**Slide Show Notes — Gains from Integrating Regions**

**[Slide 1]**

What does the diagrammatic explanation of comparative advantage look like from the perspective of geographic regions with big populations?

**[Slides 2-3]**

Imagine Indiana as two geographic regions:

* Wabash River watershed in the north.
* White River watershed in the center and south.

**[Slide 4]**

Focus on two of the goods produced in both regions. Just call them 'A' and 'B'. (Maybe they're apples and butter.)

When we consider a region with many producers, the PPFs are going to have many segments — as many segments as there are different opportunity costs among the factories or farms. When we stand back away from the PPF, we won't see the individual segments. Instead, the PPF as a whole will look like a smooth curve.

When producers in the region adjust to changing prices, the total output of the region as a whole will move from one point on the PPF to another point on the same PPF. In between those two points, there are segments corresponding to some number of producers.

We can refer to those particular producers as "marginal," not because we would want to do without them, but because — at the initial prices — those particular farms or factories are on the margin between A and B.

In other words, marginal producers' profit is pretty close for either good. If they're producing A, an increase in the price of B is probably going to make B more profitable for them. So they will switch over.

In the diagram, if marginal production units' segments were initially on one side of the region's production point (say, the left side, for A), then when the price of B rises relative to the price of A the region's production point will change and their segments will be on the right side of it. Their segments are still in the same place, because their opportunity costs haven't changed, but the point representing the region's outputs is a different point.

Now we're going to compare the "before and after" commercial equilibria.

* Case 1: Regions are not in contact.
* Case 2: Regions are economically integrated as "Indiana."

**[Slide 5]**

These two PPFs are drawn to represent the production possibilities that past investments have put in place.

Wabash Valley's past investment has focussed on Good A, so a long part of PPF is nearly horizontal. This represents the fact that there are many farms and factories specialized in A. Since they don't have much capability to produce B, there's little loss of B when they produce A.

(Referring back to previouls presentations: Wabash Valley has lots of "Parent" segments compared to "Child" segments.)

On the other hand, White River Valley's investment has focussed on Good B, so it has longer part of its PPF that is nearly vertical. Producers whose segments are in part of the PPF give up little A when they produce B.

**[Slide 6]**

If the two regions were kept commercially separate from each other and only bought and sold their own outputs, they would each individually end up in their individual commercial equilibrium with certain prices. Even if demand were similar for A and B, the differing production capacities would bias Wabash Valley to produce more A, pushing A's price down more than would happen in White River Valley, where by contrast B's production would be high and its price low.

Diagrammatically, the slopes of the two regions' price lines would be different.

* Wabash Valley has a relative glut of A, which is cheap, and production to meet consumption demand is biassed towards A, as shown by the dimensions of the inscribed rectangle, which is longer than it is tall.
* The price of A is quite low in Wabash Valley, compared to the price of B: slope of the price line is less (flatter).
* The White River Valley's situation is the other way around: B is cheap and dominates output and consumption: the rectangle is taller. The price of A is quite high compared to the price of B: the slope of the price line is high (steep).

Would these prices survive if buyers and producers in the two regions could buy sell in the other region? No, not since people like to "buy low and sell high"!

* Producers of A where it's cheap in the Wabash valley will ship it to the White River region, where prices are higher; with B being shipped in the opposite direction.
* Some firms — the "marginal" ones — will switch based on changed profit opportunities.

What would this adjustment look like on the PPF?

* In the Wabash Valley, the rising price of A makes the price line steeper and moves the production point to the right.
* In the White River Valley, the rising price of B make the price line flatter and moves production point to the left.
* Note that the initially different slopes of the two regions' price lines are moving towards one another: the higher slope flattening and the flatter slope becoming more steep.

Since it's the difference between the two regions' prices that drives the change, the change continues so long as the prices in the two regions are different. The end of change (equilibrium) will be characterized by the same prices in the two regions: the price lines will have the same slope as one another.

Each of the two regions' outputs of A and B will have changed. We know the direction of change in each region: more A in the Wabash Valley and more B in the White River Valley.

But do we know what has happened to total output (and consumption) in Indiana, the two valleys put together? Is there some way to use the diagrams to show this total?

**[Slide 7]**

To show the two regions total output, we could stack the White River Valley's output rectangle on top of the Wabash Valley's.

 If you're looking at the presentation using MS PowerPoint, you can "grab" one diagram and manually stack it on the other.

**[Slide 8]**

The total output of the two regions is shown by the green square.

But –

How can we use this diagram to illustrate how things change in adjustment to dropping commercial barriers?

* Both regions' output points and price-line slopes change, until price-line slopes are the same (parallel).
* Wabash (red) output point will move southeast, dragging the White River (blue) rectangle with it.
* White River (blue) output point will move northwest as the blue rectangle is moving southeast.
* That's hard to see.

What to do?

**[Slide 9]**

Thinking "outside the box," the two regions' output rectangles could also be added up by by inverting one and then moving the rectangles together.

In this diagram, White River Valley's diagram is inverted. Its output rectangle is symmetrical, so its dimensions are the same either way, inverted or not.

**[Slide 10]**

Stacking the two regional output rectangles gives the same total state output as before. The green rectangle showing the total of the two regions' outputs can be copied from the earlier slide (using "Copy-and-Paste" within MS PowerPoint) to show that the total of the two rectangles is the same as it was.

(Note that the green rectangle whose dimensions show the size of total Hoosier output goes from the "origin" (0, 0) point of one region to the origin point of the other. Any point in the green rectangle has four dimensions: A and B in the Wabash Valley, and A and B in the White River Valley.)

One thing that has changed is that we can illustrate the two regions' outputs by a single point, instead of two. If there's a change in outputs, we can illustrate it by moving the two charts so that the two regions' new output points coincide again.

Another thing that has changed is that the regions' two price lines intersect at the common output point. This highlights the difference between the price lines' slopes, or, in other words, the difference between the two regions' prices.

In Case 1, before commerce is allowed between the two regions, the two price lines cross at an angle. Since each region's PPF is tangent to its price line at that point, the two PPFs cross also.

**[Slides 11 and 12]**

How can we use the diagram to illustrate Case 2, the end of the adjustment process when people are allowed to respond to price differences between the regions?

With respect to output, we know that, at the end of the adjustment, the common production point in the diagram for both regions, which is purple in this diagram, will correspond to the same prices in both regions.

So the two PPFs' slopes at the final production point will be the same, equal to the price ratio that is common to the two regions — or, in other words, the two PPFs won't cross as in Case 1, but rather will be "tangent" at their common output point. And, their two price lines will go through that point and have the same slope — in other words, they will be one and the same line.

Thus, we can illustrate any statewide, Hoosier production equilibrium in the diagram by moving the two regions' diagrams to where their PPFs are tangent, just barely touching one another.

If we experiment by moving one region's diagram around, we'll see that there are many points where the two PPFs could be tangent. The particular point where output will go is determined by consumer demand.

The point chosen in this diagram (the purple point) shows the case where both regional gluts — a glut of A in the Wabash Valley and a glut of B in the White River Valley — are relieved by "exports" to the other region, so that relative prices — the slope of the price line — end up at a ratio intermediate between the two former values.

(Other equilibrium points are physically possible, but they unlikely to represent demand. Why would either region want to exacerbate the glut it started with??)

To show each region's individual volumes of output, you can inscribe either the initial rectangles (as in the first slide) or the final output rectangles (as in the following slide).

If you inspect the three output points shown in the diagram (two points for the pre-commerce Case 1 — colored red and blue, and one point for the with-commerce Case 2 — colored purple), you see that production in the Wabash Valley has shifted from the red point to the purple point towards more A and less B. Production in the White River Valley has shifted in a complementary way from the blue point to the purple point towards more B and less A.

At the level of individual farms and factories, the "marginal" producers along the segments of the PPFs between the Case 1 and Case 2 output points have swapped roles. Marginal producers of B in Wabash Valley are letting B producers in the White River Valley take their place, and instead they are producing A, taking the place of marginal producers of A in the White River Valley.

That reallocation of production responsibilities is like the example described in class where Parent takes over cooking from Child, and lets Child iron instead. It takes advantage of each producer's comparative advantage.

In the Parent-Child case, that move to higher allocative efficiency resulted in greater total output for the family. Is that the case in this two-region example? How can we see it in the diagram?

**[Slide 13]**

The gain from improved allocative efficiency in production is reflected in the diagram by the distance between the old output points, the red and blue ones.

To help you interpret this, four rectangles have been added to the diagram.

1. A small purple rectangle between the red and blue dots.
2. The green output rectangle from earlier slides, cut-and-pasted here to show total Hoosier output before commerce between the two regions (Case 1).
3. A new orange output rectangle to show the total Hoosier output with commerce (Case 2).
4. A small purple rectangle, of the same dimensions as the other one, to show the difference between the green and orange rectangles.

Total Hoosier output is shown by stacking the with-commerce regional rectangles. The orange rectangle that goes from the origin to origin of those two regional rectangles shows the size of this stacking.

The difference between the green and orange rectangles is the state's gain in total output.

By construction, the difference between the green and orange rectangles is identically the same as the difference between the red and blue dots.

We opened up the gap between the red and blue dots by moving the White River Valley diagram to make the two regions' PPFs tangent at an intermediate point where both regions' gluts were relieved (by exporting). That gap will open up any time the PPFs cross at the initial output point, which means any time the initial price lines cross.

(By the way, the "Little Rectangles" part of the slide's title is a reference to what university economics professors call "little triangles" in supply-demand diagrams. When supply and demand curves are straight lines, consumers' surplus and producers' surplus are shown in the diagrams by triangles. In contrast with supply-demand partial equilibrium analysis of a single good, PPF general equilibrium analysis, taken two goods at a time, shows gains as rectangles. A rectangle is two triangles.)

**[Slide 14]**

Each region's output now differs from the region's consumption, by the amount of cross-border commerce. For example, the Wabash Valley used to consumer its whole output of A; now it exports some A and imports some B. How does the diagram show the difference between regional output and consumption?

The diagram in this slide shows an example of a consumption point by a yellow dot. Commerce goes from output at the purple dot to consumption at the yellow dot by moving along the black price line — in other words, by buying and selling at the prices that determine the price line's slope.

As was pointed out earlier, the price line is an isovalue line. The contribution of A and B production to the Wabash Valley's gross regional product is the value of the output quantities at the purple point. All the points on the isovalue line through this point are volumes of A and B that the Wabash Valley can afford using its income from A and B production.

Turning things upside down, the diagram shows the same thing about the White River Valley, along the same isovalue line.

So, according to the relative strength of demand for A and B in the two regions, consumption will be driven to some point on the black line. (To remind: each point has four dimensions: A and B for the southern region and A and B for the northern region.)

The yellow dot shows a point of balanced consumption of A and B, at about the same balance as before there was interregional commerce.

Note that the amount of consumption is more: more A and more B in both the Wabash Valey and the White River Valley. Whatever index-number problems there may be in measuring the exact increase in gross regional product, given that the two output mixes are produced at difference prices, the fact that the total of both products is higher shows that there is an increase.

**[Slide 15]**

The gain shown in the previous slide comes from the same efficient reallocation of production responsibilities as was already illustrated with the Parent-Child example.

In that example, we constructed a Family PPF by combining the two PPFs of the Parent and the Child. Can we do that for the two regions example?

Yes. We just have to stack up many more producers' segments than the two segments of the previous example.

Remember that we characterized both the red PPF of the Wabash Valley and the blue PPF of the White River Valley as being composed of many segments. Each PPF ranks these segment by opportunity cost of producing B and then, starting from the point that would be reached on the horizontal axis if everyone produced A, stacks them by lowest opportunity cost of producing B.

To construct the Indiana-wide PPF, you would make a single list of all the farms and factories and then follow the same procedure. As you went along stacking segments, you would be putting in some red segments and some blue segments. From a distance, the resulting PPF would look like a mix of red and blue, or probably purple, which is the color used in this slide.

**[Slide 16]**

This slide inserts the price lines from previous slides, along with two rectangles showing initial outputs and the increment to output.

The slopes of the lines and the sizes of the rectangles are all the same — just displayed within the joint PPF of the two-region state.

You can see that the high prices for goods in relative shortage — A in the White River Valley and B in the Wabash Valley — are moderated when buyers have access to supplies from outside their home region.

**[Slide 17]**

One of the points of the terms "little triangles" and "little rectangles" is that their volumes are small. It may even be difficult to see the little purple rectangle in this presentation, from a distance.

Does that mean that "gains from trade" are too small to be important? It might be if it were driven only by a relative handful of marginal producers.

That doesn't necessarily describe the structure of industry, however. And different structures can produce different results.

An important aspect of industrial structure is returns to scale, and there are diverse returns possible. Different returns to scale can be illustrated by different shapes of "production functions" for individual goods.

KOM text on page 56 shows production functions with decreasing returns to scale, which it used to construct a PPF based on allocating between the two industries shares of the resources available ("labor").

Both production functions show decreasing returns by curving "down." In the original case we started with — the family with two members — each person's production function was a straight line ("constant returns") for meals and for laundry.

In contrast, the family's production function curved down: after rising steeply due to the Parent's relatively high productivity, the production function then has a kink and rises less steeply when the source of addition output is the Child. An industry with many producers might have a production function for with many kinks, and it might look like a smooth curve from a distance.

**[Slide 18]**

But this case used is not the only possible one. As illustrated in this slide, returns to scale can be constant (straight-line production function), decreasing returns (curved down), or increasing returns (curved up).

We probably think of a modern industry as being dominated by big producers. This can be described by saying that there are increasing returns to scale in the industry: unit costs are lower for big producers than for small ones. Naturally, the big producers drive the small ones out of the market by setting prices below the smaller producers' unit costs. (Over half of U.S. output comes from firms with 250 or more employees.)

What does this mean for comparative advantage and gains from trade?

**[Slide 19]**

First, an economy characterized by industries with increasing returns to scale has PPFs of the opposite shape to what we have seen up to now. Instead of being bowed outwards from the origin, they're bowed inwards towards the origin.

PPFs bowed inward towards the origin imply that allocative efficiency results in full specialization by big producers, rather just in shifts between a small number of marginal producers.

**[Slide 20]**

Returning to the diagrams for regional economies, increasing returns to scale in the two regions would change the shape of their PPFs.

Restricting their market areas to their own localities may prevent them from taking advantage of the increasing returns to scale that are potentially available. Since people will want to consumer a mix of goods, substantial resources will need to be allocated to each good, including goods in which the region doesn't have increasing returns to scale, meaning that the region couldn't realize its potential for increasing returns.

**[Slide 21]**

This slide shows how two regions' outputs add up in the situation where local consumption depends only on local output, so a mix of goods are produced.

As in the earlier case with decreasing returns, the two regions' PPFs cross at the production point rather than just touching. So it's possible to find a production point with greater total output, which you can do by moving one of the regions' diagrams. The next slide shows the result.

**[Slide 22]**

Commerce between the two regions allows each region to specialize so as to benefit from increasing returns to scale and thus massively increase output, income, and consumption of tradables.

In this slide, the new profit-maximizing output point is purple and is located at the southeast corner. It's a "corner solution" rather than an adjustment carried out by a handful of marginal farms and factories.

The purple, "gains from trade" rectangle, rather than being hard to see, now dominates the diagram. Instead of an increase in output of 10% or so as in the decreasing-returns case, it's a doubling of previous output.

The document by Melitz and Trefler (in Canvas) discusses an example of gains of this type — the U.S.-Canada automotive sector. (See the section starting at the bottom of the 5th page: "We now highlight ... economies of scale ... .") The authors point out that removing barriers and expanding the market area allows producers to realize increasing returns to scale in more goods, increasing the number of different models that were affordable.