Chicago Price Theory

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April 2018

Videos and other materials are available from http://ChicagoPriceTheory.com

Brief Description

We have written a Price Theory textbook based on Economics 301, which is the legendary introductory PhD course in Price Theory, taught at the University of Chicago by Jacob Viner, Milton Friedman, Gary Becker, and Kevin Murphy. Viner, Friedman, and Becker each published their lectures, which became classics in the field.

Now Kevin Murphy's Economics 301 lectures have been video recorded in 3-10 minute segments, and paired with a couple of video lectures by Gary Becker (the two of them taught Economics 301 together for several years). The textbook and video series are companions.

A longstanding Chicago tradition treats economics as an empirical subject that measures, explains, and predicts how people behave. Price theory is the analytical toolkit that has been assembled over the years for the purpose of formulating the explanations and predictions, and for guiding the measurement. The purpose of the *Chicago Price Theory* course is to help students master the tools in the kit so that they can use the tools to answer practical questions.

The course is full of counterintuitive results: that fighting crime in poor neighborhoods may net harm its residents by raising rents, that so-called capital-biased technical change benefits labor, and that because of competition prohibitions (such as drugs or alcohol) can do more harm than good.

Chicago Price Theory: An Introduction

The Chicago Economics Tradition

A longstanding Chicago tradition treats economics as an empirical subject that measures, explains, and predicts how people behave. Price theory is the analytical toolkit that has been assembled over the years for the purpose of formulating the explanations and predictions, and for guiding the measurement.

The purpose of this course is to, in the tradition of Chicago's "Economics 301," help you master the tools in the kit so that you can use them to answer practical questions. Studying price theory at Chicago is "a process of immersion in those models so that they bec[o]me so intuitive to one's work that, in combination with new empirical investigation, they open[] the door to novel evaluations of market organization and government policy."[1]

Because price theory at Chicago has always been tethered to practical questions, this course and the course Jacob Viner taught at Chicago almost 90 years ago (Viner 1930/2013) share some remarkable similarities. The tradition draws heavily on Alfred Marshall in, among other things, viewing human behavior in the aggregate of an industry, region, or demographic group. Market analysis is essential to price theory because experience has shown that markets enable each person to do things far differently than he would if he lived in isolation. It is no accident that price theory is named after a fundamental market phenomenon: prices.

Price theory is not primarily concerned with individual behavior; models of individuals are provided when they offer insight about the aggregate. None of this is to say that price theory only looks at average or representative agents. Indeed, a primary reason that markets transform human activity is that people have some innate differences, which the market encourages them to amplify. Heterogeneity can be important; as we see in the example of comparative advantage below, markets can amplify heterogeneity through returns to specialization.

Price theory has not been static, though. Gary Becker, who taught Economics 301 for many years and gives a couple of the lectures in the video series that accompanies this book, developed human capital analysis, as well as extending price theory to deal with discrimination, crime, the family, and other "noneconomic" behaviors. Becker and Murphy revisited the topic of complementary goods, using it to examine addictions, advertising, and social interactions.[2] Most important, people and businesses are in different circumstances today than in Viner's time as witnessed by the decline of agricultural employment, increased life expectancy, and the rise of information technology.

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[1] Quoted from Ross B. Emmett's (2010, p. 2) introduction to his volume on the "Chicago School of Economics."

[2] See Becker (1957, 1968, 1993) and Becker and Murphy (1988, 1993, 2003).

Price Theory is Different from Microeconomics

Although strategic behavior, such as the interactions among sellers in a market where they are few in number, has been treated with price theory (Weyl 2018), the introductory Chicago price theory course has not emphasized it. Competition, by which we mean that buyers and sellers take prices as given and the marginal entrant earns zero profit, is emphasized in large part because, for most purposes, it is a reasonable description of most markets (Pashigian and Self 2007). Moreover, the competitive framework is simple enough to make room for us to master additional aspects of tastes and technology – such as product quality, habit formation, social interactions, durable production inputs, and complementarities – that are important for practical problems. Monopoly models are used on those occasions when price-setting behavior is relevant (Friedman 1966, pp. 34-5, Stigler 1972, Demsetz 1993, p. 799). More generally, price theory is stingy as to the number of variables that are declared to be important in any given application.

In emphasizing markets and competition, price theory is different from microeconomics. Both typically begin with the consumer/household but price theory stresses how consumers react to prices, many times without reference to utility or even "rationality," whereas microeconomics takes care to lay down an axiomatic foundation of the utility function and individual demand functions. Price theory then quickly gets to market equilibrium, treating related subjects such as compensating differences, tax incidence, and price controls.

The market-equilibrium approach says that the most important effects of policy, technical change, and other events are not necessarily found in the immediate proximity of the event. An ethanol-subsidy example, discussed below, features a subsidy that is paid only in the market for fuel that uses only a fraction of total corn production but has more price sensitive demand. The greater effect occurs in the market for animal feed where redirecting corn to fuel significantly reduces supply.

The ethanol-subsidy example also demonstrates how price theory guides measurement. Empirical studies of markets over time, or comparisons across countries or industries, must consider how to summarize a seemingly complicated reality behind each observation. Price theory shows how the appropriate approach to measurement depends on the question at hand.

Using *Chicago Price Theory* to Learn Economics

Graduate microeconomic texts often devote more pages to game theory than competitive equilibrium, and part of their competitive analysis is dedicated to confirming that an equilibrium exists as a mathematical object. To the price theorist, the toolkit's mathematical foundations and possible abstract generalizations are an interesting subject for specialists, whereas a general economic education requires seeing how the tools have been successfully applied in the past and preparing to nimbly apply them to the next practical question that we encounter. Completing a mathematical microeconomics course will not make you good at price theory; price theory skills are obtained by practicing applications of the toolkit.

To provide practice at applications, this book and video series contain chapter-length examples such as addictive goods, urban-property pricing, learning-by-doing, the consequences of prohibition, the value of a statistical life, and occupational choice.

Also included are more than a dozen of Professor Murphy's answers to student questions about current market events. Finally, we urge price theory instructors to reallocate their time away from lecturing – our video series can help with that – and toward developing and discussing relevant and challenging applied homework questions. At Chicago, both the students and instructors over the years have gotten better at price theory as a result of engaging with the homework.

Here is a small sample of the many questions to which price theory offers surprising answers:

1. Is learning by working on the job cheaper than formal schooling? [see Chapter 9]
2. What is the difference between prohibiting marijuana sales and subjecting its sales to a high tax? [see Chapter 12]
3. A great many manufacturers use machines and labor in fixed proportions. Does that mean that the wage rate has little effect on the amount of labor used in manufacturing? [see Chapter 7]
4. Does the availability of ebooks reduce the sales of physical books? [see Chapter 10]
5. When housing prices are above their long-run values and continue to rise, is that good evidence that home buyers or builders have unrealistic expectations about the future? [see Chapter 14]
6. Could a billion dollars in federal subsidies to farmers increase farm incomes by more than one billion? [see below]

Consider the answers before you begin the course. You will be amazed at how differently you think at the end!

Example: Ethanol-fuel Subsidies

A Market "Multiplier"

The federal government has been supporting the production of ethanol fuel with a variety of tax credits, subsidies, guarantees, etc. When the U.S. government started subsidizing ethanol fuel, the price of land used to grow corn, which is the primary ingredient in U.S. ethanol production, increased, regardless of whether the corn grown on that land actually ended up in the fuel.

Given that U.S. ethanol is primarily produced with corn, is it possible that corn farmers benefit more than $1 billion for each $1 billion that the federal treasury spends on that support? In other words, let's use price theory to examine the incidence of ethanol-fuel subsidies.

Take a simple model in which corn, C, is used to make either ethanol fuel, E, or animal feed, F. We will consider demand curves D_E, D_F, and D_C, where D_C, the market demand curve for corn, is found by adding the demands for ethanol and animal feed. A subsidy of the amount x per unit corn used in ethanol serves to increase the demand for ethanol by x units in the price dimension to D'_E. Horizontally adding the new ethanol demand curve with the stable feed demand curve, we get a new overall corn demand curve D'_C. Supply and demand for corn determine the

equilibrium price of corn, which is the same regardless of how it is used. An example of our market is shown below:

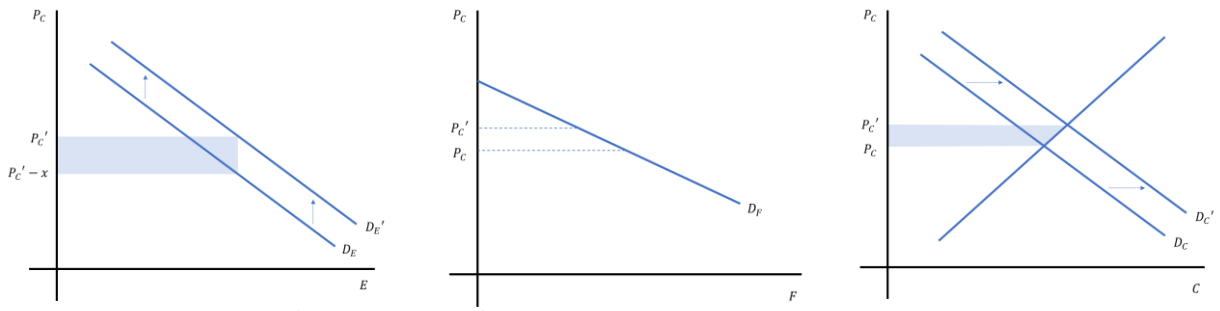

Figure 1: Can farmers gain more from an ethanol subsidy than the amount the government pays?

The result of the subsidy is that more corn is sold overall, and for a higher price (P_C' rather than P_C). Less corn is sold for animal feed, because that demand curve is stable and the price is higher. The extra corn sales go to ethanol because the subsidy amount x more than offsets the price increase.

Our question, posed from the perspective of the figure, is whether the producer-surplus trapezoid in the market for corn (see the right-most chart) can be larger than the subsidy-expenditure rectangle in the market for ethanol (see the left-most chart).

Consider a case in which the demand for ethanol fuel is perfectly elastic and the demand for feed is strictly decreasing. The overall demand curve is flat when the price is below what the ethanol market will bear. At prices above that, all corn is sold for animal feed and none for ethanol. Putting the two together, we have an overall demand curve with a hockey-stick shape, as shown below when we adapt the previous graphs to this new setting:

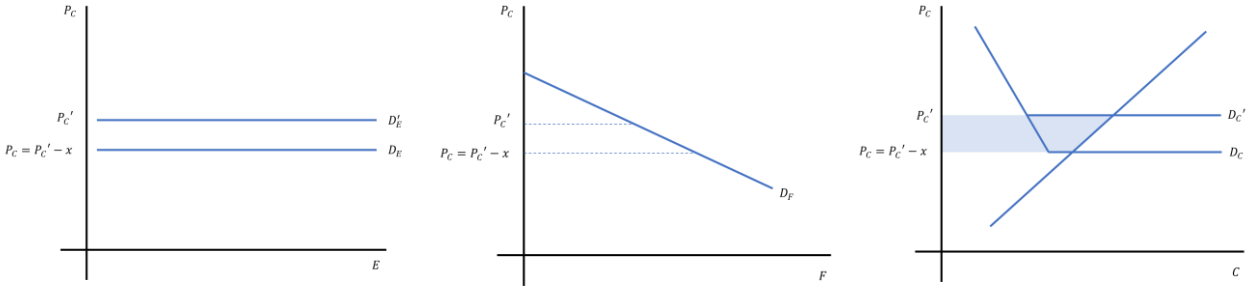

Figure 2: In a market where demand for ethanol is more elastic than the demand for feed, the benefit of the ethanol subsidy to corn farmers can exceed the amount the government spends on the subsidy.

Suppose the subsidy is $0.10 per gallon. Then, in this market, the $0.10 gap created between the buyer and seller price per gallon in the ethanol market gets carried over in full to the aggregate

market for corn.[3] If the subsidy is small enough, the gain to corn farmers is larger than the amount the government is paying.[4] Why? Not only do corn farmers get $0.10 more for the corn going to ethanol, which the government pays; they also get $0.10 more for the corn going to feed, which the animal-feed buyers pay. Maybe this also helps explain why the federal government assists corn farmers with an ethanol subsidy rather than paying the farmers cash directly.

Now consider a case in which the demand for ethanol fuel is perfectly inelastic. We leave the demand for feed unchanged.

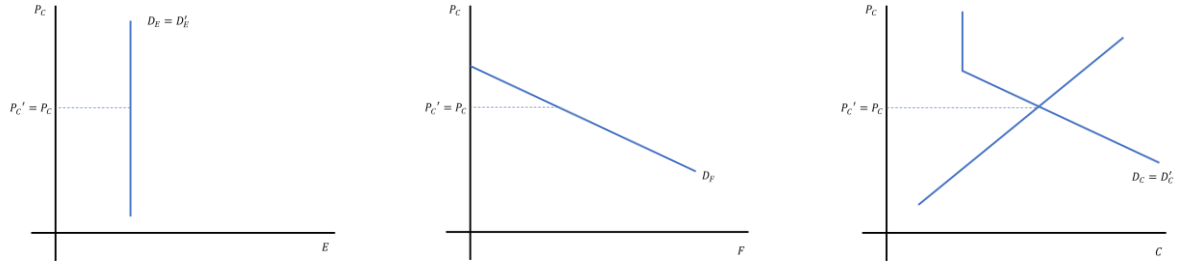

Figure 3: In a market where demand for ethanol is more inelastic than the demand for feed, the benefit of the ethanol subsidy to farmers cannot exceed the amount the government spends on the subsidy. The ethanol demand shown above is perfectly inelastic, so the subsidy has no price impact.

Here, ethanol corn demand is perfectly inelastic, which means that, given any price, people demand the same amount. So an ethanol subsidy, which reduces the price the ethanol corn buyers see, has no effect on their demand. Because the market demand curve is just the sum of the demand curves in the ethanol and feed markets, there is likewise no effect on market demand. The corn farmers, in this case, get no surplus from the subsidy despite what the government spends on it.

In general, corn farmers can benefit more than the amount the government spends on the subsidy only if the demand for ethanol is more elastic than the demand for feed. This is the empirically likely case, given that there are corn-free ways to make fuel that is essentially the same from the fuel consumer's perspective but it is not as easy to switch to alternative animal feeds. Moreover, the supply of land to growing corn may be inelastic in the short run (but probably elastic in the long run).

How can we think about this intuitively? Think about price discrimination. Normally, we want to charge the low price to the people with elastic demand and the high price to people with the relatively inelastic demand. The ethanol subsidy looks like price discrimination precisely when

[3] Here we assume that, absent the subsidy, there is a strictly positive amount of corn going to ethanol production. This assumption is visible in the chart because in that the supply curve always intersects the flat part of overall demand.

[4] For large subsidies, the comparison is ambiguous because a large amount of corn may be drawn into the ethanol market and therefore require additional government revenue to finance the subsidy program. See also the right-hand Figure 2 where some of the subsidy is paid to marginal supply that receives a net benefit of strictly less than *x*.

the demand for ethanol is price elastic relative to feed because it pushes the ethanol price down relative to the feed price. Corn farmers can gain substantially in this scenario relative to spreading the same subsidy dollars across all corn sales.

We can also look at the equilibrium from the feed market perspective. Possible feed demand curves are already drawn in middle panels of Figure 1, Figure 2 and Figure 3. The feed supply curve is a residual supply curve: the horizontal difference between overall corn supply curve and the ethanol demand curve. The more elastic is ethanol demand, the more elastic the residual supply is. In the perfectly-elastic case introduced in Figure 2, nothing is supplied to the feed market when prices are below the ethanol demand curve (all of the corn goes to ethanol) – and coincides with the overall supply curve at prices above that (no corn goes to ethanol). Figure 4 therefore draws a supply curve that is horizontal at quantities in between the price axis and the overall supply curve.

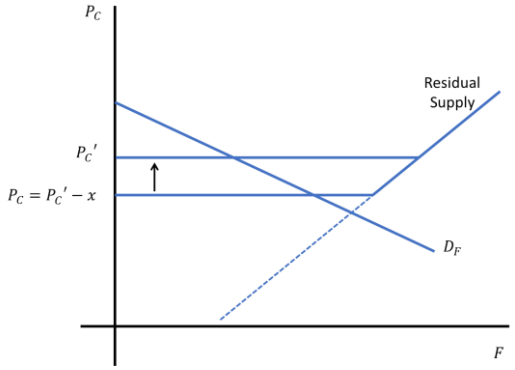

Figure 4: The supply of corn to feed usage is a residual supply curve. It is shifted up by the subsidy in the ethanol market. The case shown here corresponds to horizontal ethanol demand.

The ethanol subsidy x shifts up the residual supply curve by the amount x and raises the price the feed buyers pay for corn by x. The revenue that corn farmers gain in the feed market could easily exceed the revenue they gain in the subsidized market (ethanol) because (i) ethanol gets a minority of corn production and (ii) more important, ethanol demand is much more price sensitive than feed-corn demand.

The main idea here is that because we have a market, the subsidy on ethanol has an effect broader than the initial subsidy. The price of corn going into animal feed will also increase.

Price Theory Guides Measurement

In many labor, health, and other markets with large amounts of subsidies or taxes, there is a big difference between the price paid by buyers and the price received by sellers because one of the parties is paying a tax or receiving a subsidy. In these cases price theory makes it obvious that the proper measurement of price depends on whether buyer or seller behavior is to be explained.

In our ethanol-subsidy example, some buyers pay less than others. The use of the various prices for empirical analysis depends on the question at hand. For the purposes of predicting the amount of government revenue to subsidize corn sales, what matters is the quantity-weighted average subsidy in the market. That is the average of zero on feed corn and the subsidy rate on ethanol corn, weighted by the quantity of corn going to each use.

For the purposes of measuring the price impact, the quantity weights need to be adjusted for the price sensitivity of the buyers. In the neighborhood of no subsidy, the price-impact formula is the product of three terms:[5]

$$\frac{dP_C}{dx} = \theta \, \frac{E}{C} \, \frac{pD'_E/E}{pD'_C/C}, \qquad \theta = \frac{D'_c}{D'_c - S'}$$

where x is the subsidy rate, S' is the slope of the supply curve and θ is the usual incidence parameter indicating how each unit of a uniform subsidy would raise the price received by sellers. As a matter of algebra we could further simplify the formula but we keep the three terms separate in order to discuss their economic interpretation. The second term in the price impact formula is the quantity-weight term and recognizes that only a fraction (E/C) of the corn supplied goes to ethanol. The third term, with a price elasticity for both its numerator and denominator, adjusts for any difference between the ethanol demand elasticity and the overall demand elasticity. The third term ranges from zero when ethanol demand is completely inelastic (Figure 3) to $C/E > 1$ when ethanol demand is infinitely elastic (Figure 2); it would be one if both types of buyers were equally price elastic.[6]

In other words, the units sold to more-price-elastic buyers count more than the units sold to less-price-elastic buyers. In our example with one type of buyer that is subsidized and the less price-sensitive type of buyer that is not, the price-sensitivity adjusted weighted average subsidy exceeds the pure quantity-weighted average, which is why the corn farmers can gain more than the treasury spends on the subsidy.

The analysis above refers to a subsidy rate that is small in comparison with the price. With larger subsidies we need to consider, for example, that the three terms in the formula vary with the level of the subsidy, which is essentially the price-index problem whose solutions are discussed in Chapter 5.

Example: Acquired Comparative Advantage

With its emphasis on markets, price theory frequently highlights comparative advantage, which is about economic progress obtained through specialization and trade. The specialization made

[5] To derive this formula, totally differentiate the equilibrium condition $D_E(p - x) + D_F(p) = S(p)$ and solve for dP/dx. Multiply both numerator and denominator by pE/C and use the fact that $D'_E + D'_F = D'_C$.

[6] As shown in Figures 5 and 6, the price impact itself ranges from zero to one.

possible by markets helps explain where people live and work (Becker and Murphy, The Division of Labor, Coordination Costs, and Knowledge 1992); why economies grow (Smith 1776/1904, Book I, Chapter I); why men are different from women (G. S. Becker, Human Capital, Effort, and the Sexual Division of Labor 1985), but less so recently (Mulligan and Rubinstein 2008); and much more.

We examine the acquisition of comparative advantage in a simple market setup with two tasks, A and B. An individual has human capital for those tasks H_A and H_B. Whatever task he picks, he is paid a wage per unit human capital: w_A or w_B as appropriate. This will mean total income for an individual from task A is $Y_A = w_A H_A$ and from task B is $Y_B = w_B H_B$. The maximum income that the individual can earn is

$$Y = \max\{w_A H_A, w_B H_B\}$$

which is obtained by picking task A if $w_A H_A > w_B H_B \Leftrightarrow \frac{w_A}{w_B} > \frac{H_B}{H_A}$, picking task B if $\frac{w_A}{w_B} < \frac{H_B}{H_A}$ and picking either task if the two ratios are equal. This is comparative advantage because his task choice depends on the relative amounts of human capital that he has, not the absolute amount.

Figure 5 illustrates the choice in the [H_A,H_B] plane by drawing a solid task-indifference ray showing all of the configurations of human capital that someone could have and be indifferent between the two tasks.

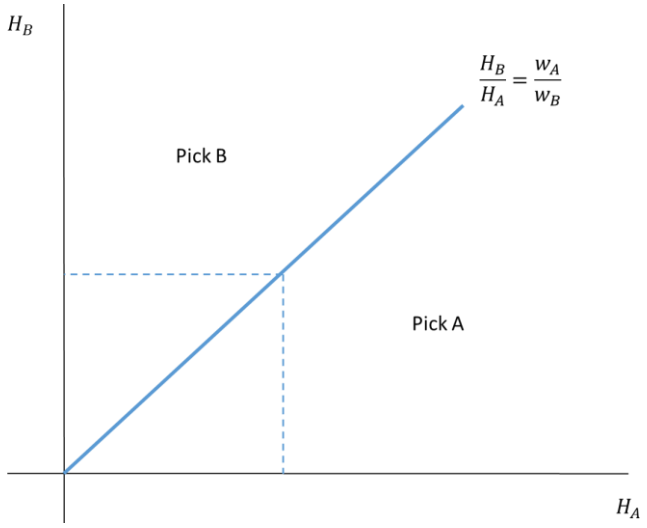

Figure 5: Supply and demand will rotate the task-indifference ray until the right number of workers is in each task.

There is demand for tasks A and B, which in equilibrium has to match up with the available human capital and the aforementioned incentives for workers to choose one task rather than the other. This happens with wage adjustments. If there were a lot of demand for A, then Figure 5's task-indifference ray has to be steep so that lots of workers choose task A and few choose B. In other words, w_A/w_B would be greater than one.

Now, assume we have reached the equilibrium, so that w_A/w_B reflects market supply and demand. Then for any point on the line, every person directly below and directly left must be earning the same income. See the dashed lines in Figure 5. This is because each person on the dashed line above the task-indifference ray has the same level of H_B and his H_A does not matter because he does not use it. Each person on the dashed line below the task-indifference ray has the same level of H_A and his H_B does not matter because he does not use it. Let's call the union of the two dashed lines an indifference curve for the worker.

Now, let's allow each agent to choose their human capital. For example, they are considering whether to be a good plumber versus being a good carpenter. The opportunity set for human capital could have an interesting shape, as depicted in Figure 6. Consider the point associated with the maximum level of H_B. As it is depicted, this person will have some positive level of H_A. This reflects an underlying story that the tasks A and B require some of the same abilities. Thus, if I choose to be a good plumber, that doesn't mean that I end up with zero human capital as a carpenter.

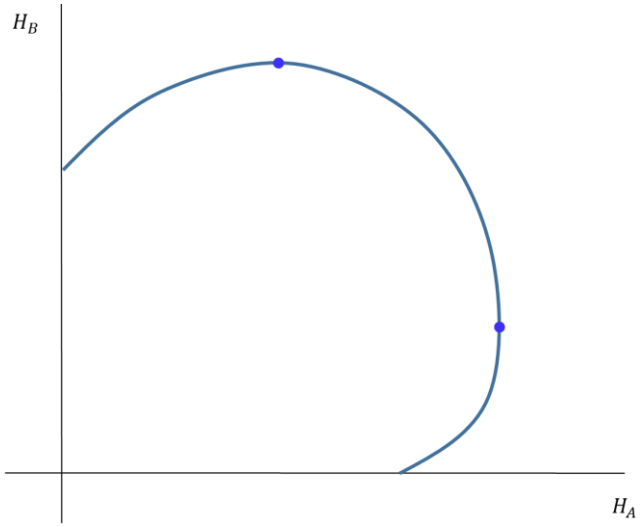

Figure 6: The opportunity set for selecting human capital. The agent with maximum human capital for task A still has positive human capital for task B.

Note further, in this graph, that the economically relevant region of the opportunity set lies between the two points and we can erase the parts of the curve close to the axes because no one would choose a human capital pairing left of the top point or below the right point. On the erased regions, the agent could be better at both tasks!

Now let's put the opportunity set together with the worker's indifference curves, as in Figure 7. We can even have everyone identical in the sense that they all have the same opportunity curve to choose from. Nevertheless, specialization is optimal behavior. Being equally good at tasks A and B is worse than being very good at just one task because you have acquired a lot of human capital that you do not use.

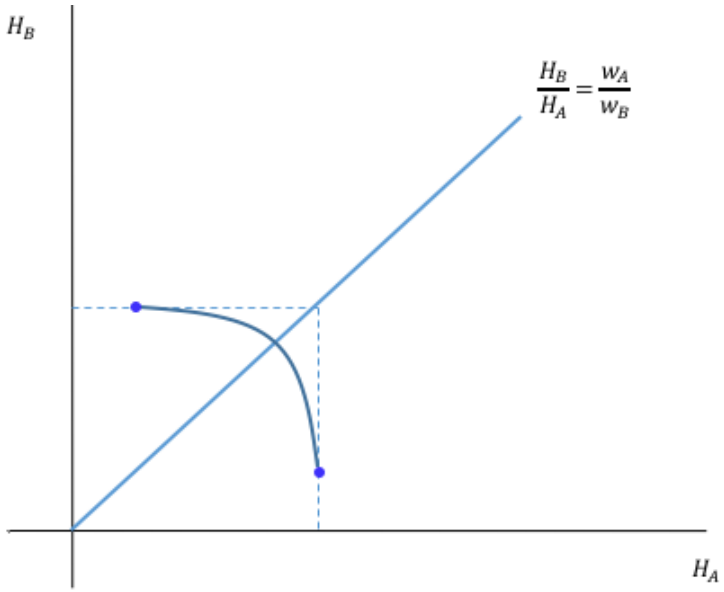

Figure 7: Specialization. Agents maximize their human capital at task A or task B.

We started this picture by indicating the types of workers (that is, configurations of human capital) who are indifferent between the two tasks. But now we have shown that people will not choose to be those types of workers. Because the human capital is acquired, it is not an equilibrium for people to be indifferent between the two tasks.[7]

The equilibrium requires that both tasks are performed, so some people specialize in *A* and the others specialize in *B*. People who are identical in the sense of having the same opportunities open to them end up being different.

You might say that it is a coin flip exactly who goes toward task *A* and who goes toward task *B*, and I would agree if people were precisely identical. But in reality, people have somewhat different opportunities open to them: in Figure 6 and Figure 7, that means somewhat different opportunity curves. Some of the opportunity curves may be relatively steep and others relatively flat. Then just a small difference among people in the slope of the curve will decide who specializes in what. Specialization in the marketplace turns small differences into large differences.

Outline of the Course

[7] This simple model abstracts from timing, uncertainty and other factors. In the more general case, the market may induce some people to be on the task-indifference ray because, at the time that they acquire skills, they do not know which task they will end up doing. But even in this case, it will not make sense for everyone to be near that ray: some of them can be confident that they will be doing a particular task and thereby specialize in it.

Three economic themes are repeatedly encountered when human behaviors are viewed through the lens of economic theory: substitution effects, market equilibrium, and durable goods. Each of these is a section of the course presenting the classic model and then going through some important applications such as price indices, learning by doing, and house prices.

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Table of Contents

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