III.iv.4. Divergent income path diagram, total income increasing:

Figure 8 represents the graph of the sectoral income paths over time, with MV increasing.

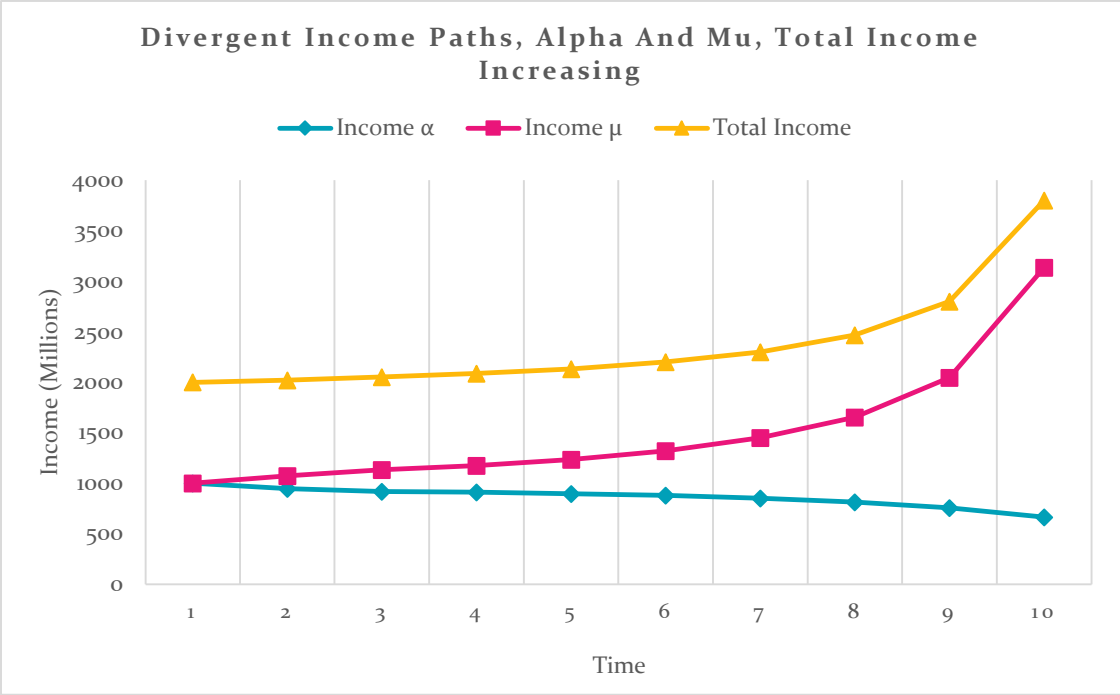

Figure 8: Divergent income paths, total income increasing

The income paths over time, of α and μ, diverge more in this graph than in the one where total income remains constant. This is a property of the numbers created for the example. This may or may not represent the situation as it might occur in the real world, although the discussion associated with equation (5), above, suggests that the more the money in circulation increases, the more rapidly the income paths diverge.

Then, over time, the agricultural sector as a whole must buy fewer, or lower-quality, inputs, relative to the last period, than the manufacturing sector.[1] (This period's income buys next period's inputs.)

To use a numerical example from Table 4 above, when the economy moves from period 1 to period 2, α's income declines from $1000m to $946.4m, while μ's income increases from $1000m to $1073.8m. The non-agricultural sector has more money to spend on inputs in the third period than in the second, whereas the agricultural sector has less. (The second period's income buys the third period's inputs.)

IV. The Scenario in Mathematics

It is customary in the academic economic literature, to present one's ideas in mathematical form. Such a "model" follows.

1.We abstract from transportation costs and other costs of inter-regional commerce, and assume that input markets are reasonably competitive, economy-wide.

IV.i. Technological know-how increases exponentially[1]

In the two-path growth scenario, productivity advance interacts with consumers' demand, specifically different demand elasticities for different types of products, to direct the progress of economic change. Schmookler (1976) shows that the possibility of economic advantage (making money) motivates inventive activity.

Data to support the idea that technological know-how increases exponentially, worldwide, over time, is presented in Figure 9.

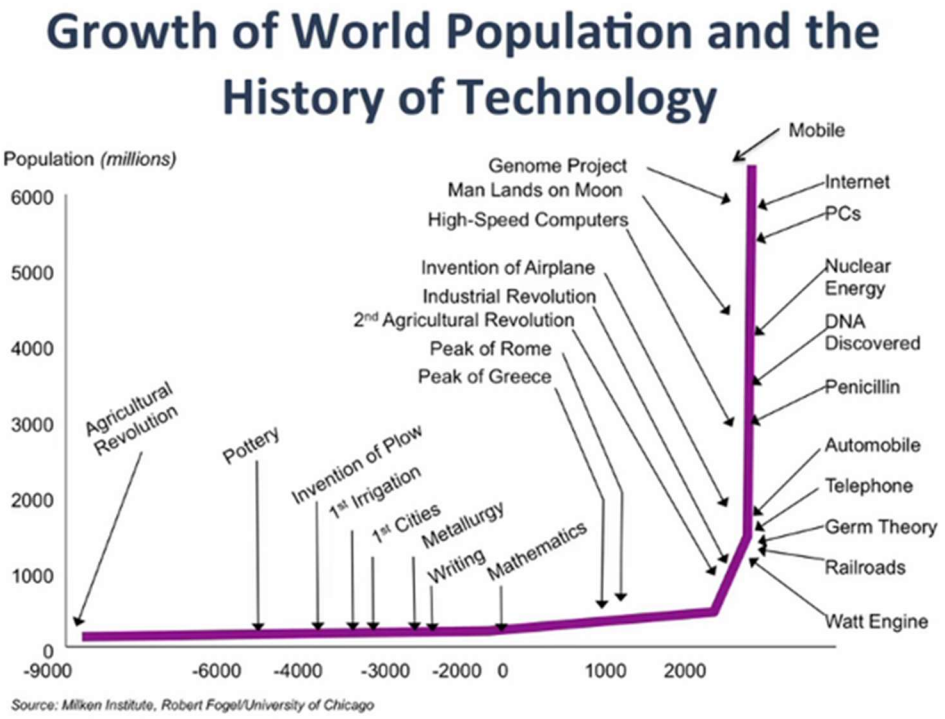

Figure 9: Exponential growth of population, upon which are superimposed some major technological advances

1.The variable that represents productivity advance, and best explains the two growth paths of the present model, is the "overall level of technological know-how," and its increase, in the economy or the world. Technological know-how can spread in a way that income does not, because two people can possess the same knowledge, as they cannot own the same income.

Productivity, in economics, is the ratio of what is produced to what is required to produce it. Usually this ratio is in the form of an average, expressing the total output of some category of goods divided by the total input of, say, labor or raw materials. Source: Britannica.com. Productivity increase is an increase in this ratio (e.g. more output for the same inputs).

The idea of capital accumulation as the primary engine of growth has been losing favor for some time (Schmookler 1976, vii). The two-path scenario investigates the impact of the "new" engine of growth, technological progress. Evidence for the importance of technological progress to economic growth was presented in section II.ix above. Also, Engerman and Sokoloff (2006, 73) suggest that the onset of growth was "not at all dependent on capital deepening or the introduction of radically new capital equipment." They indicate that productivity increased "at nearly modern rates" in small firms and farms with limited degrees of mechanization, in the early nineteenth century.

According to Schmookler (1976, 5), "technology" consists of "applied science, engineering knowledge, invention, and subinvention."

While this graph does not quantify the "level of technological know-how," it is suggestive. If a higher population can be sustained by a more productive economy, that is, we assume, one with more advanced technology; then this diagram suggests that the level of technological knowledge in the world has increased exponentially since 9000 BCE. The following quotation from "Our world in data," supports this interpretation:

"The economic historian Gregory Clark sums it up crisply: 'In the preindustrial world, sporadic technological advance produced people, not wealth.'[1] . Technological[1] improvements lead to larger, but not richer populations. If this analysis of the pre-growth economy is true than we would expect to see a positive correlation between productivity and the density of the population."[1] He means that productivity increases in agriculture cause increases in population, because what supports a population is food.

IV.ii. Assumptions for the mathematical presentation of the two-path growth scenario

The assumptions made here downplay the role for the economist's conventional sources of growth in the economy – savings, investment, and capital accumulation. Yet, the model shows how an increase in the level of technological knowledge, *by itself*, as time passes, can generate diverging paths for the incomes of α and μ.

(a) Let us retain the initial assumption that MV = K.

The next two assumptions simplify the demand conditions. According to Johnson (1991, 81), "income elasticities [for food] decline as real per capita incomes increase." And (p.87) "there is no reason why [the income elasticity for food products] cannot approach zero."[2] Therefore,

(b) Let us assume that the price and income elasticities of demand for the sectoral output of α are infinitely inelastic ($\Sigma Q_{i\alpha}$, quantity produced, is constrained to be constant by demand).
(c) And, let us assume that the price and income elasticities of demand for the sectoral output of μ are infinitely elastic. (That is, $P_{i\mu}$ are constant – infinitely elastic - in each time period, as they face producers; however, each $P_{i\mu}$ can decline over time, as total quantity of output increases, keeping MV constant, so that the same money chases more goods and the general price level must decline).

The next assumption describes the growth path of technological know-how, with reference to figure 9.

1.Source: Our World in Data: Economic Growth. [1] The note in the quotation refers to: Clark (2007) – A Farewell to Alms: A Brief Economic History of the World. Princeton University Press. Also, population density can increase the rate of technological advance. According to the literature on "agglomeration externalities," interaction among people who live close to one another, encourages exchange of ideas and inventions (Fujita and Thisse, 2002, 7-8). Thus, population density also may cause increases in productivity.

2.To explain: the whole class of agricultural goods (especially food) are not substitutes in consumption for the whole class of other goods. We will eat food until we are comfortable, and then we will buy computers, but we will not weigh the choice between food and computers, no matter their relative prices, if we are starving.

Adam Smith (1994, 188) explains it this way: "The rich man consumes no more food than his poor neighbor. In quality it may be very different, and to select and prepare it may require more labour and art; but in quantity it is very nearly the same." He goes on to explain that the wish to satisfy other types of wants can expand almost endlessly.

(d) The general level of technological know-how in the economy (or the world) may be represented by a variable $\phi = Ae^{rt}$, where A is an arbitrary starting point, that is, an initial value of ϕ; r is a constant rate of growth; and t is time.[1]

The next assumption is intended to keep attention on the role of demand elasticities, without confusing the issue with population growth, and its associated increasing demand for food. We address the relationship of population growth to the two-path scenario in Appendix I.

(e) Let us assume that population remains constant.

While there may be inter-regional barriers to movements of factors, in the real world, the present analysis does not require them. Therefore:

(f) In the mathematical model, as in the descriptive scenario above, markets are reasonably efficient (both factor and product markets), so that similar types of goods, services, and factors receive similar prices and incomes economy-wide.[2]

One further departure from convention is the following:

(g) In working with the equations, there is no separation of the price from the quantity of output, nor the factor price from the quantity of factor inputs, although the discussion addresses conceptually how prices and quantities may change, together or separately.[3]

IV.iii. Equations for the two-path growth scenario

"Structural change" in Johnson's (1991) sense in the real world is caused by the movement of factors from the agricultural sector to the rest of the economy. It is here represented by a scenario in which

1.It was not an advantage, here, to postulate an endogenous feedback mechanism. (A trend in economic growth models (Acemoglu, 2004) is to explore the role of endogenous technological change.) The present approach investigates productivity advance in two sectors, and the sectoral interactions of incomes. The reasoning of the "endogenous growth" literature applies more to a one-sector growth model, and thus more to one country versus another, or to the internal dynamics of one sector, and to individual earnings, than to sectoral interdependence. (For a discussion, see Aghion and Williamson, 1998, especially p. 55. For example, "educated labor is precisely what generates technological change," and, "the skill-abundant economy will grow at a constant rate." The present two-path growth scenario suggests that consumer demand ***directs*** technological change, which, undirected, arises spontaneously over many centuries of human development; the analysis is not constrained to a constant growth rate, which seems empirically unlikely. Also, in the two-path growth scenario, the sectors interact in factor markets, as well as in product markets; and, the typical conventional economic growth model does not explore the role of money as money, rather, such models represent earnings as they relate to a marginal product in an equation.)

2.We abstract from transport costs and different regional costs of living. These would complicate a real-world analysis, but they need not distract from the main argument presented here. Also, when we discuss the implications of the model, we will address the real-world situation wherein there may be a rural-urban wage differential for like workers.

3. Production functions in economic models have arguments that represent physical quantities (such as Q, K, L), but real-world economic data, representing those physical quantities, are measured in monetary units. For example, GDP, a measure of the output of the economy (what would be Q in a production function), is measured in monetary units.

Adam Smith (1994, 35) reasons, "Hence it comes to pass, that the exchangeable value of every commodity is more frequently, estimated by the quantity of money, than by the quantity either of labour or of any other commodity which may be had in exchange for it." Smith also sometimes writes as though the price and quantity are conceptually the same thing. For example, "Whatever part of the produce, or, what is the same thing, whatever part of its price, is over and above…." (Smith, 1994, 166)

income in α declines, followed by movement of factors out of α; while income in μ increases, associated with increasing purchasing power. In particular, jobs are eliminated in α and created in μ.

Each variable in the equations below is measured for the same time period as the others. The time period enters the equations via ϕ (= Ae^{rt}).

In order to investigate how α loses factors (and how μ gains them), let us start with a very basic production function and apply it to each sector. Factor prices are represented by the variables ξ_i and the physical quantity of factor inputs by the variables F_i. This avoids complications from working with different categories of factors, and different qualities of each of those factors. (Robinson, 1954)

$$(6)\quad (\Sigma P_i Q_i)_\alpha = (\Sigma \xi_i F_i)_\alpha \phi \;\; = (\Sigma \xi_i F_i)_\alpha A e^{rt}$$

That is, output of α (measured in dollars) is an increasing function of inputs in α (measured in dollars) and ϕ, the level of technological knowledge in the economy; ϕ is an exponential function of t; however demand conditions constrain $\Sigma Q_{i\alpha}$ to be a constant quantity (no population growth, so no increase in demand for food).

$$(7)\quad (\Sigma P_i Q_i)_\mu = (\Sigma \xi_i F_i)_\mu \phi \;\; = (\Sigma \xi_i F_i)_\mu A e^{rt}$$

Output in μ is an increasing function of inputs in μ and ϕ, the level of technological knowledge in the economy; ϕ is an exponential function of t. There is no demand constraint on output in μ.

$$(8)\quad (\Sigma P_i Q_i)_\alpha + (\Sigma P_i Q_i)_\mu = MV = K$$

Total output, (that is, output of α plus output of μ,) measured in monetary units such as dollars or pounds sterling, equals the money circulating in the economy, which is assumed constant.

IV.iv. Dynamics of the two-path growth scenario

Demand constrains $\Sigma Q_{i\alpha}$ to remain constant (demand for α is perfectly inelastic). Therefore, as time passes and ϕ increases (which is our representation of productivity increase, economywide), the only way to maintain $\Sigma Q_{i\alpha}$ at its constant level, is for factors used in α, $(\Sigma \xi_i F_i)_\alpha$, to decline, in physical numbers or monetary value, or both[1] This follows from the relationship between $(\Sigma \xi_i F_i)_\alpha$ and ϕ. Rearranging (6):

$$(9)\quad (\Sigma \xi_i F_i)_\alpha = (\Sigma P_i Q_i)_\alpha / \phi \;\; = (\Sigma P_i Q_i)_\alpha / A_\alpha e^{rt}$$

That is, total factor income in α $(\Sigma \xi_i F_i)_\alpha$ is a function of the ratio of $\Sigma P_{i\alpha}$ to ϕ (because $\Sigma Q_{i\alpha}$ is constant).

In order to conclude that factor-income (which is equivalent to product income, after its distribution to all inputs) in α declines, we must further assume that $\Sigma P_{i\alpha}$ does not increase with time to compensate for the increase in technological knowledge, ϕ, and (by implication) productivity.

1. If, as may occur in the real world, demand for $\Sigma Q_{i\alpha}$ is not quite perfectly inelastic, we can see that, the more closely $\Sigma Q_{i\alpha}$ is constrained not to increase much, the more $(\Sigma \xi_i F_i)_\alpha$ must decline.

This is easily done: as output increases in the economy, and more goods are produced, in μ, it follows that the general price level must decline (MV assumed constant). Since there are many goods, we do not worry about the general-equilibrium consequences of a decline in the price of one good; if some goods are not profitable to produce, other goods will be produced, and the general price level will still decline.[1]

We have shown that income to α declines as the general level of technological knowhow increases. Factors will move from α to μ, as α cannot support as many factors as it could before. In μ, as ϕ increases over time and income moves from α to μ, product income to μ $(\Sigma P_i Q_i)_\mu$ increases, and total factor incomes $(\Sigma \xi_i F_i)$ in μ also increase.

Factor incomes adjust as quantity produced increases, holding MV constant. There will be an increase in the quantity or quality of factors in the economy, as productivity advances. (Increasing income to μ is used creatively.[2] Then, the general level of factor prices declines, as the number of factors increases, for the same reason that the general price level declines as the number of goods increases. (MV = K)[3]

IV.v. How economic growth can outrun farmers and the uneducated – with reference to the two-path growth scenario

A general declining level of prices and factor-prices, economy-wide, need not logically lead to income inequality between α and μ, or in any general pattern, for individuals (i.e. per capita). That is, quantities of outputs increase, prices go down, quantities of factor inputs increase, factor prices go down, and everyone may get the same or more for their incomes. (This is the reasoning behind the idea that, the bigger the economic pie, the better off everyone is.)[4]

This could be true, except that economies have a spatial dimension; factor-earnings differentiate among different types and qualities of factors; and prices differentiate among different types and qualities of goods. "Higher-quality" factors and products, with higher prices, gravitate toward urban and non-agricultural regions where higher incomes cluster. Factories can occupy small land areas, surrounded by urban housing for workers, while agriculture is usually land-intensive and farms are spread out across a region.

The two-path growth scenario was developed to show how agriculture loses income share to urban regions, which explains long-run rural-urban migration, alongside urban-urban migration.

The idea that some regions lose income-share can also apply in other situations, for example, if the region is the home of a declining manufacturing industry, or if a neighborhood has little income to

1.We could postulate a theoretical case where every non-agricultural price is lower than every agricultural price, and the number of non-agricultural products is very much greater than the number of agricultural products, and increasing, so that sectoral incomes change as described, but agricultural prices increase. We believe this is a theoretical curiosity, unlikely in the real world.

2.The assumption of no population growth does not mean that we cannot produce other factors in the economy. Many kinds of capital inputs are manufactured, for example, and human capital can be generated with education and no increase in population. Those types of factors can increase in absolute physical quantities, just as output can, when the increasing income to μ gets distributed around the sector and the economy.

3.We showed, in section III.v.4 above, that the conclusions of the scenario apply, even when MV increases, and so we retain the assumption that MV = K, because it is easier to explain what happens, if we do so.

4.Output quantities would have to increase more rapidly than quantities of income-earning factors of production in order for everyone to be materially better off, on average.

spend on education, so that its residents do not develop the skills to integrate into the technologically-advanced economy.

In the two-path scenario, we assume MV = K, in order to clarify the situation without getting confused by nominal price increases. Following the reasoning introduced earlier, since the distribution of MV is a zero-sum game, it follows that, as some regions get richer, others get poorer. (Agricultural regions get poorer and farmers are left behind, relative to business-owners in high-income regions and sectors.)

Similarly, as some individuals get richer, others get poorer. (The uneducated, whose skills are not in demand in the technological economy, get left behind, relative to those with advanced technical skills.) To the extent that the educationally-disadvantaged cluster in regions, some neighborhoods can get left behind in an analogous way to the way in which agricultural regions get left behind.

Although economic agents appear to interact and share income in complex ways, and it is easy to imagine that these interactions balance out, the reality is that the economy systematically takes more money out of agricultural activity than it puts back in; and takes more money from regions where individuals cluster, whose skills are not wanted, than it puts back in. There is no trickle-down, for some, in theory as well as in fact.

According to Sachs (1991, 326), "A rising tide lifts all boats, as the old expression puts it. [A pervasive illusion is that] if the rising tide is not lifting your boat, it is probably your own fault. The forces of globalization are sufficiently strong that everyone can benefit if they can just behave themselves." Sachs does not agree with this point of view, and neither do we, as the two-path scenario illustrates.

IV.vi. An increase in the money supply does not change the overall consequences of productivity advance, for sectoral inequality

The inclusion of money in our scenario has highlighted the relationship of the quantity of money in circulation, to the distribution of income. We now discuss the relationship of real values to nominal values in an attempt to discover whether our result - that distribution of nominal income between economic sectors is a zero-sum game - is true for real income, specifically the distribution of physical quantities of goods and services, as well as for nominal income. (Does a rising tide lift all boats?)

"Real income" is the purchasing power of income. Thus, conceptually if not definitionally, "real" values are physical quantities of goods and services produced or purchased. They are represented in the two-path growth scenario by $\sum Q_{ij}$, where j represents α or μ.

When output increases, the economic "pie" gets larger. The way in which the quantities of products and services are distributed, depends greatly on consumers' incomes.[1] Because, theoretically in the market system, everyone pays the same market price, it follows that the distribution of physical output is directly related to nominal income. (The higher a person's, or a region's, nominal income, the greater the quantity of physical output he, she, or it can purchase.)

1.It also depends on wealth, but we do not address this here, except to note that high incomes and high wealth are often correlated.

Thus, the results of our scenario apply to real quantities as well as to nominal income. The agricultural sector gets absolutely worse off, as well as relatively worse off, as economic growth with productivity advance occurs.

The representation of income in monetary units, in the two-path growth scenario, rather than as a marginal product, draws attention to the difference between these two concepts. The difference between the concept of income as the sum of all prices multiplied by all quantities $(\Sigma P_i Q_i)_j$ and the concept of wealth as the total accumulated physical quantities $\sum(\Sigma Q_i)_j$ is discussed further in Appendix IV on international trade.

V. Discussion

We have developed a scenario where the agricultural sector takes an ever-smaller share of GDP (GDP is represented by MV in the equations) as productivity increases and output expands, while the rest of the economy, represented here by a manufacturing and service sector, gains GDP share.

There is nothing in this scenario to suggest that the economy will self-correct out of the situation where agriculture loses income share. Johnson (1991, 87) makes the same point in his anecdotal description of how the agricultural sector responds to economic growth.

Some may argue that, in a market economy, when we move away from equilibrium in the agricultural sector, in the following situations:

1) Demand for food increases, for example if the population increases, or
2) Food becomes scarce

that the price will be bid up. Firms will enter the industry, and producers will produce more of the desirable good, so that any shortage will go away. Therefore, there is no need to be alarmed by what happens in the agricultural sector, because if any problem should arise, the market will correct it.

The next subsection explains why the matter needs a little more consideration.

V.i. Why price signals do not act to draw resources into agriculture, even though human beings value food highly[1]

In case 1) Demand for food increases. Nevertheless, it is unlikely that the price goes up. The reason is that productivity increase, leading to price decline, outpaces the impact on the price of increasing demand. The situation is illustrated in Figures 13 and 14 below. Anderson (1987) suggests that this reason is often given for agricultural disadvantage, although the puzzle he finds it necessary to explain, is why this situation can occur in an open economy.

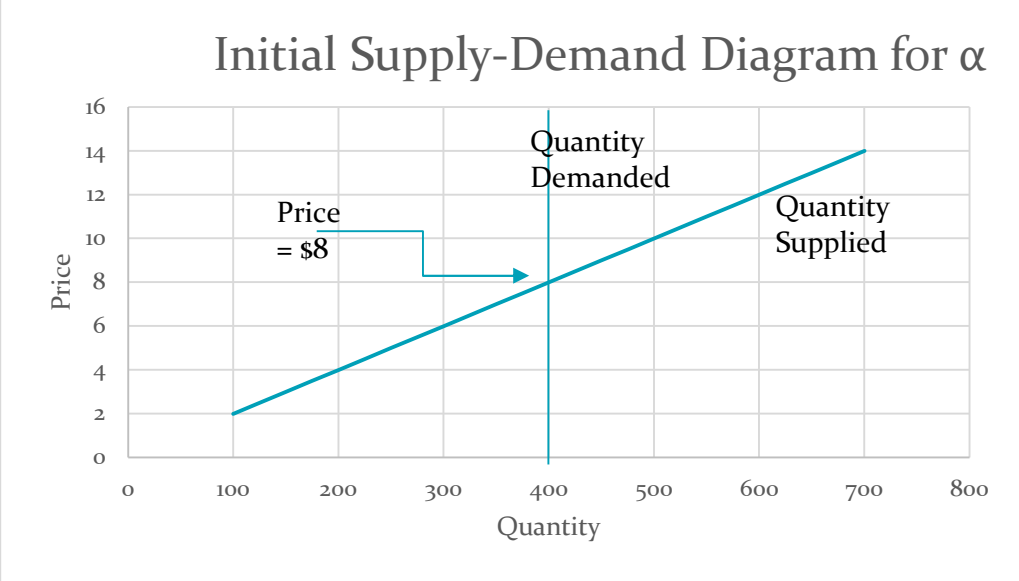

Figure 13: an example of a supply-demand diagram with inelastic demand for α.

In figure 13, the equilibrium price is $8. If population remains constant, there is no reason for demand for agricultural products, in particular, food, to increase from one period to another.

1. In what sense does the price of a good or service, represent its value? According to Adam Smith, there are two meanings for the term "value," that is: the utility of an item, or its "value in use;" and the value of an item in terms of what it can purchase of other goods, or "value in exchange." (Smith, 1994, 31). To what extent do these two types of values represent the same or a similar concept? Law (Spiegel, 1971, 176) reconciles the possible inclusion of both concepts in the market price, by means of the relative abundance of useful items such as water, relative to diamonds. Yet, neither the price nor the relative abundance of an item, reflects its actual importance to a person. A simple example is that, the same price for a commodity to a rich man as to a poor man, represents a very different proportion of the poor person's income than of the rich person's income, so that it is unlikely that the commodity has the same importance to the poor person as to the rich person (with the exception of food and water.)

In fact, prices are determined by the interactions of supplies, demands, and money. That is, the price of something depends on the quantity of money in circulation, the level of technological knowhow in the economy, consumers' abilities to pay for what they would like, and on whatever else the economy is producing. Prices can change if the economy's output mix changes, so that any price is more in the nature of a relative price than a representation of an absolute value, or importance of the item to a person.

For example, if an economy stops producing something that we would like, such as house calls by doctors, or cars we can fix ourselves, then the prices of these items become zero relative to other items produced. However, the reason these items are no longer produced, is that their cost is too high relative to alternative uses of the producer's resources, so that the proper theoretical price to put on them, for consumers who would still like them, is a relatively high price, or high economic value, not zero at all.

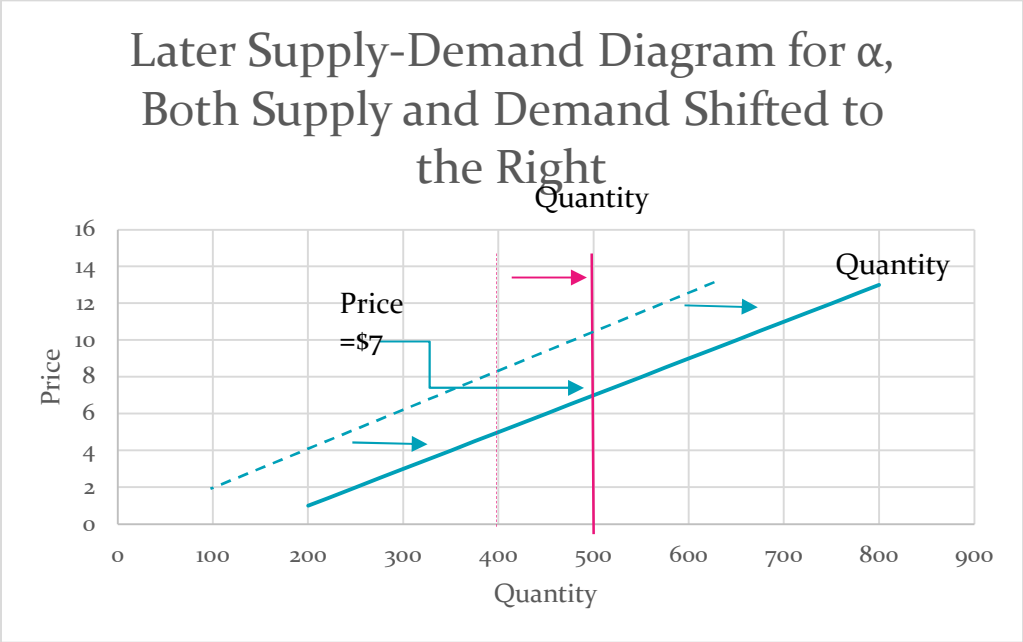

Figure 14: Supply-Demand Diagram when both the demand and supply curves shift to the right

At a later date, in Figure 14, population has increased. The demand for agricultural products has increased from 400 units to 500 units, so that at every price the quantity demanded is now 500 units. However, productivity increase has reduced the per-unit marginal cost to producers so that the supply curve has shifted to the right. Inputs are more productive, so that the quantity that would be offered at each price has increased. The new equilibrium price is $7, lower than the initial equilibrium price.

The diagrams do not show the full dynamics of the economy, and some analysts may think that there is no necessary reason for the supply curve to shift to the right so much that the price cannot rise. Appendix I shows that, in the two-path growth scenario, income moves from agriculture to the rest of the economy, even when population increases.

In case 2), concerning the economy's response to a scarcity of food:

This paper is not primarily concerned with what might happen if food becomes scarce in an economy where food is normally plentiful, but the argument needs to be addressed.

Whatever caused the scarcity will not easily be solved, because under normal circumstances the economy provides enough food for the population. For example, if climate change reduces farm productivity worldwide, it will be difficult to bring back former levels of productivity even with entry of firms into agriculture, because productive agricultural land is already limited.

Then, food remains scarce, and the price will be bid up until food becomes rationed according to those who can afford it. The new market equilibrium solution will involve severe distress, such as malnutrition or even starvation, for the disadvantaged. We doubt that this market solution would be politically acceptable.

We have shown in the two-path growth scenario that the impact of technological knowledge on production, i.e. productivity increase, causes the agricultural price to fall over time. (That is, an average sectoral price for agricultural commodities.)

Increases in the money supply, difficulties of international comparisons, and changes in types of outputs and consumption baskets, may make it difficult to observe an unambiguous decline in average agricultural prices, over the long run, in the real world. We believe that, if the right data are collected, this will be found.

V.ii. Phenomena of the agricultural industry, explained by the two-path growth scenario

The implications for agriculture of the two-path growth scenario are:

- A declining income share: productivity increases, then output increases in agriculture and the rest of the economy, and then the scenario here developed plays out: there are fewer farmers and they use fewer of the economy's resources.

- Agricultural commodity prices may fall or remain low. One author references the "chronic nature of low commodity prices for many agricultural products." (Wise 2004, 22) Charts from the USDA ERS, using IMF International Financial Statistics, suggest that even a price hike for agricultural commodities is actually a drop in its relative price. Appendix II presents the data.

- Agriculture faces a "cost disease."[1] Agriculture must compete with richer segments of the economy for resources and inputs. Land, labor, skilled labor, capital goods, services, intermediate goods, credit, and other inputs to production are in demand economy-wide. Richer entities in the economy often bid up the prices of some or all of these inputs.[1]

  Yet, it is hard for farmers to increase their product prices when input prices rise (if, indeed, they are rich enough to spare any of the product for sale). The more competition there is for the consumer's dollar from manufactures and services, the less money consumers spend on agricultural products, especially food.[2] The typical farmer is squeezed between the rising price of many inputs, and a relatively low price for farm output.

  Johnson (1991, 87) makes this point with regard to labor, although his conclusion is different from ours; he reasons that it is sensible for farmers, in order to save on rising labor costs, to substitute other inputs. He does not investigate the implications of the possibility that all factor-prices increase, ***except*** the prices of factors which embody the kind of technological progress, that leads to productivity advance. For example, he does not consider whether those, less expensive, technological inputs to agriculture accomplish any desirable end, other than the commercial end of remaining competitive.

1.Archibald and Feldman (2006) describe the cost disease in services Also, Sachs (2005, 228-232) describes the plight of the Sauri sublocation, in Kenya. For example: "Farmer after farmer described how the price of fertilizer was now out of reach, and how their current impoverishment left them unable to purchase what they had used in the past."

2. I use the word "money" advisedly. If MV is constant, the price level declines and less money is needed for food. If MV increases, the equivalent situation holds, but it is disguised by the increasing price level. As shown above, an increase in demand for a product with inelastic demand, in the presence of rapid productivity advance, will not raise the product price and attract more producers to the industry.

- Thus, financial pressures on agricultural producers make it harder for them to make a profit as time goes on, so that the industry would be expected to decline and farmers to exit the sector, in order to find a more profitable use for their assets.[1]

- Because of the above, there is pressure on agriculture to innovate, to do more with less. To compensate for fewer or lower-quality inputs, farmers may produce output (food) that is no longer nutritious or natural.[2]

- To expand on the previous point, not only does technological progress favor city growth at the expense of agricultural incomes, but also, it discourages the development of appropriate technologies for agricultural production. We can see that, if technological progress is primarily a response to an economic need or opportunity, then the incentive in economically advancing industries, is fundamentally different from the incentive in economically declining industries, such as agriculture.

  At the "leading edge," of the economy, managers and researchers have income, and can be creative in their attempts to satisfy an anticipated demand. In an industry with inelastic demand, (losing income as output expands), the need is to remain competitive, with the result that, as producers try to outcompete one another, the industry's productivity increases, the price declines. and each producer is worse off. Producers must be ever more inventive in the presence of declining quantities or qualities of inputs.

  But, because of lack of funds, the declining industry may have to do the best it can with new knowledge that has been developed on behalf of advancing industries. The needs of a declining industry, or poor country, may be very different from the needs of an advancing industry, or rich country.[3] Examples in which modern, Western technologies have been applied inappropriately to agriculture in developing countries, especially Africa, abound. (Pacey, 1990).

- Wages in the agricultural sector come under downward pressure from farm owners, although they cannot decline too far when farm workers can find work elsewhere.[4] Thus, there may be a real-world wage differential between agriculture and other industries. However, it arises more from "inertia" than it operates as an incentive.

1. According to Johnson, the industry might decline into oblivion if food were not so important a product. (Johnson, 1991, 87)

2.Webb and Block, (2012) discuss the possible impact on the obesity epidemic of the production of cereals and high fructose corn syrup rather than legumes and fruit.

3.For example, "Many of the key breakthroughs in [agricultural] technology developed in the rich countries are relevant for the particular ecological conditions of the rich countries, and are not especially useful in the tropical, or arid, or mountain environments where so many of the extreme poor live today." (Sachs, 2005, 63)

4.According to Adam Smith, "In a decaying manufacture [i.e. declining industry] …many workmen, rather than quit their old trade, are contented with smaller wages than would otherwise be suitable to the nature of their employment." (Smith, 1994 134.) We call this "inertia." Empirical evidence that incomes vary by industry may be found in Groshen (1991, 351, 353), BLS (2016), Slichter (1950, 83). See Appendix II for some data.

Sjaastad (1962, 8) suggests that, if an adverse effect is national, "such as the earnings in agriculture, …migration is feasible only if new skills are acquired by the migrant." We will return to this point later in the discussion.

- Factors of production, including labor, exit from agricultural regions. Agricultural-urban migration can persist for many years. The puzzle of why migration does not equilibrate regional differences is explained: regional differences arise as productivity increases, and those differences increase more rapidly than equilibration can occur. Urban regions grow, in the context of "leading-edge" industries and their associated networks of resources, so that regional income-shares continue to diverge. (Emerson 1992, 71-72)[1]

- Governments may continue to support agriculture in various ways, including the provision of research assistance. The prevalence of such behavior - despite many economists' recommendations to leave the market alone - suggests that it may have some value.[2]

- Worldwide, poorer countries find it hard to compete with richer countries' agricultural products.[3] It is hard to expand the market for agricultural products, (global demand is inelastic), so that there is not room for everyone in this market, whereas in industries with global elastic demand, it may be easier to gain and keep some market share.

V.iii. The future of agriculture

The squeeze on the agricultural sector will continue, although we might mitigate rural poverty in general, for example by creating urban-type jobs in rural regions. We foresee continued efforts on the part of farmers to subvert nature in order to produce the same or more output from fewer, or lower-quality, inputs.

The creativity of farmers and agricultural researchers can produce many good outcomes, in that a growing global population can mostly be fed. Yet, there are some downsides to modern ways of farming. For example, agricultural research creates high-yielding seed strains that may not adapt well to changing conditions; plants that can grow, even when sprayed with poisons (pesticides), which poisons we eat; inexpensive crops that may be unhealthy; and fertilizers which add chemicals or human-cultured microbes to the soil.[4]

V.iv. Phenomena of labor markets consistent with the two-path growth scenario, especially the roles of education and skills

Why is technical education so important to modern economic systems (OECD, 1996), when in past societies, it often was not necessary for most of the population to be able to read? Why do cities attract high-skilled migrants from all over the world? (Ewers, 2007).

1.See also, "The rich move from innovation to greater wealth to further innovation; the poor do not." (Sachs, 2005, 62)

2.Wise (2004, 20) notes that, in many economic models showing welfare gains from reduced agricultural protection, the gains are actually to consumers from lower prices, and not to farmers. For some issues in the discussion regarding farm support, see Wise (2004), Edwards (2016), and Johnson (1991).

3.Wise (2004, abstract) observes that, "World trade talks have foundered recently, in part due to developing country demands that industrialized countries reduce their large farm support programs to allow poor farmers in the global South to compete more fairly"

4. Goklany (2001) discusses some related issues in agriculture.

In the two-path growth scenario, a relatively high sectoral income to manufacturing, or the modern sector, arises, as a consequence of elastic demand for the products of that sector. Manufacturing businesses, over time, acquire more funds, because the sector's income increases as productivity advances. This enables manufacturers to hire workers with advanced skills.[1]

High incomes to businesses, in certain industries, lead to expansion, job creation, innovation, a derived demand for services, and clustering of businesses in cities where there are many advantages to a business firm, such as a large and diverse labor pool, access to transportation hubs, and business synergies.

Thus, the two-path scenario is consistent with both skill-biased technological change[2], and the marginalization of so-called unskilled workers, meaning uneducated workers, for example, in "poverty traps."

The specific consequences for education, skilled, and unskilled workers are:

- As technology advances, so high-level technical skills, and advanced business, organization (Aghion and Williamson, 1998, esp. 76), and leadership skills, become necessary inputs to large corporations making complex products. These skills often require many years of costly training and command a premium price.

- Companies or sectors with high incomes want, and can pay for, expensive capital equipment, as well as workers with advanced technological or management skills, in order to compete well in the modern marketplace (domestic or international); these workers make technologically-advanced inventions, which require technological skills to operate.

- Therefore, more high-skilled jobs exist in urban regions than in rural regions. A rural-urban differential in average wages appears and persists. Wages for similar types of workers need not show much of a differential. High-wage jobs go to the highly educated, and persons with fewer urban-specific skills may be unemployed, underemployed or employed in low-wage and less-desirable jobs, economy-wide, including within urban regions. (Emerson 1992, 71-72)

1.Krusell, Ohanian, et al., (2000) state that, "capital is more complementary to skilled workers than to unskilled workers." Capital-intensive, and technology-intensive, businesses usually locate in urban regions. And, according to Aghion and Williamson (1998, 47), "Empirical evidence from both the UK and US indicates that more technologically advanced industries are more likely to have increased their relative use of skilled workers in the 1980s." Their analysis addresses interpersonal income inequality, and, although they make many of the same points made here, regarding the interaction of productivity advance with skills, in economic growth, their analysis does not apply directly to worldwide sectoral income inequalities. For example, the interaction between sectors includes interaction in factor markets as well as product markets; if demand for skilled labor increases worldwide, and not only in high-technology countries, some aspects of their assumptions, and therefore of their conclusions, may not apply.

2.For a brief discussion of the literature on skill-biased technological change, and for one such model, see Krusell, Ohanian, Rios-Rull and Violante (2000). For anecdotal reasoning in support of the present two-path model, Aghion and Williamson (1998, 49) state, "most of the costly experimentation through which the spread [of a new general purpose technology] takes place may be concentrated over a relatively short subperiod, during which there is a cascade or s*nowball effect* resulting in an *accelerated* demand for skilled labor. This in turn will cause the skill premium to rise." We suggest that the snowball effect is ongoing, as many new technologies are developed. As mentioned in a note earlier in the paper, the literature on skill-biased technological change addresses one-sector growth in the tradition of conventional analysis. Thus, the skill-biased literature is a sophisticated attempt to apply the theory of the market system to long-run growth. Although such an approach can work, the present approach is easier and more insightful, as we demonstrate.

- The less-educated, lacking the skills for which high-income businesses will pay a premium, can therefore find it difficult to enter the system of continuously-growing wealth. This, along with the "inertia," described by Smith, could explain why some remain in traditional agriculture, in developing countries, even as the "modern sector" expands and grows. Gollin, (2014, 85-6) suggests that this is a puzzle of economic development.[1]

- Educational institutions such as universities and technical schools arise to fill the need for skilled workers, and the cycle continues. The truth that is recognized in our society, that education is the key to "getting ahead," arises.

- The two-path scenario can also explain why internet gurus make much money with little higher education. Money is drawn into their industry because consumers demand their product, so that the industry's income is high. Internet gurus can be paid a high salary from that great pool of funds.[2]

V.v. Poverty traps and the roles of education and unemployment[3]

Aghion and Williamson (1998) present a conundrum that is analogous to the migration conundrum (why doesn't migration equilibrate rural-urban differences?) – that is, "Although technological change can exert an upward pressure on the demand for skilled workers and thereby increase their wage premium over unskilled workers, education should eventually lead to an expanded supply of skilled labor and thereby to a fall in the wage differential." (p. 47)

The two-path growth scenario can explain this "theoretical puzzle," in that it is consistent with the idea of poverty traps, where the cost of learning new skills is out of reach of some communities, partly for economic reasons, but also, perhaps, for cultural reasons, or because of the complexity of the education needed. The more complex the education that is needed, the more people will be left behind, as technological advance continues.

The concept of a poverty trap, in the sense that regional or neighborhood poverty begets more poverty in a descending spiral, has some parallels with the two-path growth scenario here developed.

1.Another reason that some workers remain in agricultural regions, could be the seasonal nature of the need for agricultural labor (seedtime and harvest needing more workers than other times of the year). These workers may need to remain local even when not directly working. For example, Smith (1994, 134) discusses "Cottagers" in Scotland.

2.Sattinger (2001, lxv) observes that "the titans [of the computer industry] often lack college degrees." At that time, he thought that economic literature on skill-biased technological change lacked an adequate explanation for this.

3.For issues surrounding low incomes, poor countries, poor neighborhoods, and poverty traps, see Bowles, et al., (2006); Lipton (1980); Patterson (2010); Lal (2013, 111), Sachs (2005, 56, 70). A related issue, is the way in which high incomes to members of some neighborhoods or social strata, can be passed from one generation to another by means of education and personal networks, while other neighborhoods or social strata remain poor. De Muro, Monni, and Tridico, (2010) discuss the case of Rome. **(Read closely)**

Durlauf (2006, 170) says, "Relatively little is still understood about whether such poverty traps exist and if so, what produces them." The analysis in this paper, with its emphasis on sectoral (or - we suggest – regional or neighborhood) total income, may shed light on this matter.

The two-path scenario shows that job losses, interacting with regional or, perhaps, neighborhood, low income, and the transfer of income out of the sector (or region or neighborhood), by means of consumers' purchasing decisions, can be an important cause of sectoral (or regional or neighborhood) poverty.

Ethnographers recognize the role of unemployment in poor neighborhoods. For example, Durlauf (2006, 156) quotes Anderson's (1999, 324-25) ethnographic study of inner-city violence, saying that hopelessness in inner cities is largely a result of endemic joblessness and alienation. The other (economic) papers in the same volume (Bowles et al., 2006) mention joblessness very little. Durlauf also states that he believes that schools in poor neighborhoods suffer from a lack of resources (2006, 146). This is consistent with the present discussion regarding education.

The role of education in technological advance, discussed in the previous sub-section, suggests that demand for the skills of the uneducated is relatively low and declining as productivity increases over time. High-income, technologically-advanced, businesses will leave or fail to locate in regions or neighborhoods whose inhabitants have low technical education and skill. This could produce an escalating decline in regional or neighborhood income - with associated job-losses and cultural adaptations, that the business world finds difficult to absorb[1] - in an analogous way to the loss of resources illustrated for agriculture, above.

V.vi. Dualism explained

We have shown that the process of economic development, along the Western path, rewards manufacturing and industry, and encourages a service sector which supports them, at the expense of agriculture.[2] This process is associated with disparities in total regional incomes. It is not a "fair" process, where everyone has an equal chance of economic success. The characteristics of demand for different products help to determine the chances of market success with those products.

Specifically, it is hard to succeed in agriculture because the income elasticity of demand for agricultural products is inelastic, leading to a declining income share as productivity increases, and economic disadvantage.

Some economists reason that high productivity in agriculture, often associated with a low agricultural price, is a good thing because it frees up resources to produce other desirable products and services, and reduces the cost of living. This may be true; however, what is good for most consumers is not good for farmers. (Wise, 2004, 20)

1.Durlauf also refers to Wilson (1987, 60-61) regarding work habits associated with casual work vs. steady work. (Durlauf, 2006, 147). And, Sobel (2006, 205-6) suggests that, "changes in structural features [such as employment rates and opportunities] may lead to changes in culture."

2.We refer to the agricultural sector as a whole, over the long run. Individual products, markets and firms, in the short run, may appear to confirm the usual expectation that agricultural markets behave as conventional theory predicts.

The two-path scenario shows how dualism, a situation in which there is a poor underclass and a rich upper class, may be a natural characteristic of the market system with productivity advance.[1]

Anecdotal evidence (Hunja, 2011) suggests the following behavioral response to the realities of life in Kenya: "as a Kenyan who moved from rural Kenya to Nairobi, I suspect that the more interesting development question is 'why do Kenyans not want to live in rural Kenya'? I can attest that, particularly for the unemployed youth, urban poverty and life is much more depraving than the lives they lived in their 'villages'. And yet they keep coming to the cities! Extreme urban poverty vs. the very 'cushy' lives of the urban elite has provided the fodder of an 'army' for the low scale warfare (called car-jackings, robberies, police shooting of criminals, etc.) that's ongoing."[2]

Economic growth leads to disparities in total sectoral incomes, closely related to total urban or regional incomes, for reasons already discussed. We suggested that disadvantaged urban neighborhoods lose income and jobs to highly-educated neighborhoods, *because of educational disadvantage* – and cultural adaptations that may make residents of such neighborhoods hard to employ - and repel technologically-advanced businesses, in a similar way to the way in which agricultural regions lose income and jobs to cities, *because of (long-run) inelastic demand for agricultural products.*

What may be new in the present analysis, is that the two-path scenario demonstrates, with non-equilibrium mathematics, how growth of advancing sectors can outstrip any tendencies for adjustment to equilibrium, leaving declining sectors behind. Not only are declining sectors left behind, but they may be left ever further behind as productivity advance continues. The motivation of some economic actors is to involve themselves and concern themselves, more with advancing sectors and rich countries than with declining sectors and poor countries.[3]

V.vii. Implications for economic growth and development: when commercial interests crowd out other interests, everybody loses, especially the poor

As mentioned above, a major driver of diverging income paths in the model developed here, is an increase in technological knowledge (ϕ) over time. This property of the model is consistent with a point of view expressed in Aghion and Williamson, (1998, 11), that technological change is a major factor in "the recent upsurge in wage and income inequality in developed countries," and, "Technical progress itself is one of the major engines of economic development." (p. 80) See also Chien (2015).

1.Gollin (2014), presents some empirical findings, and some economic models, that address the concept of dualism. The two-path scenario addresses many of the empirical observations that other models do not. See especially Gollin (2014), pages 73, 85-6. For further discussion regarding regional disparities and city growth, see also Nunn, Parsons, and Shambaugh (2018), Kanbur and Rapoport (2005), and Glaeser and Gottlieb (2009).

Connell et al. (1976) suggest that the selectivity of migrant streams is bipolar (that is, there are two types of economically-motivated migration, represented by two different types of migrant): "For the poorer migrant, migration is increasingly a wandering search for work…The 'push' migration of the poor…is increasingly rural-rural and circular; the 'pull' migration of the middle income groups…is overwhelmingly rural-urban; and in most cases involves initially the urban acquisition of secondary schooling, and subsequently urban work based on the resulting qualification." (pp. 197-8)

2.See also Sachs, (2006, 330-31): "Whether terrorists are rich or poor or middle class, their staging areas—their bases of operation—are unstable societies beset by poverty, unemployment, rapid population growth, hunger, and lack of hope. Without addressing the root causes of that instability, little will be accomplished in staunching terror."

3.See, for example, Sachs, 2006, 358-359, and Aghion and Williamson (1998, 60-61).

Schmookler's (1976, 172) empirical work, using patent data, indicates that, from the pool of available knowledge, inventions are put together where economic advantage can be gained; especially where purchasers' expenditures, on the class of good to be produced, are highest. See also Acemoglu (2004, xv), and Groshen (1991). Engerman and Sokoloff (2006, 73) point out that, "inventive activity was strongly and positively associated with the extension of markets," during early industrialization, in the U.S., Great Britain, and the Netherlands.

However, inventions can be of all types, not just those that might be patented – for example, new laws, better ways to lobby, persuasive grant proposals, as well as new processes and goods.

In order for someone to benefit from it, technological knowledge has to be embodied in some real-world entity such as a production process, a successful political campaign, a machine, or a building. According to Azariadis (2006, 18) the only robust variable in regressions seeking the causes of economic growth, is the ratio of investment to GDP. Investment is embodied in the building of new physical plant, equipment, housing, infrastructure, etc. Each time the capital infrastructure needs updating, the new equipment incorporates new technological know-how.

The kind of update, and hence embodiment, is selected by the individuals who direct how a business (and, in the real world, a government) spends its income. These individuals are leaders of business and government, not usually ordinary consumers or employees.[1]

The emphasis of the two-path scenario on the role of technological progress in economic growth, can help remind us that selective embodiment of technology in ways chosen by a few decision-makers, can cause the research, productive, and financial interests of corporations (and government leaders) to take precedence over the interests of the general population.

This result is anticipated in Smith (Smith, 1994, 287-8). For example, "The interest of the dealers [i.e. business owners] in any particular branch of trade or manufactures, is always in some respects different from, and even opposite to, that of the public." He explains the tendency of "dealers" to expand markets and limit competition; he suggests that, "the proposal of any new law or regulation of commerce which comes from this order [i.e. the dealers], ought always to be listened to with great precaution," because the interest of the dealers is, "to deceive and even to oppress the public, and who accordingly have, upon many occasions, both deceived and oppressed it."

Consumers' wealth, incomes, and spending decisions are the main source of income for governments and businesses. What consumers may forget, when making purchasing decisions, is that we are asked to choose from what is offered. We may prefer something that is not offered.[2]

1.Adam Smith (Smith, 1994 287) observes that, "The plans and projects of the employers of stock [i.e. users of capital] regulate and direct all the most important operations of labour, and profit is the end proposed by all those plans and projects." Smith is concerned with production processes which are advanced by the increased division and specialization of labor; however, the same concept applies to a production process which is improved by the addition of machinery.

2.For example, if an economy stops producing something that we would like, such as house calls by doctors, or cars we can fix ourselves, then the prices of these items become zero relative to other items produced. However, the reason these items are no longer produced, is that their cost is too high relative to alternative uses of the producer's resources, so that the proper theoretical price to put on them, for consumers who would still like them, is a relatively high price, or high economic value, not zero at all.

The reason is that technological progress favors the production of certain types of products over others. The initial development of a new technology or a new work of art can be costly, but in many cases the reproduction and dissemination of that new information is relatively inexpensive. The availability of new high-technology products, which compete for income and attention, leads to continuing disadvantages, over time, for the producers of items having different economic properties, such as food, or some types of labor-intensive services (US BLS, 2018; see Appendix II), or, perhaps, spiritual teachings.

Aghion and Williamson (1998) reach a similar conclusion, regarding incomes and the market system, to that offered here, "our [theoretical] analysis displays no evidence whatsoever that economic development should necessarily bring about a reduction in inequality [of labor earnings]. On the contrary, as long as technical progress is skill biased, [then,] technical, organizational, and trade effects go in the direction of a widening of wage inequality both across and within groups of workers…if greater equality is to be a target of economic policy, it has to be tackled directly since market forces by themselves will, most likely, not do it at all." (p. 81) Aghion and Williamson's analysis is designed to address earnings inequality, not the process of structural change in its entirety.

Their conclusion says more about the real world than neoclassical economics, but they do not go far enough. For example, the two-path scenario suggests that the commercial goal is fundamentally bad for farmers and the food we eat. The problems of agriculture demonstrate, in a way that we cannot ignore, that commercially-motivated technological progress is not value-neutral – it favors some kinds of progress, and some kinds of products, at the expense of others that the society might prefer, such as nutritious food for all.

Further, although the two-path model does not address this directly, the market system also favors the short-term over the long term, and ignores costs that are not included in the market price, (such as the cost to the environment of burning fossil fuels.) The ideal of the market system has been that we do not direct the market – that it is most efficient, left to itself. Yet, the direction it has taken may not be the one we would prefer.

V.viii. Redistribution of wealth and incomes – what can be done?[1]

The two-path analysis suggests that the solution to regional or neighborhood poverty may best be found, using one or many ways to limit the transfer of income out, and encourage the transfer of income in to the region or neighborhood. Sachs (2005) gives an excellent summary of the issues, and some recommendations. Because his anecdotal assessment of the situation is similar to the implications of the two-path growth scenario, we limit the discussion here to a few main points, and refer the interested reader to his book.

Regarding the larger problem identified in the previous sub-section, how to make the market system produce what we would like to see, rather than what is commercially successful, that will require a whole different discussion.

1. For a discussion of these matters, see, for example, Lal (2013, 69-86), Bourne (2019). Sachs (2006, 348) reminds us that Smith acknowledged important roles for government. Smith, 1994, 747-1027)

Here is a brief summary of the main ways that are usually offered, to assist in the revitalization of impoverished regions:

Investment in low-income regions[1] Investment is the most consistently significant factor associated with economic growth (Azariadis, 2006, 18). Therefore, we can encourage investment in low-income regions and neighborhoods. However, the type of investment must recognize that the product needs to be feasible in low-income regions, and not only appeal to high-income customers, but also reach them.

One-time income transfers. The concept of a threshold, above which sustained growth can occur, suggests that, if enough income is transferred in, a region can start to grow. The two-path scenario is consistent with this concept. It is possible that a large one-time investment in a region, for example by turning it into a niche of high-technology businesses, could work to put a poor region onto an expanding income path. However, it is not easy to impose a growth-oriented business onto a region where it does not occur naturally. (Why did it not occur naturally?)

And, this would entail much expenditure for an uncertain result. Pacey (1990) describes several situations in which technologies introduced to a region, by governments or international organizations, who are not familiar with the region, are inappropriate or involve needless expense.

Micro-loans and mutual support. Credit is important for running a business, because the outlays for inputs to the production process occur before the product is sold. Various means for extending credit to the poor, can be created or encouraged. Some that are well known are kinship systems (Lal, 2013, 55; Hoff and Sen, 2006, 100), including in-kind transfers (Hoff and Sen, 2006, 98), and the Grameen Bank (Yunus and Jolis, 2007).

Collective action or activism. Sachs (2006, 239-240) discusses various types of collective action on the part of poor communities. Aghion and Williamson (1998, 69-70) show that the decline of unions, with the related decline in interest in minimum wage laws, is associated with increased wage inequality in the U.S. and U.K. in the 1980s.[2]

Remittances from former residents. Something that occurs, naturally, is remittances to an impoverished community from members who have migrated to richer regions and found higher-paying work.[3]

1.See also Sachs (2006, 287) and Lal (2013, 111)

2.They state that the mechanism by which this has happened is not clear (p.72). While the two-path growth scenario does not offer a mathematical path for such a change, the general expectation of the scenario, is that low-skilled workers will be at a disadvantage worldwide, even in a rich country.

3. According to Trebous, (1970, 60), "transfers of funds from [migrants in] France (1950s) [to Algeria] were equivalent to the total wages paid in agriculture in Algeria." This is just one example of such behavior.

V.ix. Summary of the discussion

The problem we sought to understand – why rural regions lose jobs while cities create them, worldwide, over the long run, despite migration which should equilibrate the situation – was explained by means of the two-path growth scenario. We showed how the closed-economy model can apply, even in a world of countries open to trade.

In the two-path scenario, productivity advance in agriculture leads to many adverse consequences for farmers, listed in section V.ii. above. Productivity advance in the rest of the economy, especially in manufacturing and "leading-edge" technologies, generates increasing incomes for those businesses and the regions in which they locate. Because of the often-technical nature of manufacturing and leading-edge businesses, the high incomes of such businesses create a demand for skilled workers (including internet gurus with little formal higher education), and services.

Economic dualism manifests itself, not just in relative agricultural poverty, but also in the poverty of those with little education. The two types of economic disadvantage are related, especially in those developing countries whose populations live, or have recently lived, primarily in agricultural regions. This is because farm workers may have little schooling. When such farm workers move to cities, they often enter the informal sector, because their skills do not meet the needs of the modern sector.[1]

An individual's solution to the deprivations of life in a poor region or neighborhood, can be to move away and offer his or her talents elsewhere. The region or neighborhood of departure can get ever more economically disadvantaged, as its income declines and "quality" factors of production (i.e. those that help generate high business incomes) move away. Businesses avoid locating in such regions or neighborhoods, which makes it harder for residents to find good-quality work, or work at all. A snowball effect can follow.

The market system with productivity advance may perpetuate this type of dualism. The two-path scenario shows how advancing sectors can leave declining sectors behind, more rapidly than equilibration can occur. A non-equilibrium situation can persist for many years. The discussion also suggests that the market system rewards the production of goods with certain economic properties, which might not be goods that are preferred under a different value system.

IV. Conclusion

We introduced an economic analysis that contributes toward a better understanding of the reasons for sectoral (related to regional) income inequality. It isolates the main process that drives economic growth – the interaction of demand with productivity advance - and shows how this process can cause sectoral income inequality to persist and increase, worldwide, over many decades.[2]

1.In developing countries, dualism may arise throughout the economy, especially in countries where there is a high population density, because of high levels of unemployment or underemployment, of the less-educated. See also Hunja (2011), quoted in section V.vi above

2.To the extent that α is rural and μ is urban, the analysis applies to regional income-inequality also. We indicate that the reasoning, with its emphasis on the ebb and flow of resources, as total regional incomes change, can apply to other regions or neighborhoods. For implications of the two-path scenario for international trade, see Appendix III.

The two-path growth scenario of long-run, worldwide structural change, can explain, directly, the persistence of the following long-run sectoral disparities in income:

- Urban growth, economic dynamism, and job-creation
- Agricultural loss of income share, population, and jobs

The scenario is consistent with the following situations, anecdotally:

- Poverty traps in regions or neighborhoods
- The increasing importance of education as economic growth and development occur
- Skill-biased technological change
- Dualism

Revitalization of poor regions involves keeping income and productive energy within the region, and attracting income in, from outside regions. Empirical work suggests that the amount of investment in poor regions has been the variable most consistently associated with economic growth of those regions.

Conventional economic analysis would require a more complex model, in order to capture what the two-path growth scenario captures. Such models in the literature, which address economic growth or income inequality, or both, are somewhat technical and value-neutral. Most economic thinking rests on the belief that economic growth and material improvement are good things.[1]

The compassionate economist's usual solution to income inequality, is re-distribution of income from the wealthy to the poor. However, people who need the benefits of economic growth the most, (i.e. the poor, located within impoverished regions), do not get them, precisely because of the nature of material progress in the market system.

Incentives within the market system, fundamentally serve commercial interests, at all levels of society, even among those with low incomes. Those with limited incomes may decry the consequences for local economies of their own decisions (such as preferring Amazon or Wal-Mart to neighborhood stores), but in each individual's own decision-making process, he or she has made the best choice.

The idea that progress is good, and redistribution is needed, especially for the very poor, is hard to argue against. Yet, the market system offers incentives to develop the types of inventions that serve commercial interests rather than other interests that society might have. Inventions that have certain types of economic properties are favored over others, regardless of their properties in terms of what is important to human beings. What might be the opportunity cost of a high-tech economy? What does it not provide, that consumers might like, or that might satisfy human nature? What does it provide, that, perhaps, the society does not really want? Is there a way to make it better at providing what its members think it should?

1. A mercantilist, Child, helped develop three formative ideas that have greatly influenced economic thought. One is the idea of *progress*, that the future will be better than the past. (Spiegel, 1971, 152)

Appendix I: Growth of Population in the Two-Path Growth Scenario

Let us consider the case of growth, where the economy gets larger over time (population grows, real GDP grows; output grows; investment grows; inputs increase). In particular, let us investigate how population increase interacts with consumers' demand.

For every new person born, demand for both types of goods (α and μ) increases. The additional money expended for the livelihood of the new person will go relatively more on manufactures than on food, as described above. Income is transferred from α to μ as shown in the discussion above.[1]

Some of these new persons will become productive workers, and will contribute to expanding output in one or the other sector. As output increases, income is transferred from α to μ as described above.

Thus, the case of population increase does not alter the conclusion, that economic growth with productivity advance transfers income from α to μ.

(This will occur in countries or a world, with enough people rich enough to be willing and able to spend more than 50% of GDP on manufactures and services, so that income is transferred from agriculture to the rest of the economy as described in the two-path growth scenario.)

Appendix II: Additional Empirical Data

Appendix II.i. Empirical data on demand elasticities

The role of demand elasticities in the closed model is very important for the two-path growth scenario. The following data support the choice of inelastic demand elasticities (both price and income elasticities) for the agricultural sector, and elastic demand elasticities for the rest of the economy.

Data on price and income elasticities of demand for agricultural products, may be found on the USDA website (USDA, 2019), which database was last updated in February 2006. The USDA database of elasticities includes empirical estimations of demand elasticities for many agricultural products, in many countries, covering several time periods since 1936, and among different income groups and regions within the U.S.

The USDA website:
https://www.ers.usda.gov/data-products/commodity-and-food-elasticities/download-the-data/
provided the following Excel file: demandelasdata092507_1_
This was last updated 2006. 4/16/2019 was the download date

The results of the investigation are as follows:

1.Strictly speaking, this situation is not an increase in income, but a consumer choice. Demand for some parental goods may decline, but there is no reason to expect that such a transfer of expenditures from adult to child would favor the agricultural sector.

Of all the estimations in the above-mentioned USDA database, for own-price and income elasticities, respectively, a high proportion were inelastic.[1] Price and income elasticities are addressed individually below.

Own-price elasticities of demand.

For own-price elasticities of demand, of 2803 estimations of own-price elasticity for various agricultural goods, 2203 are in the inelastic range (that is, between 0 and -1). This is 78.59% of the total, 2803.[2]

Income elasticities of demand

For income elasticities of demand, of 1064 empirical estimations of income elasticities for agricultural goods, 1010 are in the inelastic range (between 0 and 1). This is 94.92% of the total (1064).

Further, let us subtract out the measures of "beverage and tobacco" income elasticities from the database of income elasticities. Then, from 950 empirical measurements of income elasticities for (mostly) agricultural products, 948 are in the inelastic range (between 0 and 1). This is 99.79% of the total, 950.

1.Some of the products might not be considered strictly agricultural rather than manufactured, such as "clothing," or "other goods." However, these observations were very few, and even with them included, we find that an impressive proportion of empirical estimations on elasticities, in the USDA database of mostly agricultural products, have values in the inelastic range.

2.The agricultural products that are sometimes found to have price-elastic demand include rice, milk, grain, flour, wheat, and meat products, especially poultry; fish, some fruits. Data for the US include a number of processed foods and organic foods which have price-elastic demand, such as milk (organic, 1%), jam, butter, beer, salad (bagged), pasta sauce, baked beans, cheese, soup (dry); organic beans, peas, carrots, and corn.