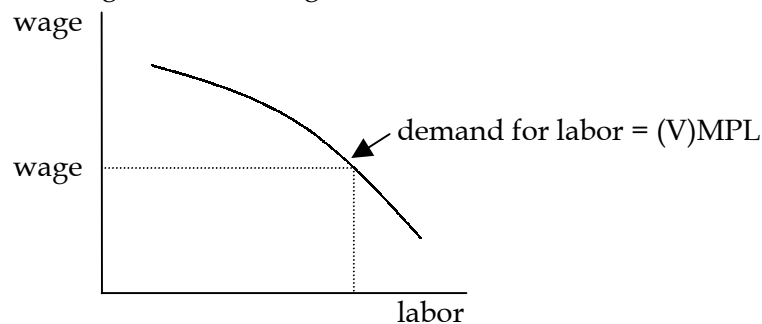


Chapter 3 – Structural Change, page 1 of 11

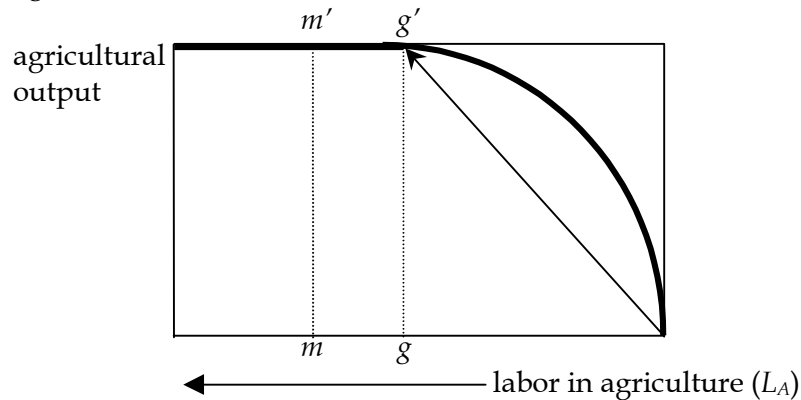
- this chapter considers differences in rates of growth for different sectors of an economy (such as the agricultural, industrial, and services sectors) unlike the single-sector models in chapter two
- the labor-surplus model:
 - the labor-surplus model is a dual economy model developed by W. Arthur Lewis, Fei, and Ranis:
 - this model considers the dualism between the agricultural/traditional sector and the industrial/modern sector in developing countries; not only do these sectors use different technologies (combinations of capital and labor) but also they differ in institutions
 - the agricultural/traditional sector:
 - the agricultural/traditional sector has a classical (pre-capitalist) economy
 - wages (earnings) are equal to the average product of labor (unlike the industrial/modern sector where wage is determined by the marginal product of labor)
 - the marginal product of labor in this sector equals zero (the last laborer added contributes nothing to total production – if he were removed, output would not decrease); thus, there is an absolute surplus of labor because workers could be removed without decreasing total output
 - if wages in the traditional sector were paid their marginal product then wages would not be paid to the surplus labor
 - the marginal productivity of labor could even be less than zero but total production will still be positive (it is produced by inframarginal labor – workers short of the last ones, having a positive marginal product)
 - workers will not move to another farm/sector as long as the average product is greater than the subsistence wage, unless the other sector is offering more than the traditional sector's average product
 - the labor surplus can be as large as 20-30% of the work force
 - the industrial/modern sector:
 - this sector follows the neoclassical model
 - the wage rate depends on the marginal productivity of labor (MPL)
 - firms will hire all labor for which the marginal productivity of that labor is greater than the wage – firms will lose money if they pay more than the marginal product of labor to workers; the last worker hired will have a marginal product equal to the wage
 - a diagram illustrating the neoclassical model of labor supply and demand:



- page 93 – the three part diagram illustrates the labor-surplus model:

Chapter 3 – Structural Change, page 2 of 11

- the first diagram illustrates total agricultural output as a function of labor in agriculture:



- labor in agriculture (L_A) increases from right to left in the diagram
- total output increases with additions of labor to agriculture until L_A equals g ; to the left of g output does not increase even if more labor is added to agriculture
- to find the average product of labor in agriculture, a ray is drawn in from the origin to the point of total labor in agriculture and total agricultural output: the height of the triangle equals total agricultural output and the base of the triangle equals total labor in agriculture; thus:

$$\text{average product} = \frac{\text{agricultural output}}{L_A} = \frac{\text{height}}{\text{base}}$$

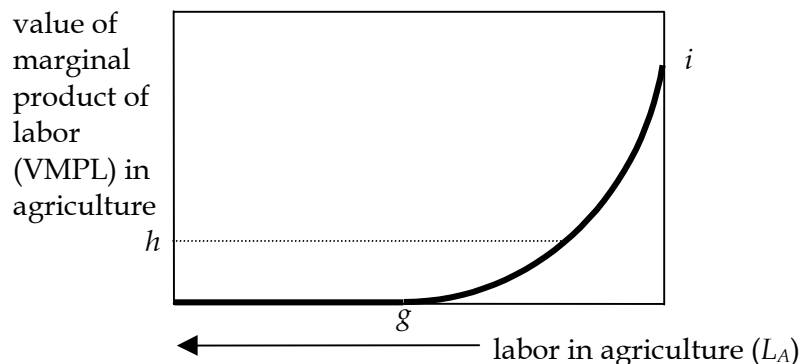
- beyond g , the total agricultural product ceases to grow so the average product decreases but remains positive ($mm' = gg'$)
- it is impossible to sustain more workers when the average wage falls

below the subsistence wage; $\frac{m'm}{m} > \text{subsistence wage}$

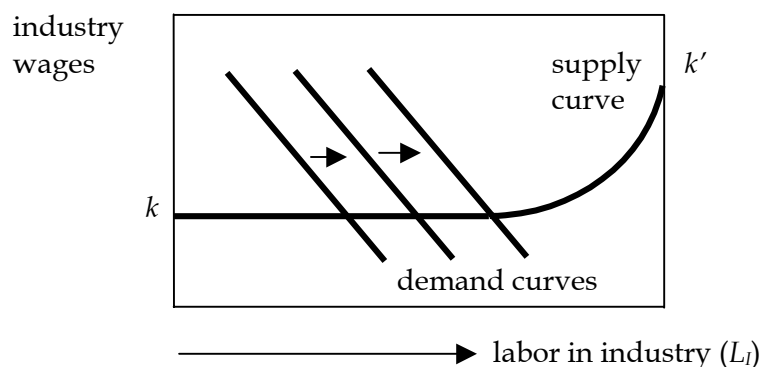
- thus, in a poor developing country, there is an absolute overpopulation working in traditional agriculture; for example, this might occur in peasant agriculture
- if half the labor is in absolute surplus, then it could move into another sector without decreasing agricultural output but still increasing output in the other sector (for example, industry)
- labor exists in surplus because of a family institution that works on principles different from those of a firm; a firm would fire workers whose marginal productivity equals zero because they are not profitable; however, a household works on traditional beliefs and cannot do this; thus labor “hides” in the agricultural sector
- although this might appear to be inefficient, notice that if the agricultural sector suddenly switched to a modern wage economy basis, millions of people would be thrown out of work and made destitute; thus, it seems desirable that change be gradual

Chapter 3 – Structural Change, page 3 of 11

- this illustrates how institutions can be different between the traditional and modern sectors
- the second diagram illustrates the value of the marginal product of labor in agriculture:



- to the left of g the marginal product of labor equals zero
- to the right of g the marginal product grows to i
- h is the subsistence wage of the traditional sector
- the third diagram illustrates labor supply and demand in the industrial sector:

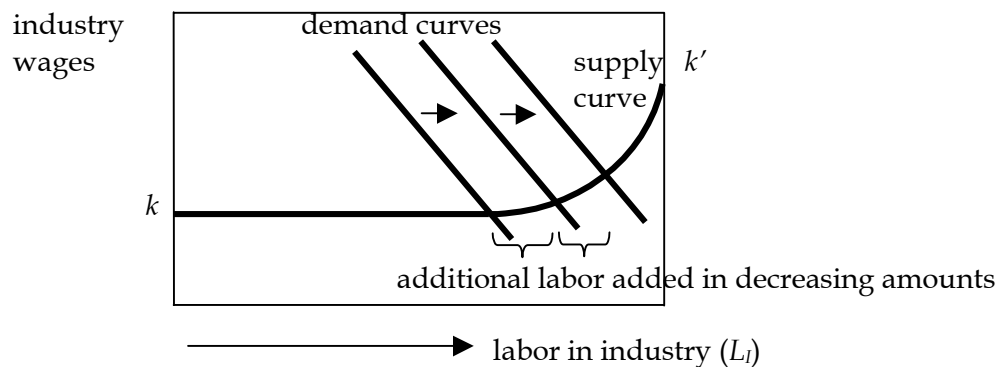


- workers whose marginal product in agriculture is zero would be willing to move to the industrial sector for a small premium over the subsistence wage h ; industry will pay wage k , which includes a premium over h to pay for migration costs, etc.
- firms are willing to pay workers if their marginal product is greater than the wage; thus, the demand curve for labor is the marginal product of labor curve
- dynamics of the labor-surplus model:
 - as profits are plowed back into capital accumulation, the demand curve shifts right because workers have more capital to work with and their marginal productivity increases
 - eventually removing labor from agriculture will reduce agricultural output and at some point the wage industry offers must increase because: 1) the total amount of food produced by agriculture decreases so prices increase and 2) industry competes with the wage offered by agriculture, which becomes a

Chapter 3 – Structural Change, page 4 of 11

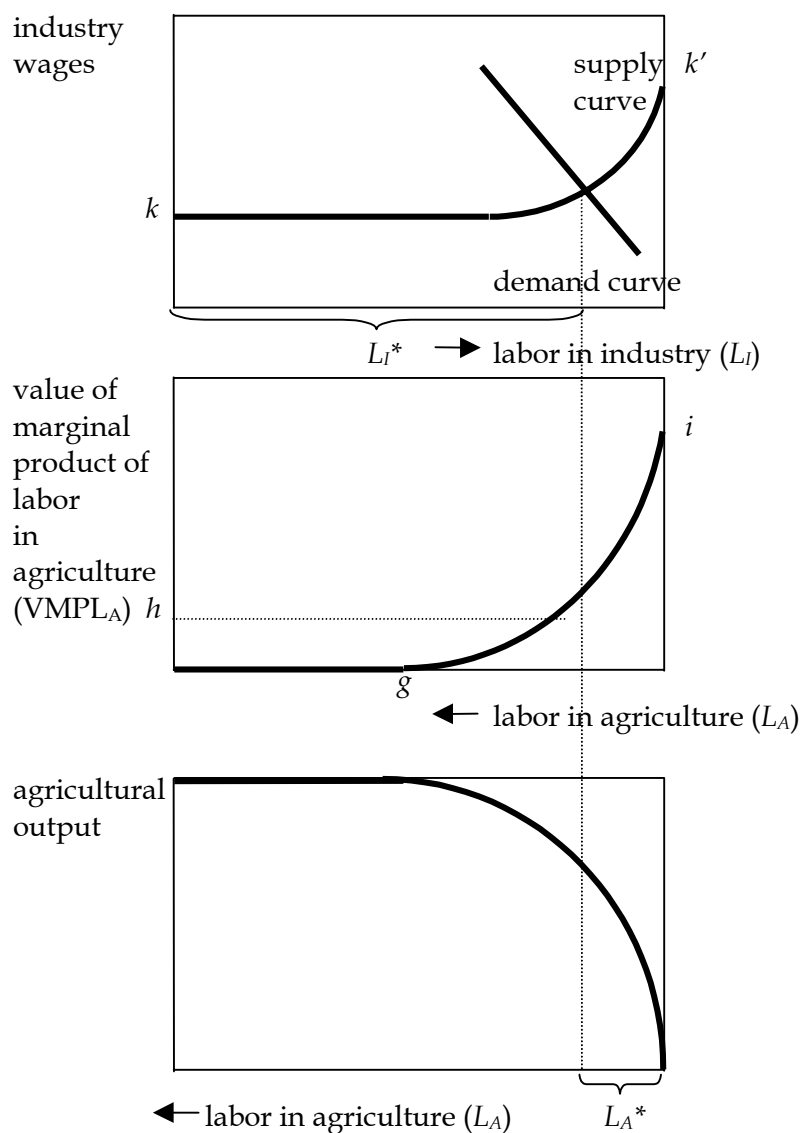
function of agriculture's now increasing marginal product of labor; specifically, once the marginal product of labor in agriculture becomes greater than k , the labor supply curve to industry starts rising because industry must compete with agriculture for labor (this model assumes the size of the total labor force is fixed and that labor is either in agriculture or in industry)

- over time, the proportion of labor in agriculture decreases and the proportion of labor in industry increases
- when the supply of labor is no longer “unlimited” (the supply of labor is considered unlimited while the marginal product of labor in agriculture equals zero) there is a cost to the economy for moving labor from agriculture to industry (because some agricultural production is lost)
- as the labor demand curve shifts outward, fewer additional workers are hired because the wage is increasing:



- eventually the supply of labor to industry is choked off because the dualism between the agricultural and industrial sectors is eliminated
- the ultimate goals of development are:
 - 1) to absorb the labor surplus from the traditional sector into the modern sector – this increases the economy's total output because the marginal productivity of labor in agriculture is zero, but the marginal productivity of labor in industry is positive
 - 2) end the dualism between the traditional and modern sectors
 - 3) make the value of the marginal product of labor in agriculture equal the value of the marginal product of labor in industry ($VMPL_A = VMPL_I$), illustrated by the amount of labor in agriculture (L_A^*) and the amount of labor in industry (L_I^*) below:

Chapter 3 – Structural Change, page 5 of 11

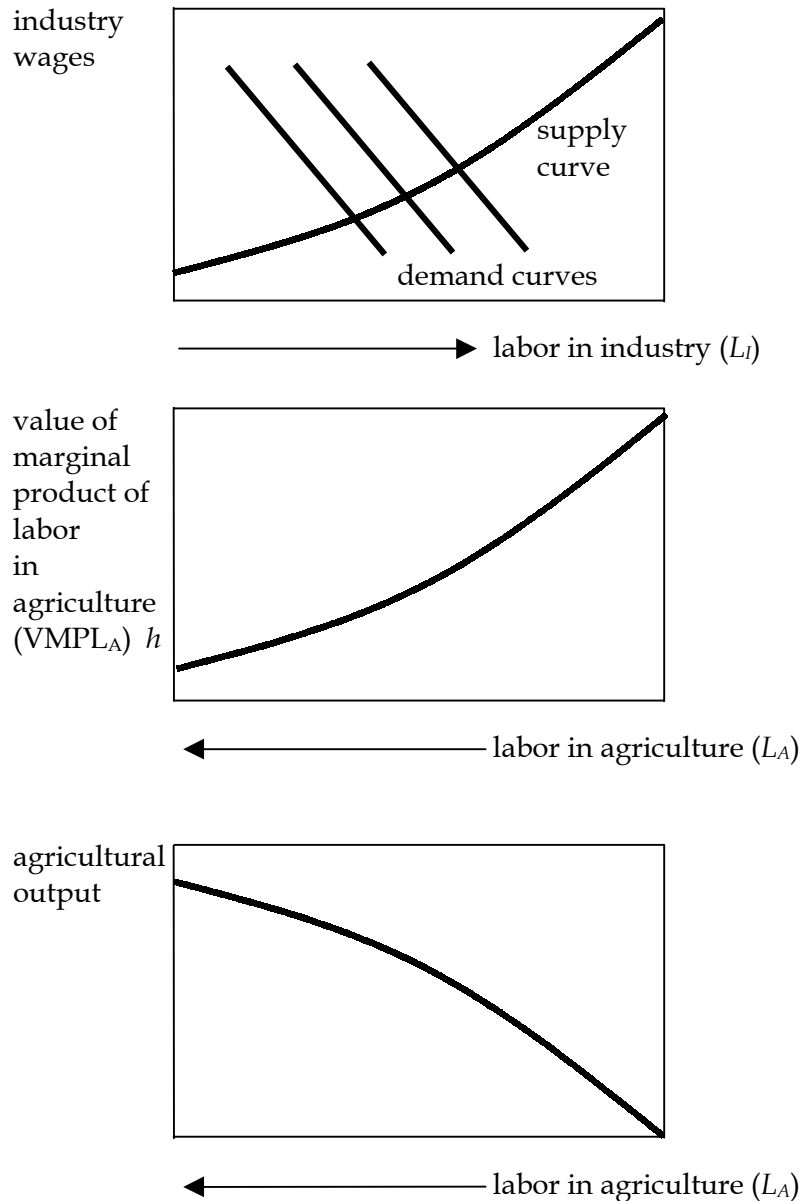


- when the marginal product is the same in both the agricultural and industrial sector, the two sectors are competitive
- just like the allocation of labor in industry, in a competitive economy at equilibrium the marginal product of labor is the same in all firms; thus, the MPL in industry will equal the MPL in agriculture; agriculture will become just another competitive sector in which labor is allocated efficiently
- this will also end the dualism of institutions - on farms workers are hired based on their marginal product (not the average product); the entire economy runs on a modern commercial basis; workers will choose employment based on the highest return to their labor
- investment in agriculture and the two-sector labor-surplus model:
 - it may appear that agriculture is playing a passive role and that it contains a “swamp” of surplus labor that needs to be drained; thus, it would seem there is no need to invest in agriculture

Chapter 3 – Structural Change, page 6 of 11

- however, if agricultural productivity grows simultaneously then the point at which industrial wages rise could be delayed (giving the appearance of more surplus labor); moreover, it is undesirable for limited food production to become a check on industrialization
- thus, there should be a balance of investment in agriculture and industry
- many countries (such as in sub-Saharan Africa) have harmed agriculture through taxes, etc. with disastrous results for the entire economy
- during the post-independence period agriculture was not seen as a solution to the problem of economic development; much of the value of agricultural production was siphoned off by government marketing boards that bought the crops and sold them to the urban population or exported them (to generate revenue); in many cases this led to a decline in agricultural exports
- this government policy was motivated by an incorrect belief that agriculture is not a part of modernization and is only a source of tax revenue – later on, agriculture as a matter of policy was dealt with more carefully
- population growth in the labor-surplus model:
 - population growth (leading to more workers in the agricultural sector) does not increase total agricultural output in the two-sector labor-surplus model because additional workers have a marginal product equal to zero
 - however, as population grows the average product in agriculture will decline and, thus, so will the standard of living of agricultural laborers
 - population growth will increase the “unlimited supply of labor” available to industry at the low wage h – a growing population will prolong the time it takes industry to absorb the surplus labor and, thus, it will take longer to establish a modern commercial economy
 - thus, this model suggests why population growth is considered harmful to development
- empirical foundations for the two-sector labor-surplus model:
 - page 87, figure 3-1: shows that empirically across all countries as income grows, the share of workers in agriculture decreases and the share of workers in industry increases
 - however, there is a large gap between the value of output of workers in industry and in agriculture
 - in some countries income in the informal sector is larger than income in peasant agriculture; the income gap is even greater in the formal sector (mining, government, etc.)
 - average income for the economy rises as portions of the labor force get more capital to use
- the neoclassical two-sector model:
 - the neoclassical two-sector model uses a slightly different production function that assumes the marginal product of labor in agriculture never reaches zero – some economists prefer this as a more accurate representation because a marginal product equal to zero is not observed empirically
 - although this modification to the two-sector labor-surplus model affects all other curves (for example, the labor supply curve is never flat), the basic dynamic and policy implications of the neoclassical model are the same as those of the labor-surplus model:

Chapter 3 – Structural Change, page 7 of 11



- policy and industrialization:
 - some industries may develop earlier than others during development:
 - early industries – supply food and clothing, etc., use basic technologies
 - late industries consist of consumer durables, require a high amount of capital to create (such as steel, automobiles, etc.), may first need to be imported
 - middle industries – lie somewhere between early and late industries
 - however, empirical studies of this are not decisive – there might be some regularity in which industries are established earlier and which ones are established later
 - however, there might be circumstances in a particular country which determine whether certain industries develop first; for example, if there is coal and iron ore in a country then it might start an iron or steel industry, but if those natural reserves did not exist then it would not
- the role of government versus the role of markets in the development process:

Chapter 3 – Structural Change, page 8 of 11

- the policy implications of early/late/middle industries: should the government have a policy/plan regarding the sequence of industries? if the country has a low capital stock then should the government start a capital-intensive industry (like steel or automotive manufacturing)?
- the majority of economist in academic and policy settings believe the government should have no such plan and should deregulate; this liberal economic environment allows the private sector to invest – which industries develop first would be discovered empirically as development proceeded, not dictated by abstract economic models or by the government
- balanced versus unbalanced growth:
 - earlier in the field of development economics there was a debate among economists as to whether development should occur in a balanced or unbalanced fashion
 - balanced growth:
 - assumes a country produces all goods domestically and does not trade internationally (the country is autarkic)
 - different sectors must grow in proper proportion to each other in order to support each other
 - however, an iron mining industry would not develop without demand from the steel industry; the steel industry would not develop without a demand from the automotive industry; and so forth – this would not be a problem if international trade existed because if an industry were not well established, the same input it produces could be acquired from another country
 - this suggests that growth is unlikely without government intervention because if there are no steel, iron, coal, and automotive industries already then it is unlikely that someone would invest in any single industry because there might not be anybody to buy the output; it is also unlikely that somebody would invest in all these industries at the same time
 - this suggests a “big push” is necessary through government intervention; either the government could directly own the industries or help the private sector develop the industries (such as by assuring that complementary industries would develop simultaneously, offering subsidies, etc.)
 - the argument against autarky is that it is not in a country’s best interest to not engage in international trade (and most countries are not autarkic); however, the approximation of a large country as autarkic is a good approximation, but smaller countries require more international trade
 - discussions about autarky generally took place in political contexts – self-reliance (with trade as a possible small add-on) was considered desirable by some nationalist parties, etc.
 - the evidence today is that autarky is bad for growth – greater international trade correlates with greater growth (we’ll study this in detail later in the course)
 - unbalanced growth:
 - Albert Hirschman – argues against growth in a balanced way – growth occurs naturally through unbalanced disproportions among sectors
 - an example illustrating unbalanced growth:
the steel industry (supplying the automotive industry) might grow more rapidly than the iron and coal mining industries supplying it; the economy will work to correct this imbalance

Chapter 3 – Structural Change, page 9 of 11

the shortage of iron and coal would raise their prices and make investment in them more profitable;

of course, unless investors determine exactly how much more iron and coal are necessary, the iron and coal industries might “overshoot” their demand

the price of iron and coal would drop due to the industries’ excess capacity and either the iron and coal industries would cut back on production or the steel industry would grow quickly because it would become more profitable now that its inputs are cheaper (the latter is more likely)

thus, economies do not grow smoothly but go from one disequilibrium to another

- investment is spurred not by government insuring balance but by bottlenecks (imbalances creating higher/lower profitabilities among sectors)
- thus, economies grow from one imbalance to another
- backward and forward linkages:
 - linkages are the relationship between two industries; they relate the growth of one industry to the growth of another industry; linkages can be forward linkages or backward linkages
 - backward linkages – examples: growth of the steel industry affects the iron and coal industries through a backward linkage, a backward linkage connects cigarettes to tobacco growers, a backward linkage connects textiles to cotton growers
 - if policy makers want to become involved in development, they should look at linkages and invest in those industries with the strongest domestic forward and backward linkages; these linkages should be domestic because it is not as desirable to have an industry buy its inputs from abroad and then export its output (this would have a limited effect on the domestic economy)
- the input-output model (input-output analysis):
 - the input-output table was developed by Wassily Leontief is sometimes referred to as a Leontief matrix
 - the input-output model is important to planned economies such as the former Soviet Union or China which used government planning and did not rely on market signals
 - this model assumes autarky (trade is nonexistent or negligible)
 - a table is used to describe the relationship among the domestic sectors:

| | | Uses | | | | | |
|---------|-------|------|------|-------|--------|-------------|---------------|
| | | Iron | Coal | Steel | Export | Consumption | Total Product |
| Sources | Iron | | | | | | |
| | Coal | X | | | | | |
| | Steel | | O | | | | |

industries are listed under both Uses and Sources because an industry will act as a consumer of output as well as a producer of output (for example, the steel industry will use some steel, iron, and coal to produce steel)

Chapter 3 - Structural Change, page 10 of 11

going down a column shows how much production the sector under "Uses" requires from the corresponding sector to the left (under "Sources")

going across a rows shows how much output the sector listed under "Sources" produces for the corresponding industry above (under "Uses")

for example: the X represents the amount of coal used by the iron industry and O represents the amount of steel used by coal

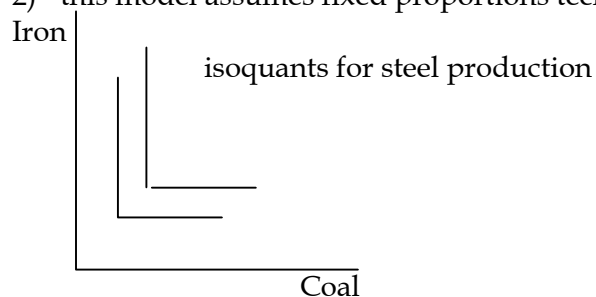
the output in each box can either be in physical quantities (such as tons) or in money terms (such as dollars)

the "Export" column lists the amount from the industry on the left that is exported

the "Consumption" column shows the amount produced by the industry on the left that is used for direct consumption

"Total Product" is the total amount produced by the industry to the left (under the Sources heading); the total product equals the sum of the amounts used in industry, the amount exported, and the amount used for consumption

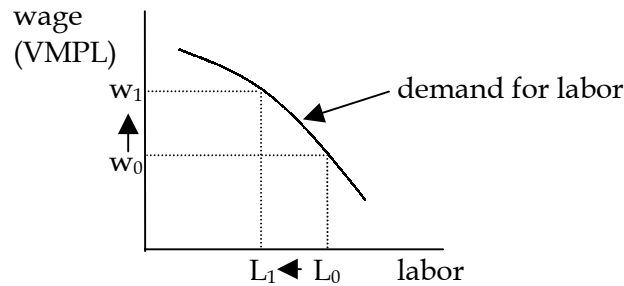
- if an industry, such as steel, increases production, this table can be used to determine how much more every industry needs to produce to provide the steel industry with the proper additional input
- equations relating each industry to the other industries can be written using a_{ij} coefficients; a_{ij} equals the quantity of product i used per unit of output of product j
- writing out a matrix of a_{ij} coefficients allows predictions to be made, such as: if steel production increases, how much more coal and iron are needed?
- in order to produce more steel, more iron and coal need to be produced; however, to produce this additional iron and coal, even more steel, iron, and coal need to be produced, and so on; the total amount of additional production can be fully solved using a matrix procedure (which we will not pursue further); however, for a given increase in an output, the table can be used to determine to a first-order approximation how much more input is required
- this model is limited:
 - 1) the model is almost irrelevant to an open economy because imports can be substituted for domestic products
 - 2) this model assumes fixed proportions technology (L-shaped isoquants):



Chapter 3 – Structural Change, page 11 of 11

however, it might be better to change the technology used based on the possibly changing scarcity of the inputs; input-output analysis is a “snap-shot” of an economy’s technology and does not consider change in production techniques

- social accounting matrix (SAM):
 - this is an extension of the input-output model
 - the model represents government, the rest of the world, etc.
- general equilibrium vs. partial equilibrium:
 - partial equilibrium:
 - partial equilibrium can be illustrated by considering the effect of a change in the wage on employment:



when the wage increases from w_1 to w_0 , the amount of labor employed decreases from L_0 to L_1

- however, this model does not consider all the effects of a higher wage; there may be other consequences, for example:
 - 1) some people will lose their jobs while others earn a higher wage, which will have an effect on total income – this, in turn, affects the demand curves for different goods
 - 2) because of the higher wage, the firm(s) could use different technology or move to another country
- thus, partial equilibrium analysis does not follow the effects of a change all the way through the entire economy
- general equilibrium:
 - in contrast to partial equilibrium, general equilibrium considers how all markets interact with each other and determines all secondary, tertiary, etc. effects
- computable general equilibrium (CGE) models:
 - CGEs are quantifiable (computable), multi-sector models
 - they model the entire economy using a set of equations; once the model is set up, it can be used to make predictions; for example, if the minimum wage decreases, a general equilibrium model can trace through the effects this would have on the rest of the economy
 - economists have tried to use general equilibrium models to predict the effect of policies
 - however, a general equilibrium model is only as good as its assumptions and needs to simplify; thus, the model allows an effect to be traced through the entire economy but its predictions are not exact