 , and the prices are p_1 and p_2 . Sometimes in these notes I slip up and call the good by its quantity x_1 . That's a common blurred line economists misuse.

² Already, a fundamental point arises: what you can buy depends on prices.



But what does that line itself tell us? First of all, everything on the inside of that line is affordable, since it'll cost less than m , while everything on the outside of that line is not affordable since it'll cost more than m . Check that by moving straight upwards from a point on the budget line. Then everything under the line is a collection of affordable bundles, what we'll call "the budget set".

But what about the budget line itself? We can easily find the slope of the line: convert the equation $p_1x_1 + p_2x_2 = m$ into the formula for a straight line: $y = sx + c$. We get:

$$x_2 = \frac{m}{p_2} - \frac{p_1}{p_2}x_1. \quad (1)$$

But what does this even mean? Well, the slope of the line is p_1/p_2 , which are market prices. This tells us the rate that the *market* is willing to substitute good 1 for good 2.³ That is, if you want to increase consumption of good x_1 by 1 unit, you have to reduce consumption of x_2 by p_1/p_2 units. Why? Well one extra unit of good x_1 costs p_1 dollars so you have to give up exactly that amount's worth of good x_2 .

Here is where we get to a massively important concept called opportunity cost.⁴ In order to consume more of x_1 , you give up some of x_2 . Remember economics is the allocation of scarce resources. If you had an infinite supply of money, you wouldn't have to give up anything in order to get more of good 1. The opportunity cost of an extra unit of good 1 is p_1/p_2 units of good 2. This is important. We can generalise this to say: the opportunity cost is the value of the thing you've given up in order to choose/get something.

How can you think about the 'rate' at which the market substitutes one good for another? Think of another 'rate'—the exchange rate. The exchange rate is the price of Barbados dollars relative to US dollars. If I want 1 USD, the exchange rate is the amount of Barbados dollars I need to give up in order to get that 1 USD. That rate is 2 BBD to 1 USD, a rate set by the market⁵. Similarly, the 'rate' at which the market is willing to substitute good 1 for good 2 is the opportu-

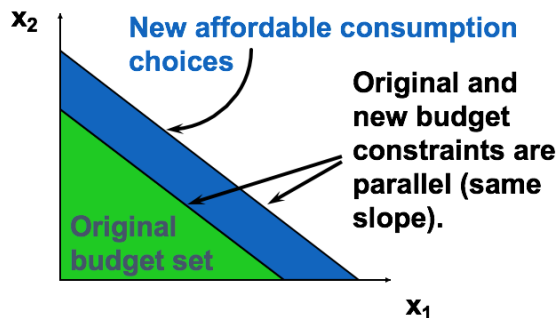
³ This is a tricky concept. Maybe think about it as the rate that two *businesses* would exchange their produce: one cows for 200 eggs. The point is that it is based on equilibrium market prices (or rates of exchange) that the consumer can't change.

⁴ I suggest you Google it. See what context it is used in. Is it ever discussed in the news? Can you find examples of opportunity cost? Is it a popular idea outside economics?

⁵ That is to say *you* can't change it.

nity cost, which is given by the slope of the budget line. In order to get 1 more unit of good 1, I need to give up p_1/p_2 units of good 2. If good 1 costs \$1, then I need to give up $1/p_2$ units of good 2.

What if there's an income change? Then m moves. This means you can afford more, right? It means that your budget line moves... outward! But since prices don't change, the *slope* of the budget line remains exactly the same.⁶



⁶ Look, we're changing exogenous things and seeing what it does to the model: we're being economists!

Okay, so how about if the price p_1 of good 1 decreases? Remember how we created the budget line? The quantity x_1 you can get spending all your money on x_1 must be **more** now, since the good is cheaper. This means that the budget line now cuts the x_1 -axis at a different point. That point must now be further to the right since you can get more x_1 with your income than you could before.

- Is an increase in income better or worse for the consumer? Why?
- Is a decrease in the price better or worse for the consumer? Why?

Two Goods Section 2.2 is a brilliant example of the type of simplification that makes microeconomics so useful. If we're only interested in one good, we can focus on this (x_1), and call everything else you might want to spend money on x_2 . Since x_2 is now a composite good, it manages to describe your entire budget in two terms, x_1 and x_2 . And yet it manages to focus our attention entirely on good x_1 . This is the concept of *generality*.⁷ Generality implies that this very simplified representation of reality actually captures a broad range of cases. In the case of the budget constraint, these two terms manage to encompass your entire budget choices. It's been boiled down to "spend money on good x_1 or other things".⁸

The Numeraire All prices are inherently relative. If you get paid \$500 a week, then \$600 a week for an apartment is out of the question. If you get paid \$2,000 a week, then that same apartment is now doable. Normally in economics we pick a single good as the reference price,

⁷ At some point you'll hear the phrase "without loss of generality". This comes from mathematics but is used in economics and essentially says that while we focus on a specific case, it holds for all other cases too.

⁸ "Should I buy this cup of coffee or keep that money to spend on other things?"

Make sure you read Section 2.5 of Varian on the Numeraire.

so that all other goods are measured relative to that one. We simply set that price to 1. There's one good in any economy that its price is always 1—money! This means that when we combine the concept of the numeraire with the two-good budget constraint, we can get an easy representation of how much *money* is spent on good x_1 , and how much is spent on everything else.

Price Ratios If the ratios of the prices tell you the rate at which good 2 can be substituted for good 1, what does the equation:

$$\frac{\Delta x_2}{\Delta x_1} = -\frac{p_1}{p_2} \quad (2)$$

tell us if good 2 is the numeraire?⁹ What does it tell us if good 2 is the numeraire and represents "money spent on other things"? Do you understand why there's a negative sign?

Opportunity Cost Opportunity cost is one of the most important concepts that economists have come up with. Opportunity cost is the cost of the choice you've made, priced in terms of the best alternative you've given up. That is, opportunity cost is the value of doing the next best thing. It is the money you've given up by choosing one option rather than another.

Imagine you're presented with two options, Option A pays \$10, Option B pays \$12. You choose Option B and get \$12. The opportunity cost of choosing Option B is the money you've given up by not choosing Option A. Therefore, the opportunity cost of choosing Option B is \$10.

To paraphrase James Buchanan¹⁰, opportunity cost is the valuation of the second-best alternative. Some even call it 'alternative cost'¹¹. Opportunity cost is based on the notion of *scarcity*¹² that underpins economics. If there were no scarcity, you could choose both Option A and Option B, and the opportunity cost of choosing them would be zero. If we could satisfy all demands, we'd never have to give up anything, and economics would be pointless.

Taxes, Subsidies, Rationing In the syllabus I say economics is a policy science. Taxes are the main policy instrument that the government has, and it is the main policy instrument that regular people care about. You need to understand the difference between a quantity tax, an ad valorem tax, a lump sum tax, and a subsidy. A quantity tax is a fixed amount you pay *per unit* of a good—for example you may have to pay a fixed environmental levy of \$4,000 for importing any vehicle. An ad valorem tax is paid as a percentage of the value. For example, you may have to pay a 60% tax on the value of the

⁹ Read the footnote in Varian: the triangle is a Greek letter called Delta. We use this to represent the change in a variable. We may be making \$100 a month, and get a 5% raise. Our income M is \$100 before the change. Then $\Delta M = \$5$, and $M + \Delta M = \$105$.

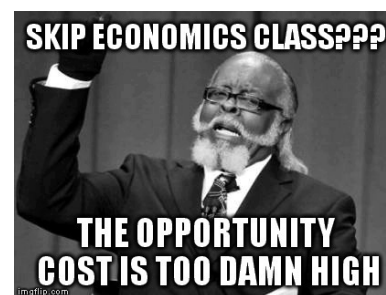


Figure 1: Understanding opportunity cost is a very useful skill. Can you think of any ways it can be used in the real world?

¹⁰ James M Buchanan. Opportunity cost. In *The world of economics*, pages 520–525. Springer, 1991

¹¹ This is really the original term from [Friedrich von Weiser](#).

¹² Remember that economics is the study of the allocation of scarce resources.

vehicle you import. A lump sum tax is a tax that is imposed in a fixed value regardless of what you do. Imagine a government taxes everyone in the country \$100 per month, with no way to escape it. A lump sum tax is a very wild tax: they're seen as very unfair but very efficient. Margaret Thatcher is the most famous example of a politician trying to impose a lump sum tax, and it ended her career.¹³ A subsidy is simply the opposite of a tax. It can also be thought of as a negative tax. For each type of tax, there is a similar type of subsidy: quantity subsidy, ad valorem subsidy, lump sum subsidy. Most importantly for this course, you need to understand how they enter the consumer's budget constraint. A quantity tax changes the price from p_1 to $p_1 + t$. An ad valorem tax is multiplicative so its imposed as $p_1(1 + \tau)$.¹⁴ A lump sum tax is simply written as T , and so subtracts directly from the consumer's income: $m - T$.

¹³ <https://www.bbc.com/news/uk-38382416>

¹⁴ Note that τ here is a percentage expressed in decimal terms, so a 20 percent tax would be written as 0.20.

Notes The concept of opportunity cost is one of the most important tools for an economist. In fact, it is a big part of what makes an economist an economist. To be fair, it appears that even years of graduate training in economics doesn't always help economists perceive opportunity cost correctly: <http://jfzuluaga.com/wp-content/uploads/CostoDeOportunidad.pdf>. More seriously, part of what Robert Frank suggests in his own Intro Micro course is that we (I) microeconomics instructors do not make clear the relative importance of certain topics. So here I am emphasising the importance of opportunity cost to your training as an economist. Understand it, enjoy it, use it in your daily lives! If you prefer listening, here's a podcast from the US central bank explaining choice, scarcity, and opportunity cost: <https://www.stlouisfed.org/education/economic-lowdown-podcast-series/episode-1-opportunity-cost>.