**Slide Show Notes — Comparative Advantage**

Out of curiosity, how well do you feel you understand the concept of "comparative advantage"?

On a scale from 0 to 10:

* 0 is "Never heard of it,"
* 1 to 3 is "Have heard of it but have only pretty vague understanding,"
* 4 to 6 is "Have studied it some, understand the concepts, and know the basics about how it is applied,"
* 7 to 9 is "Am intimately familiar with mathematical models of trade that include comparative advantage," and
* 10 is "I was awarded the Nobel Memorial Prize in Economic Sciences for my books on trade theory."

Okay, show of hands for the various levels.

Comparative advantage is cited as the foundation of a lot of policy. The WTO certainly cites it. It's in all the economics textbooks.

But on the other hand, it's also problematic, and the WTO hints at that too. Comparative advantage is spoken of as being incomprehensible and unconvincing. The classical statement of this mystery is Prof. Paul Samuelson's, which the WTO cites.

When you see statements like Prof. Samuelson's, however, you should be suspicious. How can something be both (a) taught in all undergraduate textbooks and also (b) be incomprehensible? People say that quantum physics is incomprehensible, but nobody turns around and claims to be able to explain it to any student who cares to sign up for Econ 101.

Maybe the right response is not to include it in the course. You're not training to be university economics professors, for whom it's essential. And it's arguably not essential for understanding policy and institutions. The practical advantages of reducing political discrimination between sources are pretty clear when you look at particular cases, like aluminum or sugar in the U.S., even without knowing comparative advantage theory. (The references we'll look at in this course touch on a couple of those cases.)

On the other hand, since comparative advantage is constantly cited, I do think you need to know what is being talked about, whether you agree with the conclusions or not. As Prof. Joan Robinson, another famous economist, said, "The point of studying economics is so as not to be fooled by economists."

Also, I've polled students in previous semesters, and there is always a good number of people in this class who appreciate having a bit of "hard" economic theory.

So, let's give it a try, and hopefully we can all get to the '4 to 6' range of familiarity with comparative advantage when this module is over.

A couple additional concepts will also come up, along the way: "gains from trade" and "the Invisible Hand."

When something is a "mystery," we need to be suspicious of miscommunication between people whose perspectives are framed differently. If we can manage to put ourselves in the shoes of each side, alternately, maybe we can reduce the "mystery" to just confusion.

My own impression from teaching and reading is that there is, indeed, confusion about comparative advantage. There are two things that are really separate but that are being confused:

(a) comparative advantage as an aspect of allocative efficiency, and

(b) comparative advantage as a theory explaining where industry is located.

So, my hope is that, if we take those two things separately, then — no confusion!

Each of the two things has to achieve credibility on its own. If one makes sense, the other can still be wrong.

I'd like to introduce our first concept, allocative efficiency, at the most familiar level possible — a family. (Based on my own experience.)

The essential part of the setup is that the family has more than one task that needs to be done to get the overall result (a comfortable life) and more than one person who can contribute. There's inevitably a choice about who should do which task, or, the way university economics professors put it, about allocating resources.

You might suppose that as long as each of the two people in the household works efficiently at some valuable task — that is, work with technical efficiency, they'll get as much as they can out of their effort. That turns out to be false.

The first thing to clarify is the difference between technical efficiency and allocative efficiency.

It matters who does what. Assigning tasks in different ways produces different results, and some results are better than others. If an allocation of the family members' work gives you a result that you can unambiguously improve by a different allocation of tasks, then it's an "inefficient" allocation.

Although it may sound surprising, it's not only very easy to "prove" logically, but in fact we all apply that logic constantly and intuitively, without having to think much about it.

Let's look at a simple proof. Here's the two-person, two-task setup, using numbers that are unimportant except that they make the two people's productivity different. (If their productivity were the same, you wouldn't really have any choice to make.)

You can describe productivity either by how much is produced with a given amount of time or by how much time it takes to produce a given output. The two descriptions are just algebraic inverses of one another. And, by the way, remember that if one number is bigger than another, then its inverse is smaller than the inverse of the other: if 3 is bigger than 2, then 1/3 is smaller than 1/2.

When I concocted this demonstration a few years ago, I started with an allocation of time that had a particular characteristic that I knew would make it inefficient (allocatively inefficient). The allocation was 80:20 for the parent and 100:0 for the child.

It would probably be too hard for you to spot the "tell": the characteristic that guarantees that this is an inefficient allocation. I'll show you in a moment.

Anyway, the outputs from this allocation of work time ("Plan 1") are noted.

Now for the proof. The trick is to switch the parent out of ironing duty. The new allocation ("Plan 2"), 100:0 and 20:80, produces as much cooking and three times the amount of ironing. Obviously, the first allocation was inefficient.

That doesn't mean that either person was lazy. It was the allocation that was inefficient, not the person or the effort.

Okay, so now I'll show you the "tell" that allowed me to be sure that the initial example was allocationally inefficient: it was that in Plan 1 the two people were simultaneously working at tasks in which each had comparative disadvantage. That is, the child was cooking at the same time that the parent was ironing. That's shown in red.

How did I know that the two-person family's Plan 1 was allocating effort in a way that reduced what the family got out of its effort? By calculating opportunity costs.

How many fewer shirts would Parent iron if Parent cooked one more meal instead? Easy: 10. In terms of labor requirements, in one quarter of a day, Parent can either prepare 1 meal or iron 10 shirts. In the table, 10 is the ratio of 40 to 4, or the ratio of 0.25 to 0.025.

How many fewer shirts would Child iron if Child cooked one more meal instead? Easy: 30. And it takes a whole day.

So, who should cook an additional meal, if they want one? Well, duh: Parent's opportunity cost is a third of Child's, so Parent should cook the additional meal.

If Parent has lower opportunity costs in one thing (cooking), then by the purest mathematical necessity Child's opportunity costs are lower in the other thing (laundry).

(Why? Because each person's opportunity costs are the inverses of one another, and if a number is higher than another, then its inverse is lower than the other's.)

Let's finally introduce the term "comparative advantage." What it means is lower opportunity cost, in terms of other things you might have produced.

Opportunity cost is measured in the amount of those other things you might have produced: the number of shirts you might have ironed if you hadn't been cooking.

Regular cost is the amount of the inputs, not the amount of the alternative outputs. Regular labor cost is measured in hours or days of work.

Lower resource cost is sometimes referred to as "absolute advantage," and it's different from comparative advantage. You can have absolute advantage (lower resource costs) and yet still have comparative disadvantage (if your costs in other things are even lower).

Let's pause for a moment here to recognize that, although the setup is simple and the arithmetic is not hard, this is a bit of a brain twister. Prof. Samuelson may think it's obvious, but it's not.

Contrast it with productivity.

* Productivity is a single comparison between input and output: a ratio of two visible things.
* Opportunity cost is the ratio of two productivities.
* Comparative advantage is a comparison of two opportunity costs, or, in other words, a comparison of two ratios (opportunity costs), each one of which is the ratio of two other ratios (input-output ratios).

It's hard to even say it, much less to understand it!

Given this complexity, what made me say that "we all apply that logic [of comparative advantage] constantly and intuitively, without having to think much about it"?

Think back to the family. I'm the child and my mother is the parent. She's better at cooking than I am by a million miles and also better at ironing, although I could iron shirts okay. Now, imagine a scene where she is ironing shirts and I'm trying to prepare dinner. What does your intuition tell you when you see that scene? It tells me that my mom is about to say, "Wait a minute. Come here and take care of this ironing. I'll take over the cooking."

When we work together with other people, we try to make the group work as best it can. We try to find each member's comparative advantage. And I think we typically succeed. But whether we succeed or not, the effort to make the group work well pushes us to find comparative advantage whether we call it that or not.

That's the logic of opportunity costs, comparative advantage, and allocative efficiency.

Notice that there's no cross-border element in this logic. Borders between sovereign territories only have to do with discriminatory policies and separate currencies, not with economic logic.

But what about "gains from trade"? How can this parable about a two-person, two-task family explain that?

Let's re-tell the story with "trade" in it.

Suppose that the family members don't share but rather work on their own and either consume only their own outputs or have to trade (or barter) with each other to consume anything different than what they individually produce.

Does this setup allow us to figure out whether they would trade, and whether they would gain from trading, in terms of more consumption?

Sure.

If they don't trade, they each need both food and clothing so they each have to both cook and do laundry. So Child will cook some of the day and Parent will iron some of the day. We know that this is the "tell" of allocative inefficiency and that their joint outputs, summed together, can be raised by reallocating their efforts.

So if Child cooks less and Parent irons less, their total outputs will go up and they can trade (barter) — Child giving some laundry and Parent giving some meals — so that each person comes out ahead in the sense of having both more food and more clothing than they did without trade.

"Gains from trade" thus arises from allocative efficiency. It depends on cooperation, which could be either sharing or commerce, including barter.

Diagrams are visual aids to understanding logical (or mathematical) statements.

Take supply-demand diagrams, for example.

Supply-and-demand could be described with equations or with diagrams. How would equations work?

* The equations could be simple linear equations, one for supply and one for demand.
* You could use the substitution method to solve this system of two equations algebraically, and you would get the price and quantity pair that solves both equations simultaneously (supply quantity = demand quantity at the "equilibrium" price).
* This solution would take the form of two functions, one for the equilibrium price and the other for the equilibrium quantity, each function based on the parameters in the supply-demand equations.
* Then you could use differential calculus to show how the equilibrium price or quantity change with respect to a change in one of the parameters, which would give you various formulas for the derivatives, all of them depending on the underlying parameters.

You could do all this. But ... yuck!

What a classroom instructor does instead is to use a supply-demand diagram that represents all the algebra but that is visually more appealing and intuitively easier. Straight lines represent linear functions, their intersection shows the equilibrium, and it's easy to see the equilibrium’s change when you shift or tilt the lines (corresponding to changing the equation's intercept and slope parameters). The results are the same, but much more understandable.

Just for fun, I've put in the Canvas Files another example of how diagrams can allow you to understand things that would be impossible without visualization. See the file on "Sum of Odds."

For comparative advantage and gains from trade, the diagram we need is called a Production Possibility Frontier, abbreviated PPF.

How many of you have been in an economics class that talked about Production Possibility Frontiers? Show of hands.

Supply and demand diagrams relate to a single thing, and the essence of allocative efficiency is the option to produce various quantities of two things, which is why we need the PPF instead of just supply-and-demand.

Also, we know from studying the WTO that what economists call "commercial policy," although it's sometimes discussed in terms of a single good (raising or lowering its tariff), really always deals with two goods (at least), because of compensation or retaliation that follows action on any one good.

It's too bad that we can't use supply-and-demand, because it's so well understood, and you have probably all seen it and feel familiar with it. PPFs are, frankly, harder. But you should learn about them, to understand what it is that policy makers have in the back of their minds. (Remember what Joan Robinson said!)

A PPF is a "frontier" because you're in different territory on the two sides: one side is feasible; the other side is not — it's more than you can produce.

The great thing about the PPF is that its slope equals opportunity cost! So comparing PPF slopes of different producers tells you who has comparative advantage.

This chart draws PPFs using the data from the family story. Please look at it and verify that the intercepts show output possibilities with specialization in only one task, and that the slopes show the opportunity costs we calculated from the original data.

To demonstrate that the PPF's slope equals opportunity cost, take the case of Parent. Productivity in laundry is shirts ironed per day, or S/D. Similarly, productivity in cooking is meals per day, or M/D. The ratio of the two productivities, S/D ÷ M/D = S/M, is laundry per meal, which is the opportunity cost of a meal and also is the "Rise (S) over the Run (M)" of the PPF (when S is measured on the vertical axis; rotating the axes so that M is vertical is the same as inverting all the algebraic formulas).

The green line on this diagram shows a particular mix of the two goods: about 8 to 1. Suppose this were the mix of consumption that each person desired.

Without sharing or trade, each person would allocate production time accordingly and the outputs would be the amounts on the two PPFs where the green line intersects them.

We know they could do better by cooperating, because we can see that this production plan has the "tell" of allocative inefficiency: each person will be working with comparative disadvantage in at least part of the same group work program.

Building a PPF showing efficient cooperation between members of the families has to obey comparative advantage. Remember that a PPF is a frontier of maximum possibilities. So it charts allocative efficiency as well as technical efficiency.

This slide builds a family PPF from the two individual persons' PPFs.

The maximum possible output of meals per day, both persons working full-time at cooking, is 5. That's the point on the bottom right.

If they only needed 4 meals instead of 5, but on the other hand needed some laundry done, we know Child should do the laundry because the sacrifice of cooking is less. So the Joint PPF follows Child's steeper PPF for the initial reduction of one meal.

But if the family only wants 3 meals in the day and Parent also cuts back on cooking time by one meal, then the gain in laundry out is less. Since Parent needed to spend so little time to produce a meal, freeing that time up doesn't result in that much additional laundry output. The Joint PPF doesn't rise as steeply as when Child reallocated effort.

If you want a guide that walks you through construction of the Joint PPF, look at this slide's bullets.

Inspect this diagram and verify how three of the production plans relate to the PPF.

* The very first production program (Plan 1) is inside the PPF.
* Plan 2, which takes advantage of comparative advantage, lies on the PPF.
* The autarkic "8 to 1" outputs without trade between Parent and Child (on the green ray from the origin), is inside the PPF.

So, we've supplemented the basic logic of comparative advantage with a diagrammatic illustration. Whether in algebra or diagrams, it's pure mathematics.

Let's turn to the question of whether this logic is relevant to the real commercial world of producing, selling, and buying.

In making the transition, let's not forget, however, how intuitive the basic idea is. What made the simple cases as simple as they are?

Mainly it's that the group of resources are cooperating and that a single authority is in charge.

When we turn to a commercial economy of innumerable producers and inputs, spread over wide geographic areas, it gets less simple. We lose the two simplifying factors of cooperation and unified direction.

Why would anyone think that such a big, diverse, and anti-cooperative group would achieve allocative efficiency the way a small, unified, cooperative group does?

Well, economists have a theory for this. In place of the guiding hand of your parent or coach, it's "the Invisible Hand"! The conclusion is that, yes, all those producers will end up dividing up tasks according to their comparative advantage.

This theory, however, depends heavily on the assumption that "competition" will take a specific form. And, actually, that's not a very good assumption, especially for long-distance commerce, and most especially for cross-border commerce, where larger firms that have monopolistic characteristics are the main ones involved.

On the other hand, just because there might be doubts about this particular theory doesn't mean that resource allocation is inefficient. It might just be that other factors besides the Invisible Hand play a role. After all, allocative efficiency is beneficial, so it's reasonable to expect that people will try to find a way to get that benefit.

As a first step in understanding "Invisible Hand" theory, let's use the framework we've worked with so far and do the minimum to make it commercial.

For now, I'll keep the same productivities, thus the same comparative advantage, but I'll measure things in money terms.

Resources continue to be available only for the day, like a person's work is, so you get maximum advantage from using them all, meaning that resource cost is not variable and doesn't influence choices. We'll call the resource cost $100, but $50 or $150 would have the same basic result.

Where do the prices come from? From market competition. For now, let's just say that we know what the market equilibrium prices are, and see what actions the two producers opt for.

The example's data should look familiar. Use it to calculate the profits from different production programs for each of the producers. Where does each producer maximize profits?

This doesn't take a lot of higher math, does it?

A meal is a lot more valuable than a unit of laundry output, but on the other hand, each of the two producers can complete quite a few units of laundry per day, compared to the number of meals they can whip up.

In fact, Child Corp.'s relative productivities actually more than make up for the difference in output prices, and make it more profitable to specialize in laundry, despite the lower per-unit profit. Child Corp. "makes it up in volume" (as the old saying goes).

On the other hand, Parent Corp.'s productivity is quite a bit more skewed towards cooking, so that's where maximum profit is found for them.

By the way, Parent Corp. would make more profit in laundry than Child Corp. does, but — who cares? By cooking, Parent Corp. makes even more profit, so that's what they do.

Here's the diagram.

The PPF doesn't change, since I've kept the same physical productivities.

What's added is the prices, in the form of a "price line," or the "isovalue" line, which groups together output combinations whose market value are all the same, at those prices. To do this, the line has to have the slope given by the ratio of the prices: 20-to-1.

The price of a meal is $/M = $200 per meal, and the price of a unit of laundry services is $/L = $10 per ironed shirt. The ratio of the prices $/M ÷ $/L = L/M = units of laundry per meal = "Rise over the Run" = the steepness of the Isovalue Line.

We know that the points on the PPF are the frontier: the most output the two producers together can manage (with both technical and allocative efficiency). Any smaller amount of output inside the PPF would be less valuable, at any prices, and thus less profitable.

But which output point on the PPF is the most profitable of all?

You can draw an isovalue line with a 20:1 slope through any point on the PPF, and all the points on that line would have equal sale value. So, what we're looking for is the point on the PPF whose isovalue line is the highest.

That highest isovalue line is the one shown in the slide, which goes through the point (4,30). For any of the other points on the PPF, if you drew an isovalue line through it, that isovalue line would be a lower line (less value) than the one in the slide.

As we already knew, this shows that profit is maximized when Parent Corp. specializes in cooking, producing 4 meals, and Child Corp. specializes in laundry, producing 30 units.

So, whether you figure it arithmetically (as in the previous slide) or diagrammatically (on this slide), we're illustrating that firms don't have to get together with a coach to figure out where their comparative advantages lie. All they have to figure out is what's most profitable, and it takes them to the same place.

I should reiterate that political borders are not a factor in this story. It's true whether there's a border running between producers, or between producers and customers, or not. Just as borders don't matter for comparative advantage, they don't matter for commerce either (until and unless sovereigns institute discrimination at the border).

The previous slide's PPF-with-Isovalue Line diagram for a two-firm holding company illustrates the principles that apply to firms located around the world. But it has at least a couple shortcomings.

* It isn't framed to try to explicitly represent the large, separate regions that we traditionally talk about when we talk about "international trade."
* It only shows the final destination, the equilibrium, without illustrating the dynamic of how things change when separate regions are integrated by opening borders to commerce.
* It doesn't include considerations of returns to scale, which are important in the real world.

These shortcomings can be repaired by a more complicated PPF presentation, which I have put in a separate slide show. We'll turn to that now.

Hopefully, the diagrammatic presentations of comparative advantage have been understandable.

When we come back to common-sense intuitions, however, one doubt that seems common is how a higher-cost producer can (apparently) out-compete a lower-cost producer. How could a U.S. firm ever, ever compete with a Bangladeshi firm? (Or, is it "How could a Bangladeshi firm ever, ever compete with a U.S. firm?" I forget.)

In our example, it's how can Child Corp., which spends $3.33 to produce a unit of laundry services, dominate the laundry industry, when Parent Corp. is able to produce the same service at a unit cost of $2.50??

It seems worth it to try to address this is a common-sense way, as a complement to the diagrams.

Here's another way of telling the story. Maybe it will help your intuition.

When capitalists get together at Davos or wherever it is that they hang out, do they brag to each other, "My costs are lower than your costs!" Is lower cost their bottom line, their point of pride?

No. It's profits. (At least, that's what the textbooks say: firms try to maximinze profits.)

Now, costs are a factor in profits, but not the only one: revenues are the other factor. So, just having lower costs doesn't tell you everything you need to know about profits and the behavior of firms.

Revenues come from prices, and prices are driven up or down by the strength or weakness of competition between firms.

But a firm's ability to compete also depends on its costs, so you can't neglect them either.

Here's a scenario to pull it all together, intuitively:

* Suppose your firm can produce A or B, as can other firms, and you have to figure out where you can "compete," in the sense of making the most profit.
* If other firms have higher costs than you in product A, you might figure, "Okay, I'll produce A."
* But suppose they have even higher costs than you do in producing B. Then, if, hypothetically, you went ahead with your plan to produce A, out-competing them due to your lower costs, they're going to be pushed into producing B.
* In that case, their even greater inefficiency in B means that prices of B would be so high that you could make even more money by choosing to produce B instead of A.
* When you shift to B and push your competition out of B and into A, they don't do so bad a job as they do in B, and A's prices don't rise to a level that would tempt you to switch back.

That's the logic of comparative advantage.

And, again, the firm only has to go for the highest profit.

The two regions we examined in the regional PPF analysis were purely economic regions, not political regions. They don't lie in different sovereigns' territories, and they don't use different currencies. So, when people don't have to worry about changing money or having the value of their products change because the exchange rate between the two territories' currencies changed.

In polemics about cross-border commerce, however, it's claimed that currency exchange rates artificially influence what industries a region can have. Is this based on an effect that currency exchange rates have on comparative advantage?

To see about this, let's say that our two familiar firms are affiliates of Global Conglomerate, Inc. located in the territories of different sovereigns, U.S. of Parent and U.S. of Child, with two different currencies, the U.S. dollar (USD) and the euro (EUR). Describing prices, costs, profits, etc. becomes a little tedious, because we have to keep track of which currency we're using. (It's tedious in actual cross-border commerce also!)

But the effort is needed if we're going to inspect the commercial equilibria at two different exchange rates to see what changes.

Here's the arithmetic. So the answer to our question about currency exchange rates and comparative advantage: nothing changes. The Conglomerate's two divisions have maximum profits in the same industries at the two different exchange rates.

The Conglomerate's total profits are also maximized with the same production program, regardless of the exchange rate.

This exercise illustrates once again that comparative advantage and allocative efficiency, etc., aren't political concepts. Borders and currencies, which are political creations particular to a multi-sovereign world, only become relevant when sovereigns take acts like instituting discrimination at the border or making currencies nonconvertible — policies that that give rise to "international economics."

Turning back to the rationale for an institution like the WTO:

Its objective of helping member countries reduce discrimination and grant market access to more sources is hopefully justified by the prospect of raising output through allowing better allocation of resources.

A more open market is also bigger, generating other economic benefits as well. A larger market provides economic niches for a greater variety of goods than a small market does. It may also allow firms to realize economies of scale in production, lowering technical costs. More competition in a more open market may lower excess profits and make income distribution fairer.

The WTO also argues that there are non-economic benefits, including reduction of corruption as well as reduction of geopolitical tensions.

Saying that there are gains from reciprocal expansion of market access, thanks to comparative advantage, is one thing. The actual location of industries around the world is a completely different thing and it's not necessarily explained by comparative advantage.

One obvious source of difference between comparative advantage and the actually location of industries is that sovereigns set up barriers at their borders, which blocks the process through which comparative advantage would influence transactions between industries and thus the location of industry.

However, there are some characteristics of global industry that sometimes surprise people and that the concept of comparative advantage can help make understandable.

For example, back in the 1950s and 1960s it was assumed that producers in developing countries would be stuck forever as exporters of primary products (like agricultural and mining goods) because they couldn't possibly compete with firms in technically advanced countries on industrial products (like garments and cars).

That seems laughable now, of course.

But even though people see firms from lightly industrialized countries like Bangladesh exporting manufactures to heavily industrialized markets like the U.S., they don't quite understand it. Shouldn't a U.S. industry be able to out-compete Bangladeshi industry, especially in U.S. markets, using superior efficiency?

That's only one puzzle. Bangladesh also imports manufactures from the U.S. despite wages in Bangladesh being so much lower. How can U.S. firms possibly compete with that?

You have probably heard questions of this type.

Understanding comparative advantage makes these phenomena less surprising. To repeat points that we have already made:

* Costs, including wage rates, are only part of what drives business.
* You can't analyze location of one industry without considering whether other industries might out-compete it in a given location.

When you take these considerations into account, some puzzles look more like just misunderstandings.

On the other hand, there are things that the principles of comparative advantage don't seem to apply to.

In particular, since comparative advantage would explain the location of industry by differences between productivities in different regions, it's hard to use that to explain why there's commerce between regions that are economically very similar to one another, or why a region might both export and imprt the same basic product. A huge amount of commerce has exactly these characteristics. If it's not due to comparative advantage, what's going on?

What's going on is that comparative advantage can be built as well as inherited.

Some traditional economics comes to us from a world of 200 or more years ago where primary industry dominated and productivity was an inherited endowment of the natural world. Among the people who explained comparative advantage coming from that source, David Ricardo (1772-1823) is among the most famous.

If you inherit comparative advantage, that may help explain the location of industry.

But the vast increase in cross-border commerce of more recent times has resulted from voluntary specialization.

We've seen that competition between producers who differ in their productivities can push them towards specialization, rather than each producer dividing time among various lines of production. Specialization can also have benefits of its own: achieving returns to scale, technical improvements from learning, and commercial advantages from bulk buying. A famous early discussion of this process was provided by Adam Smith (1723-1790).

And if you can create comparative advantage practically anywhere by building an industry with returns to scale and technology in that place, then the place's resulting comparative advantage doesn't explain anything. Instead of being the exogenous factor that does the explaining, comparative advantage becomes endogenous and is the thing that needs to be explained itself.

The question becomes: why did people build comparative advantage in one place and not in another?

Comparative advantage on a global scale tends to mean that the organization needs a certain scale: it can't be a one-person shop. Cross-border commerce is dominated by larger firms.

How do you become a larger firm with potential in a wide, possibly cross-border market? Consolidation of firms into a large firm and IT-enabled distribution are two techniques that worked in the past.

From a government policy perspective, how do you make your territory a preferred host for such firms? Low barriers to cross-border commerce is one way.

Another possible aspect of your strategy might be based on "complexity theory," which is one heir of Adam Smith's famous parable about specialization in a pin factory. Real-world policy makers in many countries have been interested in Complexity Theory and have consulted experts to help make detailed studies for their thinking about their countries' places in global industry, as well as about regions within their countries.

Complexity Theory has an idea about how to identify which industries would be most likely to be able to build comparative advantage in a particular region. Once the government knows about this, it can try to take steps that will realize this potential in the short term and that, in the longer term, will expand the range of industries that can build comparative advantage in their region.

First, how to identify the industries that a region is attractive to? The theory ends up doing this by looking at trade statistics. But the rationale for this method is an underlying theory that relates high productivity to complexity and scale.

The theory observes that modern products depend on a range of knowledge that is wider than individual humans can master. So you need a team of persons if you're going to have access to this range of knowledge. (Probably, team members will be specialized experts in different domains of knowledge.)

Complexity theory thus takes account of the fact that there is no one thing that is sufficient to make a region attractive. A region needs to have a lot of different factors available to make it likely that producers can build comparative advantage there. And it's difficult to know what all those important factors are: they're complex.

The cheapest way to tell if the factors are available for a given industry is to look for the result, which is success in global markets as measured by trade statistics. So the empirical analysis starts by looking at existing export performance.

Once you know what your region has succeeded in, what do you do? Complexity Theory says that you should look at other regions that share your success in a particular industry and ask what other industries those regions have done well (exported a lot) in.

If a number of other regions that share your success also share success in the same second industry, Complexity Theory hypothesizes that the second industry may require the same hard-to-observe factors that are needed success in the first industry. So your region might also have the factors for success in the second industry and you should look at trying to attract it.

Analysts of Complexity Theory have prepared a reference for the question of "which other industries do regions export if they all export X," and that reference is called "the product space." The produce space is in two dimensions, like the surface of a sheet of paper. It has a dot for each industry (or for each product group) and the distance between two dots is smaller the more regions there are that export a lot of both of them.

For example, the dot for a product whose exporters don't export anything else, or who export different things, would not be near the dot for any other product. It would be isolated in the product space. Crude oil turns out to be an actual example.

If your success is in products that are isolated in the product space, there is no obvious path to diversification. You have to jump into a different part of the product space and there is no evidence that you have the factors for success in that cluster. So you may have to plan for a long period of financial losses while pioneering firms build, partly by trial and error, the basis for success in your region — and they may fail

The opposite example is a product whose exporters all seem to also export the same group of other products. The dots for those products are all going to be near one another in a cluster in the produce space. Machine tools turns out to be an actual example.

If you've had success in this type of product, it's reasonable to suppose that your region already has the factors for success in neighboring products too.

For this class, however, the importance of Complexity Theory is to show that comparative advantage is far from being the whole story about location of industry.

Exercise: build an export industry as a new entrant in the presence of an established industry.

* Costs are potentially lower, although not initially.
* Negotiation is possible.
* Video primer on negotiation.

To sum up:

* We all try to allocate resources efficiently in everyday life, and we implicitly use and understand the concepts of opportunity costs, comparative advantage, and gains from trade (or, gains from cooperation and sharing).
* The pure logic of allocative efficiency is simple and true.
* University economics professors use the pure logic of allocative efficiency in complicated models that have a lot of assumptions made for special purposes — assumptions about returns to scale, for example. So even if some of the conclusions about "The Invisible Hand" may not apply in many cases, the logic of allocative efficiency is still true.
* Comparative advantage isn't only inherited or innate: it can also be built.
* Actual location of industry is heavily affected not just by inherited comparative advantage and by trade barriers, but also by increasing returns to scale, by who happened to get started first, and by the ability to finance entry into established industries.
* Looking back at the WTO's use of "comparative advantage" as a rationale for the kind of cooperation that it tries to support, it does seem to be a good rationale, but it's not the only one. There are several other benefits to getting sovereigns to reduce discrimination against one another.
* Prof. Samuelson's point about comparative advantage being hard to understand is wrong in the sense that what is really difficult isn't the pure logic of allocative efficiency, but rather the empirical claim that comparative efficiency determines the actual location of industry that we see in the world. Not only do sovereigns short-circuit comparative advantage with barriers, but there are other factors at play that sometimes make comparative advantage endogenous rather than an explanatory factor.