# Divergent Income Paths: How Economic Growth Leaves Food-Producing Regions Behind

Lesley Emerson, November 3, 2019

Update – December 26, 2023 –

Since the advent of the COVID-19 pandemic in early 2020, this paper's analysis has been updated; in particular, the recommendations have been changed from a focus on investment in rural regions to a recommendation for serious debate on monetary tightening, by means of increasing the required reserve ratio. Owing to other demands on the author's time, the changes have not been finalized and turned into a new paper. Nor has the paper been peer reviewed, because, according to at least one well-known economist, academic journals avoid printing anything this controversial, especially by someone outside the scholarly peer group.

## Abstract

The analysis in this paper captures the economic mechanism by which an advancing sector advances at the expense of a declining sector, without any equilibria, stable or unstable.

Those who work in communities of poverty, such as poor developing countries, rural regions far from cities, or inner-city neighborhoods, have been hampered in their efforts to relieve the distress of such communities, because economists have given misguided advice. The reason is that economists have found it challenging to adapt the theoretical concepts of the market economy, to the way the world behaves in the long run.

This paper contributes toward such an adaptation. It isolates the main drivers of economic growth – the interaction of demand with productivity advance - in order to show how income inequality can persist, worldwide, between two sectors, over many decades. The analysis shows how people who need the benefits of economic growth the most, (the poor), do not get these benefits, precisely because of the nature of material progress in the market system. The analysis presents a way to organize one's thoughts regarding economic growth, that a) works without an equilibrium condition and b) generates two paths for income-growth, using well-accepted economic principles.

The discussion, of the implications of the analysis, draws attention to a conflict between a money-oriented conception of income (PQ), and a material-oriented conception of wealth (large Q).
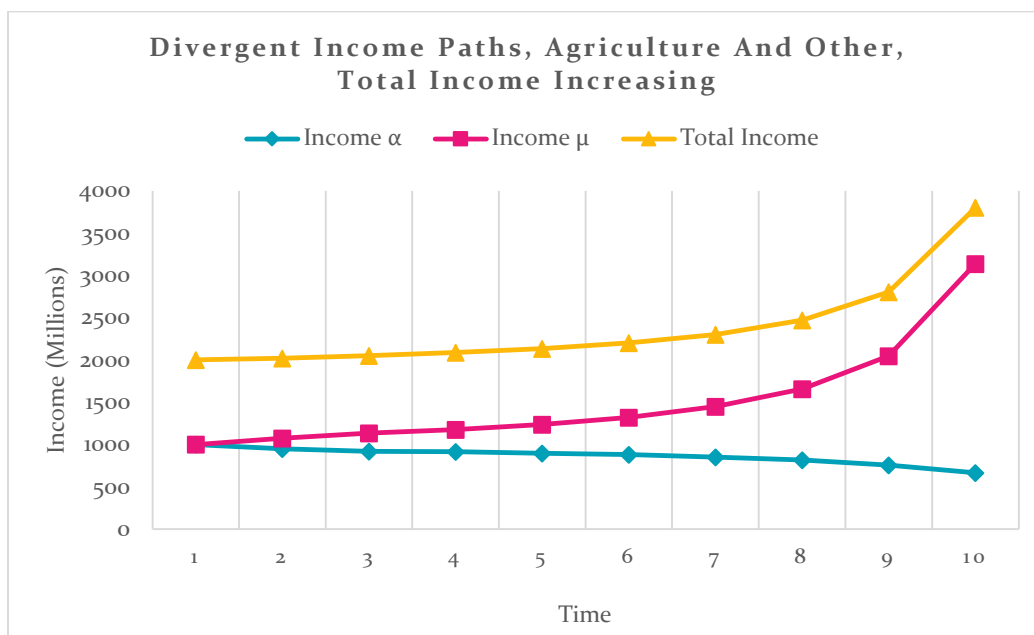
## Preview



Figure 8: Divergent income paths, total income increasing

This chart of a postulated relationship between the long-run income paths over time of an agricultural sector, α, and the rest of the economy (other), μ, fits observed, worldwide, long-run reality - specifically, "structural transformation" out of agriculture - better than other basic models of economic growth that this author has seen.

# I.    Introduction

Those who work in communities of poverty, such as poor developing countries, rural regions far from cities, or inner-city neighborhoods, have been hampered in their efforts to relieve the distress of such communities, because economists have given misguided advice. The reason is that economists have found it challenging to adapt the theoretical concepts of the market economy, to the way the world behaves in the long run.

This paper contributes toward such an adaptation. It isolates the main drivers of economic growth – the interaction of demand with productivity advance - in order to show how income inequality can persist, worldwide, between two sectors, over many decades. The analysis organizes the economist's tool-kit in a different way from conventional analysis, to show how productivity advance can lead to sectoral (closely related to regional) income inequality that can persist, worldwide, over many decades.[1]

The analysis is called the two-path growth scenario. It differs from the usual economic thinking in several ways, most notably the following:

- It was designed to understand the long run persistence of rural to urban migration, as it has continued, worldwide, over more than two hundred years
- It does not have an equilibrium solution, nor does it need one in order to understand the transfer of labor from one sector to another
- It has two growth paths, not one
- The drivers of growth in the two-path growth scenario, are the interactions of consumers' demand with technological know-how and, related, productivity advance
- It is a micro-economic model, with money
- It deals with sectoral rather than factor incomes
- The "technology" variable, $\phi$, is the total level of technological know-how in the economy or the world. Exponential growth of technological know-how has been empirically demonstrated, and is a property of $\phi$. Quantifying $\phi$ is beyond the scope of the paper.
- It does not use Cobb-Douglas production functions; nor does it use utility functions
- Capital, if used for growth, does not have its own sector, but is included among all inputs

The discussion, of the implications of the analysis, draws attention to a conflict between a money-oriented conception of income (PQ), and a material-oriented conception of wealth (large Q).

The discussion also suggests that the same process that causes agricultural job-stagnation or job-loss (flight of resources due to declining agricultural prices and income), may also apply to the concept of a "poverty trap" in the inner city, (flight of resources due to educational dysfunction and loss of income). A combination of the two effects (agricultural disadvantage and educational disadvantage) offers an explanation for dualism in developing countries. "Dualism" is an attribute

1.Jeffrey Sachs (1991,), who has been actively involved in real-world development economics for many years, describes anecdotally the exact situation that I explain with the "two-path growth scenario." I quote: "Over the span of two centuries, the innovation gap is certainly one of the most fundamental reasons why the richest and the poorest countries have diverged, and why the poorest of the poor have not been able to get a foot-hold on growth. The rich move from innovation to greater wealth, to further innovation; the poor do not." (p.62)

of developing countries, in which a modern sector, of glass high-rises and modern businesses, exists alongside an "informal sector" of shanty towns or slums, and too many people trying to sell trinkets or shine shoes. The two-path growth scenario shows that poverty in poor regions is the natural "other side" to productivity advance and economic growth in rich regions. Rich countries are responsible to poor countries, not only out of the goodness of their hearts, but also because we are all interconnected.

This paper is organized as follows:

In Section II, the "building blocks" of the two-path scenario are assembled, using both empirical data and other analysts' assessments of the realities of rural poverty. These building blocks are: a) urbanization with long-run rural-urban migration, which migration should theoretically reduce any wage-differential between rural and urban regions, until there is no further incentive to migrate, b) a low income elasticity of demand for agricultural products, and c) productivity advance economywide. Section II also briefly discusses the theoretical differences between an open-economy model and a closed-economy model.

Section III provides an initial description of the two-path growth scenario, using examples derived from basic principles of economics, in order to introduce an analytical framework for thinking about economic growth, that is different from the ones often presented in academic papers. Section IV develops a basic mathematical "model" of the scenario, while Section V addresses the implications of the analysis, and Section VI is a conclusion.

## II. Components of the two-path growth scenario – what causes agricultural disadvantage with job stagnation or decline, and urban growth with job creation

### II.i. Percent employed in agriculture declines as economic growth proceeds

Figure 1 shows that the percent of the labor force employed in agriculture has declined, in England, the Netherlands, and France, from 1500 to 2000. This pattern is generally understood, by development economists, to be the usual situation, for countries on a development path.

This pattern is associated with an increase in the percent of a country's citizens living in urban regions, or "urbanization." The increase in the percent urban, worldwide, is shown in Figure 3 in the next subsection.

Why does this pattern arise? Several explanations have been offered, but the following was selected here:

Johnson (1991), an eminent agricultural economist, indicates that the reason agricultural regions lose income share and population, as economic development proceeds, is the low and declining income elasticity of demand for agricultural products, especially food, as economic growth occurs over time. He reasons that the associated "structural change" is a natural part of the development process.

## Percent Employed in Agriculture, 1500 to 2000



Figure 1: Source: Our world in data: employment in agriculture

The usual understanding of the economic mechanism for structural change, is that cities are dynamic and create jobs, and that an increasing demand for labor increases wage rates; similarly, stagnant or declining demand for labor in rural regions decreases wage rates in rural regions relative to urban regions. Thus, one would expect a wage-differential between rural and urban regions, corresponding to the way in which demand for labor changes in those regions as structural change occurs. This wage-differential would encourage rural-urban migration, which would tend to bring the economy back to equilibrium.

Closer investigation reveals some problems with this explanation. In the 1980s, while working with data for migration in Algeria, Emerson (1992)[1] sought to understand general patterns of migration in a developing country. There was not a model of migration which explained the long-run persistence of the differences between rural and urban regions. The typical economic model of migration would take a regional wage-differential, as both exogenous, and the major incentive for migration. (For example, Harris and Todaro, 1970).

If one wishes to understand what happens in the long run, such a model is inadequate. If rural-urban wage differentials are the signals encouraging rural-urban migration, the model needs to

1.Emerson (1992) presents a comprehensive empirical analysis of migration and labor markets in Algeria, using much detailed data, generated by the Algerian government, which collected more data than is typical for a developing country. The work references many economic models of migration, empirical migration studies of the day, and includes ideas from the literature on labor economics that are a little different from the mainstream of economics, in which latter, it is often assumed that labor markets clear every day, using a supply-demand diagram similar to the ones used for products.

explain a) why the wage-differential persists long-term in the presence of continuing rural-urban migration, which should equalize regional wages, and b) why there is also much urban-urban migration.

Figure 2 below presents migrant flows within Algeria over the period 1966-1977. The Algerian census of 1977 was unusual for a census, in that questions were asked specifically to address migration, so that it was not necessary to try to derive migration data from data on population growth, birth and death rates. The reason to include this figure here, is to show that many migrants moved from one urban region to another. For example, more than 2,000 individuals migrated from Alger to Oran between 1966 and 1977, and there was a similar migrant flow from Oran to Alger.
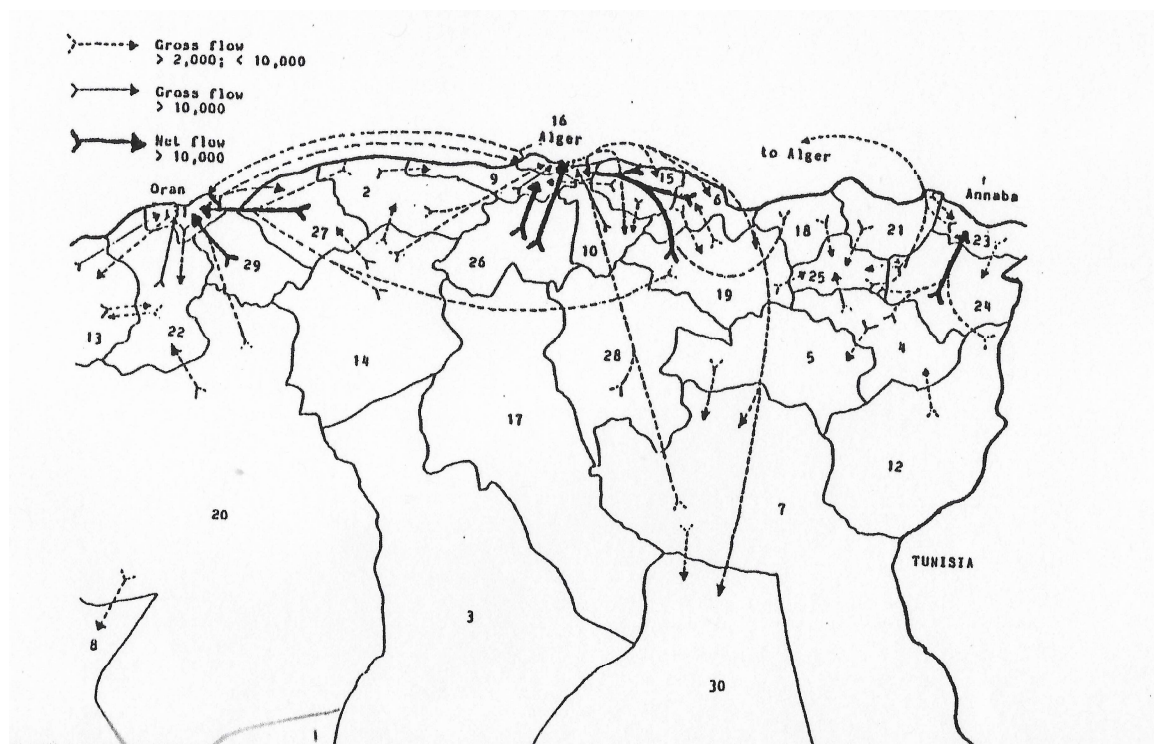
**Gross and Net Migration, Algeria, 1966-77**



Figure 2: Gross and Net Migration Between Administrative Regions in Algeria, 1966-77. Map compiled by Emerson (1992) from the Algerian census, 1977, Series B, Volume 10

The largest city in Algeria at the time, was Alger (Algiers), in the administrative district of Alger (16); the next largest city was Oran, in the administrative district of Oran (31); and the other major urban regions were Annaba (23), and Constantine (25). Administrative district 30 (Ouargla), in the Sahara Desert, was and is a major site of oil and gas fields. Available information on administrative district 7 (Biskra) offers no immediate explanation for the migration there from Alger and administrative region 5 (Batna), except perhaps that an oil pipeline from Ouargla to Alger passes across Biskra.

If, as seems reasonable, a major motivation for migration within Algeria was to find, or move to an already-existing, job, then these migrant streams conform to the general understanding of what happens in a developing country. In the special case of Algeria, we have migration to oil and gas

fields in the desert, as well as the more-typical migration to coastal cities. There is very little migration to the poor regions of the interior of Algeria, many of which are in the Sahara Desert.

The figure also shows that migration arises among urban regions. We cannot explain the two-directional flow between Alger and Oran by means of a regional wage-differential. Another interesting question is, why does there seem to be an out-and-back pattern of migration from Alger to the oil and gas fields? (Why are relatively few other residents of Algeria going to the oil and gas fields?) Further, why is there not a large migrant flow from region 12 (Tebessa) to region 7 (Biskra, the neighboring administrative district, which attracts migrants from Alger), but there is a relatively large flow from region 12 to region 4 (Oum el Bouaghi, the neighboring district to the north)? If the incentive to migrate to jobs in the oil and gas industry, is a high regional wage, why do residents of region 12 (Tebessa) not move there in large numbers? If there is not a high regional wage associated with the oil and gas fields, why do residents of Alger move there?

Two answers immediately come to mind: 1) people are moving to where they can, or think they can, get a job and 2) not everyone can get every type of job. The obvious conclusion is that differences in average regional wage rates do not represent the job-market incentives facing heterogeneous individuals.

We concluded that urbanization results from the different rates of job-creation in agricultural vs. urban regions, with or without a wage differential for *similar types of workers*. In Algeria, jobs were also being created in the desert, where oil and gas fields are located; according to Nelson (1979, 138), "There appeared to be little opportunity for southerners to obtain well-paid jobs [in the oil industry] because most of the hiring was being done in Algiers [Alger]."

## II.ii.    Creation and elimination of jobs in the absence of a wage-differential

In support of a job-focused approach, rather than a wage-focused approach, we offer the following:

a)      In competitive agricultural markets, productivity advance increases the quantity produced of the commodity at each price (that is, there is an increase in supply). Adjustment to the new equilibrium involves quantity adjustments in factor markets, to satisfy the new, lower, equilibrium price. [1] (That is, factors are "laid off.") When producers lay off workers, the wage need not decline, if workers can find work elsewhere at the wage they were earning before the change. [2]

b)      The migration literature of the 1980s was just beginning to disaggregate migrant streams by level of skill, and the picture that seemed (tentatively) to be emerging, was that, the more one investigated the situation, taking into consideration the heterogeneity of migrants and differences

1. We assume regional or local markets, so that an infinite price-elasticity of demand does not apply. Adam Smith shows how a temporary movement away from equilibrium, ceteris paribus, adjusts back to equilibrium by the workings of the market system. (Smith, 1994, 62-69). He reasons that, when there is excess supply of a commodity, landowners will withdraw land, laborers will withdraw labor, and owners of stock (capitalists) will withdraw stock, from the production of this commodity. Then, the quantity produced of the commodity will decline, its price will rise, and the effectual demand [the demand of those who are willing to pay the natural price [the price that just covers the cost of production-p.62] for the commodity, or the whole value of the rent, labor, and profit, which must be pain in order to bring it thither-p.63] will be satisfied. (Smith, 1994, 64-65). In the case of productivity advance described here, there is no adjustment back to the original equilibrium price, so that the exit of factors is permanent. Smith does not address this particular scenario.

2. Johnson (1991, xv), in his book, "World Agriculture in Disarray," points out that farm people can use their resources in alternative opportunities in the rest of the economy, and often do. This is a quantity adjustment in factor markets. It may or may not be a response to a change in the wage rate

in costs of living by region, the less one observed a wage differential for like workers. (Bellante, 1979; Kelley and Williamson, 1984, 6; Harris and Sabot, 1982, Emerson, 1992, 134).

c)        A summary of evidence on U.S. interregional wage differentials suggests that a major cause of perceived inter-regional labor earnings differentials is the aggregation of heterogeneous labor types. The authors state that, "Returns to labor market characteristics are geographically invariant." (Dickie and Gerking, 1989)

d)        More-recent migration literature emphasizes the interaction of highly-skilled migrants with city growth. (Ewers, 2007, Kerr et al., 2017, Kanbur and Rapoport, 2005) The presence of relatively more highly-skilled (highly-paid) workers in cities, would raise the average earnings in cities, relative to that in rural regions. Earnings for like workers need not differ by region.

e)        The relationship between rate of migration and the wage rate has a time dimension. (Yap, 1977, 243; Emerson, 1992) There might be, for example, a $5 wage-differential between two regions. The relationship of migration to this wage-differential would be twice as great, if one measured the rate of migration over two years, rather than over one year. We concluded that the rate of (economically-motivated) migration, a flow variable, was more likely to be consistently related to the rate of creation of jobs, another flow variable, than to the wage rate, or a wage-differential.

## II.iii. "Immiserizing growth," agricultural job-losses, and the closed-economy model

The data (see Figures 1 above and 3 below), suggest that there is a long-run difference between the rate of creation of jobs in urban regions and that in rural regions, worldwide, as "structural change" and urbanization proceed. The economic literature offers a very reasonable explanation for this situation – the low income elasticity of demand for agricultural commodities, otherwise known as Engel's law (what is called "immiserizing growth," here). Engel's law is a major driver of the present two-path growth scenario.

However, many economists working with countries open to international trade, reject this explanation, because the typical open-economy model gives a different result. This and the next three sub-sections explain why Engel's law can apply, even for countries open to trade.

Figure 3 below illustrates the increase in percent of population living in urban regions, 1500 to 2016, for India, China, the US, Japan, and the world.

There has been a significant increase in the percent urban, worldwide, especially between 1800 and 2016. The conventional understanding is that rural-urban migration plays a major role in this process. Johnson, (1991), believes that Engel's law is the explanation, and Anderson, (1987), an economist with a specialty in international trade, wrote a paper to try to explain why the agricultural sector behaves in accordance with Engel's law, even in an open economy.

The following statement summarizes the development (and international) economists' dilemma, regarding how to explain long-term rural-urban migration: "[In the Kelley-Williamson model] rapid productivity advance in agriculture tends to forestall outmigration to the city. This result stands in stark contrast to the closed dual-economy model where productivity advance in agriculture meets with demand-absorption problems, a declining farm terms-of-trade, and thus a 'labor surplus' which out-migrates to glut urban labor markets. Immiserizing agricultural growth of this type is not an attribute of our open-economy model." (Kelley and Williamson, 1984, 102; see also 125, 183)

"Immiserizing agricultural growth of this type," as described by Kelley and Williamson, is an excellent explanation for long-run, worldwide rural-urban migration. It is consistent with Johnson's (1991) understanding of "structural transformation," although Johnson does not model the process.
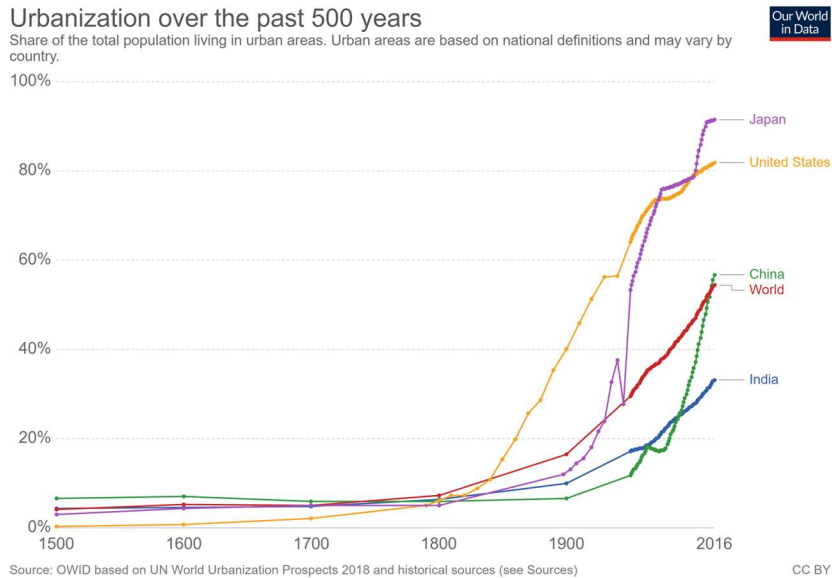


Figure 3: Source: Our world in data: urbanization

The empirical reality was the guide for which type of model to apply in this paper.

## II.iv. Why the closed-economy analysis applies

Why does the closed-economy model fit the data better than the open-economy model, which seems logically more appropriate in a world of countries open to trade?

The choice of the closed model for the two-path growth scenario is explained as follows:

a) The typical open economy model does not have a major role for a non-infinite elasticity of demand (price- or income-elasticity), because the price elasticity of demand for traded goods is infinite in these models. This is a problem, if one believes, with Johnson, that the income elasticity of demand and Engel's law are important. The open-economy model does not capture this effect.

b) An open country economy can display some characteristics of a closed economy. For example, not all goods are traded. Transport costs and perishability can limit tradability. Many agricultural markets, especially in poor countries, are local and regional. (Wise 2004, 23) Elastic demand for non-traded goods can encourage transfer of productive resources out of agriculture (Anderson 1987).

c) In the global economy, even if each country faces an infinitely elastic demand for its product at a moment in time, the price of the product can fall over time. One reason that the international price of a traded product can fall over time, is that global output of that

product increases more rapidly than global demand for it increases. (In global agricultural markets, such a price decline would result from a global version of Engel's law.)

This point is so important to the present analysis, that we explain it in detail in the next two subsections.

## II.v. Why market demand elasticities matter, even when individual producers face infinitely elastic demand

The small country's position relative to global markets is theoretically analogous to the small firm's position relative to market demand in its industry. That is, each faces perfectly elastic demand and competes with other "small" entities in its market.

The usual presentation of the theory of the firm under perfect competition examines the individual firm's supply decision and ignores market demand conditions, because the demand facing the firm is assumed infinite.[1] That is, each small firm faces infinitely elastic demand.

If the market price changes, the economic (i.e. profit) environment is now different for that type of firm, even as it continues to face perfectly elastic demand. Firms will enter or exit the industry.

Total market demand is downward-sloping, but the individual firm is too small to take this into account. However, the elasticity of market demand for the product is important in determining the potential profitability of the product across all firms in the industry. It will affect the number of firms that enter or exit the industry after a price change, caused by, for example, an increase in productivity across all firms.

## II.vi. Demand elasticities and structural change

Structural change is related to the numbers and types of businesses, and their associated derived demands for resources, that might enter or exit an industry, or market, or region, or sector, in response to changing economic conditions in the long run. For this emphasis, the usual presentation of perfect competition - short-term market conditions as they face one producer – is not appropriate.

For example, in the closed economy, when the agricultural price declines, firms either leave the industry or lay off factors of production, because each firm's income has declined. (Ed < 1) But, when the price of a product in an "advancing" sector, such as computer manufacturing, declines, firms either enter the industry or hire more factors of production, because each firm's income has increased. (Ed > 1)

Thus, the total market response is different in the two cases. This pattern and its consequences for the long run are not considered in the introductory presentation of the market theory of the individual firm's behavior, nor in some economists' thought-process regarding the nature of economic adjustments.

1. For example, "Once the firm acts as if it faces a perfectly elastic demand curve, there is nothing to restrict size from the demand side. *Size must be restricted from the cost side*." (Italics in original.) (Eaton and Lipsey, 1977, 63, quoted in Fujita and Thisse, 2002, 14). I argue that this analysis, which may be true from the point of view of the firm, is not true for the industry. Demand limits entry and exit of firms to the industry.

## II.vii. Structural change in the global economy

Just as the perfectly competitive firm faces perfectly elastic demand, so a small country open to trade faces perfectly elastic demand for its traded products. Just as there is a market demand in the small firm's industry, so there is a global (market) demand in an environment comprised of small countries. The properties of global demand can affect the degree of entry or exit into world markets in a similar way to the way in which the properties of total market demand can affect entry or exit of firms into a perfectly competitive market. The elasticity of global demand for a product may not appear important in the short run, for a small country, but it matters a great deal in the long run, for all countries.

Therefore, the international price of agricultural commodities should fall as productivity advances in global agriculture over the long run. The resulting "immiserizing growth" for agricultural producers worldwide, is closer to the closed-economy solution than to the open-economy solution. However, the relevant "closed economy" in this case would be the global economic system, and not the individual country economy. (Clearly, the global economy is a closed system, albeit a very complex one: Earth does not trade with Mars or Venus.)

## II.viii. Elasticities of demand

Economists in general agree that price- and income-elasticities for agricultural commodities are inelastic. This is so important for the present analysis, that it was confirmed, with reference to empirical estimations. The detailed investigation is presented in Appendix II.

Empirical estimations of demand elasticities, in a USDA database, for many countries, types of agricultural commodity, and different dates, support the assumptions made in the present analysis, that price and income elasticities of demand for agricultural products are inelastic (less than unity). Further, the elasticity response of demand for the output of the agricultural sector as a whole is inelastic.[1] (That is, sectoral rather than product elasticity of demand, a concept that may not have been investigated empirically.)

Further, Johnson (1991, 75) reasons that, since "the income elasticity of demand for all goods and services...is unity..." then, "if the income elasticity of demand for food is less than unity, the income elasticity of demand for all other goods and services is greater than unity." Therefore, it is assumed that the income elasticity of demand for the sector that, in the two-path growth scenario, represents the rest of the economy is elastic (greater than unity).

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1.We thus predict an inelastic sectoral demand response, from the predominance of inelastic demand for many types of agricultural products. It can be argued that this is not logically correct: the relative proportions of different foods consumed might affect whether the price and income elasticity responses for the agricultural sector as a whole are elastic or inelastic. For example, in countries where rice is a large part of the diet, and if rice has price-elastic demand, it may be difficult to determine whether the price-elasticity response of demand for all agricultural products together is elastic or inelastic.

2.In this paper, we address long-run economic growth. Therefore, the income elasticity of demand is more important for determining the long-run growth path of the economy than the price elasticity of demand. We leave this technical matter regarding the price-elasticity of demand unresolved, believing however, that it is unlikely that goods with price-elastic demand, such as rice or milk, are so large a proportion of most people's diets, as to invalidate our discussion.

## II.ix. Productivity increase, consumers' demand, and money, in the two-path growth scenario[1]

The role of productivity increase is described, in the economic literature, as follows: "Most economic historians would surely endorse Paul Romer's view... that technological progress lies at the heart of long run economic growth," (Crafts, 2003) And, "It has been shown, both theoretically and empirically, that technological progress is the main driver of long-run growth." (Chien, 2015) In addition, "Technological progress itself is one of the major engines of economic development. It is also an important source of [earnings] inequality whenever it is not neutral, that is, if it affects differently the productivity of the various types of labor." (Aghion and Williamson, 1998, 80)

The importance of demand in directing inventive activity, may be found in a multi-year empirical study by Schmookler (1976). He argues that the potential for economic gain (making money), largely determined by demand for a product, determines the amount of inventive activity directed toward the making of that product.[2]

Therefore, creativity and invention will cluster in high-income industries and regions. They will find fewer opportunities in low-income industries and regions. (It has already been suggested that Engel's law implies high city incomes and declining agricultural incomes, in so far as cities generate many jobs and rural regions generate few jobs.)

In the two-path scenario, money (income) gravitates toward manufacturing and industrial regions (usually urban regions) and away from agricultural regions (usually rural regions).

The reason that the two-path growth scenario includes money, is that what happens to relative prices is different from what happens to the general price level, as output increases economywide. In the two-path scenario, all prices can decline as output increases. This is explained further as we develop the argument, and also in Appendix IV.

1.This is an analysis of long-run economic growth; fluctuations may occur around the general trend, over periods of a year or a few years, for example if market conditions change temporarily. Markets for specific commodities, especially in the short run, may not follow the general sectoral trend.

2.Schmookler looks especially at the relation between inventive activity and capital goods markets. His conclusions include a similar analysis for consumer goods markets, and we can also infer that most capital goods are used in the eventual production of consumer goods, so that capital goods markets are a derived demand, driven by consumer demand.

# III. The two-path long-run growth scenario, illustrated with examples.

## III.i. How the two-path scenario generates two income-growth paths - that of an advancing sector, and that of a declining sector

Let us assume that the total money circulating in a closed economy is constant (MV = K).[1]

In the following equations, $P_{1\alpha}$ is the agricultural price in period 1, $P_{2\alpha}$ is the agricultural price in period 2; $Q_{1\alpha}$ and $Q_{2\alpha}$ are the quantities of the agricultural product sold in periods 1 and 2 respectively. For the non-agricultural sector ($\mu$), the suffixes are equivalent.

Because MV = K,

$$(1) \qquad P_{1\alpha}Q_{1\alpha} + P_{1\mu}Q_{1\mu} = MV = K = P_{2\alpha}Q_{2\alpha} + P_{2\mu}Q_{2\mu}$$

Rearranging:

$$(2) \qquad P_{1\alpha}Q_{1\alpha} - P_{2\alpha}Q_{2\alpha} = P_{2\mu}Q_{2\mu} - P_{1\mu}Q_{1\mu}$$

This equation tells us that the nominal income that the agricultural sector, $\alpha$, loses, the non-agricultural sector, $\mu$, gains. We have assumed an increase in output economy-wide from period 1 to period 2, with a constant quantity of money in circulation, so that the price level must have declined in period 2.

We must therefore further be sure that, after any price changes, $P_{1\alpha}Q_{1\alpha} > P_{2\alpha}Q_{2\alpha}$ and $P_{2\mu}Q_{2\mu} > P_{1\mu}Q_{1\mu}$. This, indeed, follows from the assumptions about the elasticities of demand (both price and income elasticities), so that income (=PQ) declines in $\alpha$ and increases in $\mu$ as prices decline.

Therefore, for $\mu$, productivity advance caused output to increase, the price of $\mu$ to fall, and income to the $\mu$ sector to increase. (Ed > 1, and the price has declined.) In $\alpha$, productivity advance causes

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1.This assumption abstracts from the complications of working with money. This assumption, although simplistic, is better than leaving money out of the analysis. If we try to work with sectoral incomes in a more conventional model, it becomes clear that the solutions delivered by such a model, are counter-intuitive and probably incorrect. See Appendix III.

Adam Smith (1994, 36) suggests that, "as a measure of quantity, such as the natural foot, fathom, or handful, which is continually varying in its own quantity, can never be an accurate measure of the quantity of other things, so a commodity which is itself continually varying in its own value, can never be an accurate measure of the value of other commodities." (He is referring to changes in quantities of silver or gold, as new mines are discovered, regarding their abilities to serve as money in the sense of a measure of value. We hold the money in circulation constant, in order to investigate how income share changes. The amount of money in circulation is equivalent to the total nominal income in the economy.)

In monetary economics, the equation of exchange is the relation: MV = PQ

    where, for a given period,

        M is the total nominal amount of money supply in circulation on average in an economy.
        V is the velocity of money, that is the average frequency with which a unit of money is spent.
        P is the price level.
        Q is an index of real expenditures (on newly produced goods and services).

Or: $M.V_T = \sum(p_i\, q_i)$ where $p_i$ and $q_i$ are the respective price and quantity of the i'th transaction, and $V_T$ is the transactions velocity of money.

output to increase, the price of α to fall, and income to the α sector to decline. (Ed < 1, and the price has declined.)

The high, and increasing, incomes in μ, closely corresponding to urban regions, generate a derived demand for services[1], so that manufacturing and service sectors expand, while the agricultural sector, closely corresponding to rural regions, loses income share.

And, the agricultural sector develops a disadvantage, relative to the rest of the economy, in the competition for inputs (land, labor, services, and intermediate goods, including capital goods).

### III.ii. The two-path scenario can accommodate heterogeneous outputs and factor inputs

The two-path scenario can support a situation where there are many goods, because it deals with sectoral demand rather than demand for one or two stylized goods. That is, demand for the output of each sector as a whole is elastic or inelastic, so that there is no need to specify a single good, or a specific output mix, for each sector.

Let us now assume that there are many goods in each sector and that the number of these goods increases over time, as it does in a growing economy. We continue to assume a constant quantity of money circulating, MV = K. Then we can understand how, as the same money chases more goods, the nominal prices of *all* goods can decline. Relative prices cannot all decline.

Thus, we may model the real world just as well by analyzing the inter-related incomes of two sectors, as by investigating relative prices and factor-incomes in a two-good economy. We are now ready to present the two-path growth scenario with illustrative examples.

### III.iii. Initial illustrative presentation of the two-path growth scenario - money circulating does not increase over time

The data described by the tables and diagrams below, are invented, but not arbitrary. There are some very specific relationships among the two sectors and the money circulating in the economy. The scenario has two consumption-good sectors, α (agriculture) and μ (manufacturing and services, or "the rest of the economy").

For the initial presentation, the quantity of money in circulation (MV) is constant (=K).  The tables represent not only the theoretical, or unseen, relationship between price, quantity, and income for each sector at a point in time, as conventional supply-demand charts may do, but also the consequences for sectoral incomes, over time, of actual price changes.[2]

1.By definition, services serve. The typical behavior of those who have a service to offer, is to find out who has the money to pay for the service, and to try to persuade that person or organization, that one's service will meet their needs. Therefore, services are more likely to serve businesses, or employees of businesses, who have money to spend (i.e. high incomes). According to Adam Smith (1994, 79), "When the landlord, annuitant, or monied man, has a greater revenue than what he judges sufficient to maintain his own family [or business, we can say], he employs either the whole or a part of the surplus in maintaining one or more menial servants [or business service providers, we can say]. Increase this surplus, and he will naturally increase the number of those servants [or business service providers]."

2.The underlying assumption, in order that the same data can represent these two different situations, is that demand relationships remain constant over time. This can be true if there are only two goods and if their prices change in such a way, as total output increases, that consumers' demand curves for each of them remains the same as it was in previous periods. This assumption permits us to keep focus on the main point of the argument, that the sectoral distribution of money income within the closed economy is a zero-sum game.

**Demand for Output of α**

| Period | Quantity (Millions) | Price | Sectoral Income (Millions) | Total Income (Millions) |
|---|---|---|---|---|
| 1 | 100 | 10 | 1000 | 2000 |
| 2 | 104 | 9 | 936 | 2000 |
| 3 | 112 | 8 | 896 | 2000 |
| 4 | 125 | 7 | 875 | 2000 |
| 5 | 140 | 6 | 840 | 2000 |
| 6 | 160 | 5 | 800 | 2000 |
| 7 | 185 | 4 | 740 | 2000 |
| 8 | 220 | 3 | 660 | 2000 |
| 9 | 270 | 2 | 540 | 2000 |
| 10 | 350 | 1 | 350 | 2000 |

Table 2: Relationships among price, quantity, time period, and income for α

Table 2 above represents demand for the output of α, the agricultural sector.

*III.iii.1. Demand for the agricultural sector, α*. In the tables and diagrams, let us assume one good for each sector. This is, again, to maintain focus on the relationship between sectoral incomes. Each period (1, 2, etc.) represents the same time period in each table (that for α and that for μ). The total income in each period (income to α plus income to μ) adds up to \$2000m, the money income in the economy (= MV = K).

The sectoral income of α, the agricultural sector, declines as productivity advances and output increases. For agricultural products, when output increases in a closed economy, prices decline and $E_d < 1$ so that producers' income declines. (In this section, $E_d$ is the price elasticity of demand.)

These invented data have similar properties to those of invented data in Principles of Economics textbooks. They are meant to illustrate a point, and the point here is that, as the price of the agricultural good or sector declines, the quantity demanded increases, but not enough to offset the decline in price, so that total income to the sector declines. ($E_d < 1$; this is a property of inelastic demand.)

The graph of these data is shown in Figure 5. The x axis can represent either quantity demanded at one period of time as the price may theoretically change, or actual quantity demanded as time passes, productivity increases, and the actual price declines. (That is, quantity produced increases

over time, so that we take a journey along the demand curve from left to right, with income changing as we move from points A to B to J).
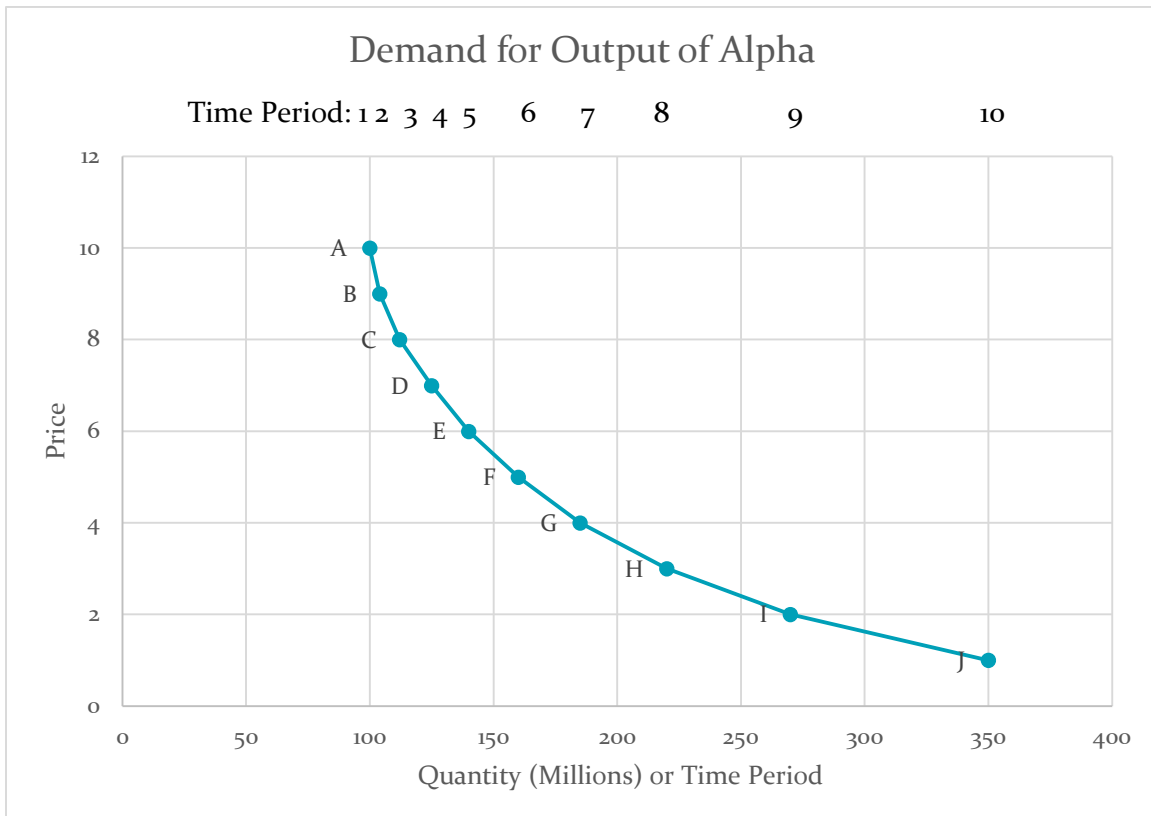


Figure 5: Demand for Output of α, as Price Declines and Time Advances

Time periods on the x axis (top) are not related to one another by the usual proportional scale. This will give a hint regarding the nature of the eventual, mathematically generated, income paths of the two sectors over time.

At point E where P = 6, Q = 140, farmers' income (sectoral income) is represented by area 0,6,E,140, = 6 x 140 = 840

At point G where P = 4, Q = 185, sectoral income is represented by area 0,4,G,185, = 4 x 185 = 740

Area 0,4,G,185 is smaller than the area 0,6,E,140 and thus we can see on the diagram as well as in the chart, that sectoral income declines when moving from point E to point G.

### III.iii.2. Demand for the rest of the economy, μ.

Turning now to the "rest of the economy," Table 3 represents demand for the output of μ, the manufacturing and services sector, representing the non-agricultural share of the economy.

Income to μ increases as productivity advances and output increases, because, for the non-agricultural sector, when output increases, prices decline and Ed > 1, so that sectoral, (i.e. producers') income increases.

**Demand for
Output of μ**

| Period | Quantity (Millions) | Price | Sectoral Income (Millions) | Total Income (Millions) |
|---|---|---|---|---|
| 1 | 100 | 10 | 1000 | 2000 |
| 2 | 118 | 9 | 1064 | 2000 |
| 3 | 138 | 8 | 1104 | 2000 |
| 4 | 161 | 7 | 1125 | 2000 |
| 5 | 193 | 6 | 1160 | 2000 |
| 6 | 240 | 5 | 1200 | 2000 |
| 7 | 315 | 4 | 1260 | 2000 |
| 8 | 447 | 3 | 1340 | 2000 |
| 9 | 730 | 2 | 1460 | 2000 |
| 10 | 1650 | 1 | 1650 | 2000 |

Table 3:  Relationships among price, quantity, time period, and income for μ

As for α above, these invented data have similar properties to those of invented data in Principles of Economics textbooks. They are meant to illustrate a point, and the point here is that, as the price of the manufactured good, or the overall price level in its sector, declines, the quantity demanded increases, more than enough to offset the decline in price, so that total income to the sector increases. Ed > 1, and this is a property of elastic demand.

The graph of these data is shown in Figure 6. The x axis can represent either quantity demanded at one period of time as the price may theoretically change, or actual quantity demanded as time passes, productivity increases, and the actual price declines. (That is, quantity produced increases over time, so that we take a journey along the demand curve from left to right, with income changing as we move from points K to L to U.)
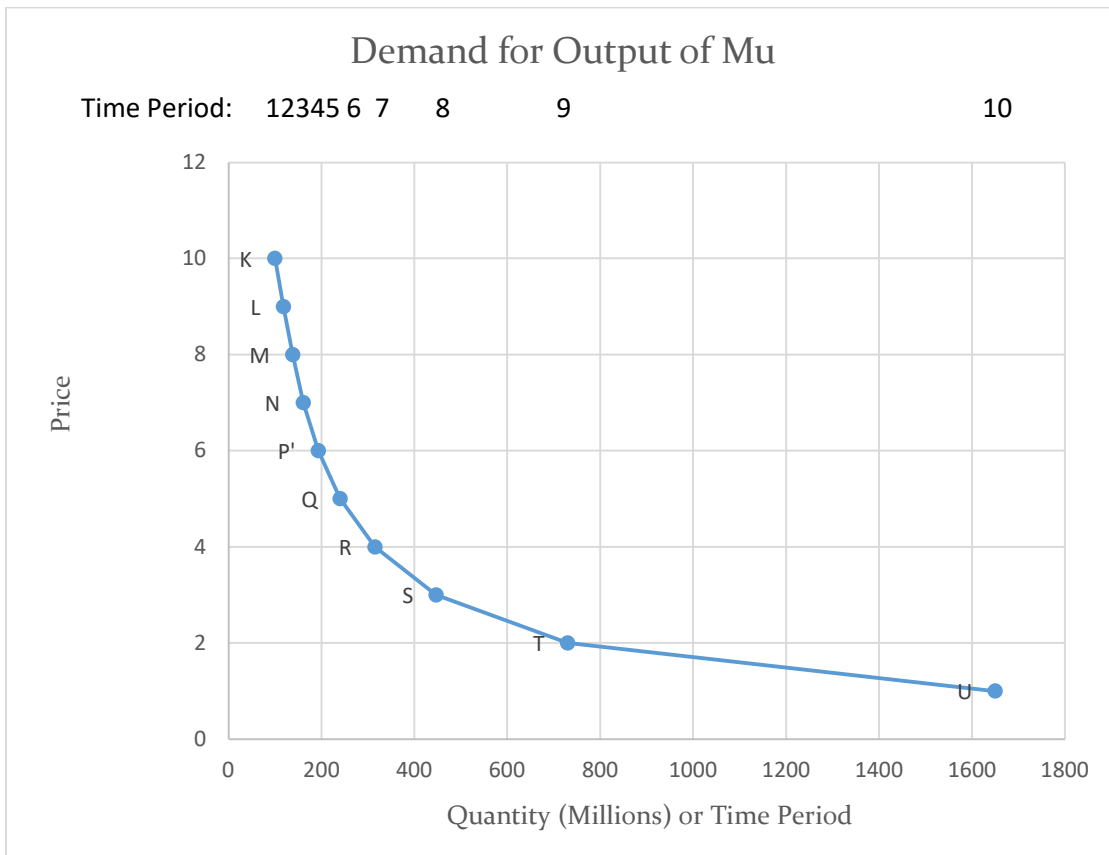
Figure 6: Demand for Output of μ, as Price Declines and Time Advances

At point P' where P = 6, Q = 193, manufacturers' income (sectoral income) is represented by area 0,6,P',193 = 6 x 193 = 1160

At point R where P = 4, Q = 315, sectoral income is represented by area 0,4,R,315 = 4 x 315 = 1260

Area 0,4,P',315 is larger than area 0,6,R,193 and thus we can see on the diagram as well as on the chart, that sectoral income increases when moving from point P' to point R.

As with the time periods for α, the relationship of one time period to another on the x axis (top), is non-linear.

Given the two paths for sectoral income-change over time, developed in these tables and diagrams, we can plot them both on a graph that shows the relationships between income and time period, for each sector and for total income (=MV).

*III.iii.3. Initial illustrative presentation: divergent income paths, total income unchanged:*

Agricultural income declines over time, while manufacturing income increases, even as total income remains constant.
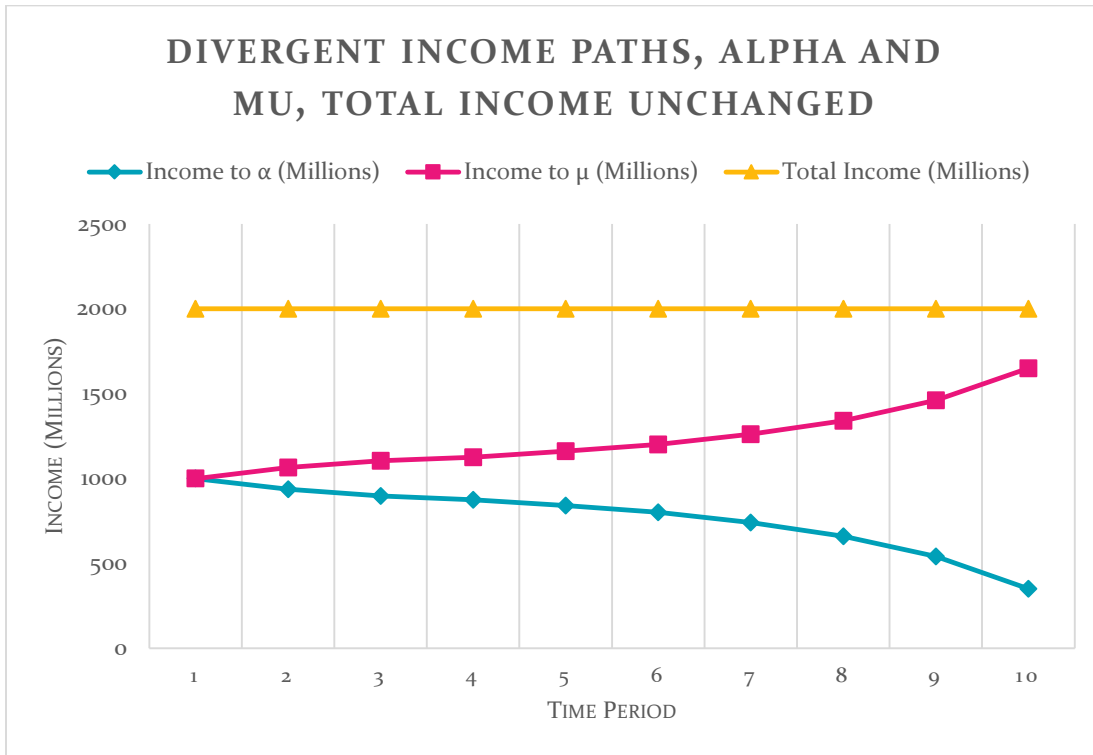
Figure 7: Divergent Sectoral Income Paths, Total Income Unchanged

The two-path long-run growth scenario that we have developed, has been derived from supply-demand diagrams, and price elasticities of demand, that look very much like the ones generally accepted by economists.[1] The underlying argument is based in both real-world data and these generally-accepted economic ideas.

What is different here, in comparison with conventional analysis, is that we have linked the two sectoral demand diagrams by means of a constant quantity of money circulating, that is, a constant money income which they both must share.

## III.iv. Divergent income paths with an increase in the quantity of money in circulation

In the above discussion, the money in circulation (MV) remains constant. This artificially constrains the economy to appear not to grow, in the sense of higher nominal income in later periods. (In the discussion so far, instead of allowing the money supply to grow, we have by implication, placed a lower value (lower price) on each unit of the higher output that exists in later periods.)

Let us change our point of view and reason that wealth and higher incomes are created in the economy as goods and services accrue and their numbers increase. The money supply can increase and often does in the real world. The subscripts 1 and 2 represent the first time period, and the second time period, respectively. The money in circulation has increased from period 1 to period 2.

1.The precise way in which the sectoral income paths might diverge in the real world may not be inferred from the diagram, because the price, quantity, and income data are invented (although their relationship is not).

Our equations become:

$$(3) \qquad P_{1\alpha}Q_{1\alpha} + P_{1\mu}Q_{1\mu} = (MV)_1$$
$$(4) \qquad P_{2\alpha}Q_{2\alpha} + P_{2\mu}Q_{2\mu} = (MV)_2$$

Rearranging:

$$(5) \qquad (MV)_2 - (MV)_1 = P_{2\alpha}Q_{2\alpha} - P_{1\alpha}Q_{1\alpha} + P_{2\mu}Q_{2\mu} - P_{1\mu}Q_{1\mu}$$

Again, $P_{1\alpha}Q_{1\alpha} > P_{2\alpha}Q_{2\alpha}$ and $P_{2\mu}Q_{2\mu} > P_{1\mu}Q_{1\mu.,}$ because of the assumed properties of the demand elasticities. The increase in money circulating (that is, $(MV)_2 - (MV)_1$) equals the nominal income-loss in $\alpha$ plus the nominal income-gain in $\mu$.

The nominal income-gain in $\mu$ is greater than the increase in money circulating, because it includes an amount to offset the nominal income-loss in $\alpha$. Money is transferred from $\alpha$ to $\mu$ even when the money in circulation increases. There is not, in this model, a nominal gain in $\alpha$ when there is a nominal gain in $\mu$. (A rising economic tide does not lift all economic boats. Trickle down does not occur, for the particular case of agriculture.)

As wealth and income increase, we also need to investigate the role of the income elasticity of demand in our model.

### III.iv.1. Relationships among demand and income elasticities[1], α and μ

$E_I$ in the discussion below, is the income elasticity of demand.[1] $E_I = \%\Delta Q / \%\Delta I$

We assume that the income elasticity of demand for agricultural products is less than one, and for products of the rest of the economy, is greater than one. Empirical data and reasoning in support of these assumptions were presented above.

Given these properties of income elasticities, it follows that consumers will spend more of any increase in income on the rest of the economy than on agricultural goods. The reasoning is as follows:

If a consumer receives $100 in extra income, she has to allocate it between $\alpha$ and $\mu$.

If $E_{I\mu} > E_{I\alpha}$, then $\%\Delta Q_\mu / \%\Delta I_\mu > \%\Delta Q_\alpha / \%\Delta I_\alpha$

It follows that $\%\Delta Q_\mu / \%\Delta Q_\alpha > \%\Delta I_\mu / \%\Delta I_\alpha$

---

1. The income elasticity of demand ($E_I$) is defined as:

(% change in quantity demanded (Q))/(% change in income (I))

Necessity goods have an income elasticity of demand between zero and one: expenditure on these goods increases with income, but not as fast as income increases, so that the proportion of income spent on these goods falls as income rises. This characteristic of the income elasticity for food is known as *Engel's law*.

Since the change in the consumer's income for consideration in the spending decision on μ (i.e. the product of the μ sector), equals the change in consumers' income for consideration in the spending decision on α (i.e. the product of the αsector), which both equal the change in the consumer's income, $100, that is:

$$\%\Delta I_\mu = \%\Delta I_\alpha = \%\Delta I = \$100, \text{ so that } \%\Delta I_\mu / \%\Delta I_\alpha = 1$$

it follows that $\%\Delta Q_\mu / \%\Delta Q_\alpha > 1$ and $\%\Delta Q_\mu > \%\Delta Q_\alpha$

That is, the percent change in the quantity of μ purchased, for a given increase in income ($100 in this example) is greater than the percent change in the quantity of α purchased.

### III.iv.2. Why increases in income are spent more on "the rest of the economy" than on agricultural goods

In order for the above to imply that consumers will spend more of any increase in income on "the rest of the economy," we must further assume that the percent of agricultural products in the consumer's original budget is less than 50%. The reason this assumption is necessary is outlined below:

If μ takes more than 50% of the original budget, and $\%\Delta Q_\mu > \%\Delta Q_\alpha$, it follows that the increase in μ must be greater than the increase in α, both because the original quantity was greater, and because the percent increase is greater.

If α takes more than 50% of the original budget, and $\%\Delta Q_\mu > \%\Delta Q_\alpha$, then the absolute increase in α consumed, may be greater or less than the increase in μ consumed, because the original quantity of product α is greater than the original quantity of product μ, but the percent increase is greater for μ.

Thus, after the point in economic development at which non-agricultural products and services consume more than half of consumers' budgets[1], income will tend to accumulate in non-agricultural regions rather than in agricultural regions. The result, for an economy that is past such a point, is a similar divergent income growth path situation to that presented above for price elasticities.

### III.iv.3. Data tables for α and μ, MV increasing

Table 4 represents the case where the economy has reached and passed such a point, and where the money in circulation (MV) increases. We say that MV and the economy's nominal income are conceptually one and the same, and will use them interchangeably. Once again, the data are invented, but with a very specific purpose.

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1.Could this be the condition for "take-off"? The word "take-off" may be outdated today; however, the concept still exists. For example, "All good things tend to move together [on the ladder of development] at each rising rung: higher capital stock, greater specialization, more advanced technology, and lower fertility. If a country is trapped below the ladder, with the first rung too high off the ground, the climb does not even get started." (Sachs, 1991, 73)

The table is related to the two previous tables. As more money exists in the economy, the prices in each period are a little higher relative to the other tables (because more money is spread out over the same goods – quantity in each time period has not changed, from Tables 2 and 3 to Table 4, but MV has increased). The quantities in Table 4 and in Tables 2 and 3 are the same. The total money income starts out at $2000m, as before, but it increases over time.

**Table 4: Demand for Outputs of Both Sectors, MV increasing**

|  | Alpha | | | Mu | | |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Period | Quantity (Millions) | Price | Income (Millions) | Quantity (Millions) | Price | Income (Millions) | Total Income (Millions) |
| 1 | 100 | 10 | 1000 | 100 | 10 | 1000 | 2000 |
| 2 | 104 | 9.1 | 946.4 | 118 | 9.1 | 1073.8 | 2020.2 |
| 3 | 112 | 8.2 | 918.4 | 138 | 8.2 | 1131.6 | 2050 |
| 4 | 125 | 7.3 | 912.5 | 161 | 7.3 | 1175.3 | 2087.8 |
| 5 | 140 | 6.4 | 896 | 193 | 6.4 | 1235.2 | 2131.2 |
| 6 | 160 | 5.5 | 880 | 240 | 5.5 | 1320 | 2200 |
| 7 | 185 | 4.6 | 851 | 315 | 4.6 | 1449 | 2300 |
| 8 | 220 | 3.7 | 814 | 447 | 3.7 | 1653.9 | 2467.9 |
| 9 | 270 | 2.8 | 756 | 730 | 2.8 | 2044 | 2800 |
| 10 | 350 | 1.9 | 665 | 1650 | 1.9 | 3135 | 3800 |

Table 4: the relationships among time period, quantity demanded, price, and incomes, for both sectors, MV increasing

In the table, income to α declines as the price of α declines, while income to μ increases as the price of μ declines. Income to α and income to μ add up to the total money income in each period. Although total income changes from period to period, the link between the two sectors still exists, because each sector must share the total income for that particular time period with the other sector.

We will move directly from the table to the income-path diagram. Price and income elasticities for each sector move income in the same direction (down for α and up for μ), and so we do not concern ourselves with the technical analysis of the precise effect of either.

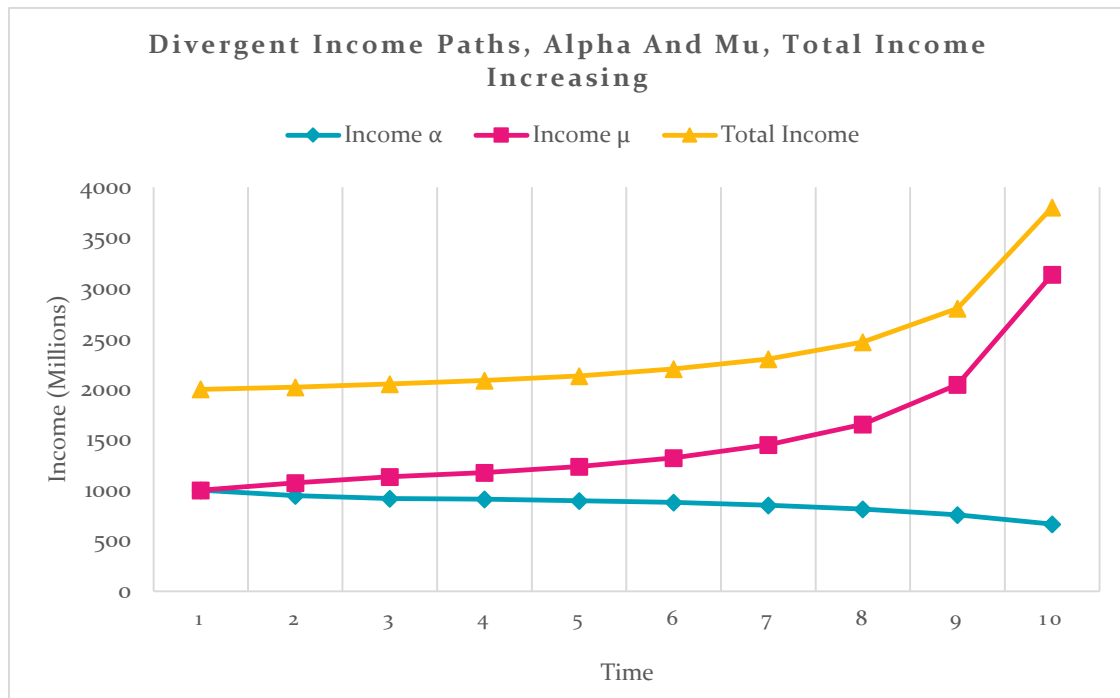Figure 8 represents the graph of the sectoral income paths over time, with MV increasing.



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.
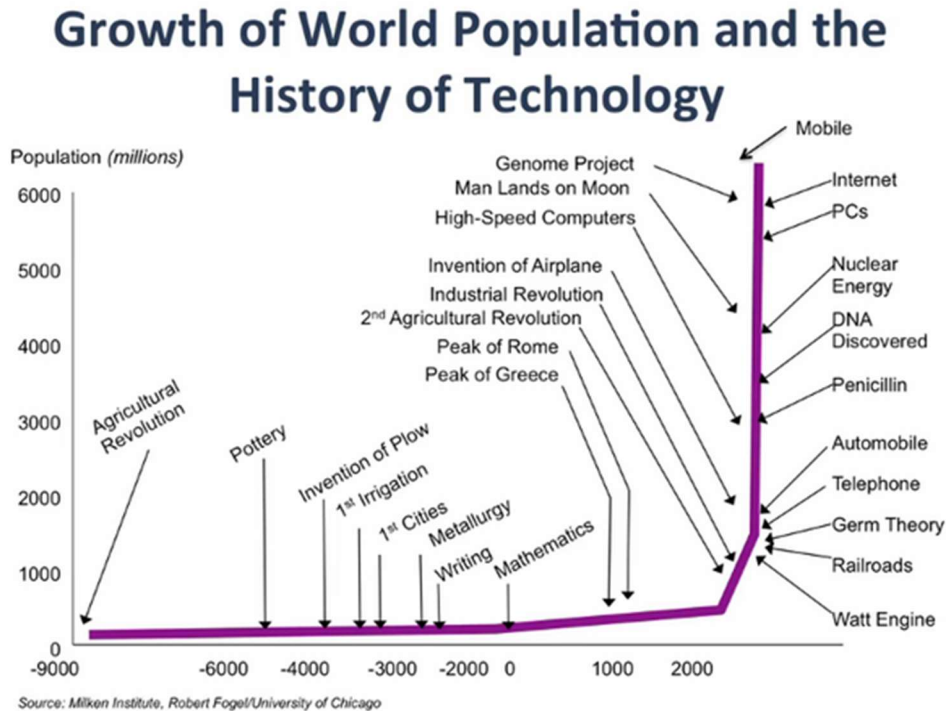


## Growth of World Population and the History of Technology

Source: Milken Institute, Robert Fogel/University of Chicago

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 $\phi$; 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 $\phi$ (= $Ae^{rt}$).

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 $\xi_i$ 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 $\phi$, the level of technological knowledge in the economy; $\phi$ 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 $\phi$, the level of technological knowledge in the economy; $\phi$ 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 $\phi$ 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 $\phi$. 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 $\phi$ (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, $\phi$, 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 $\alpha$ or $\mu$.

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.
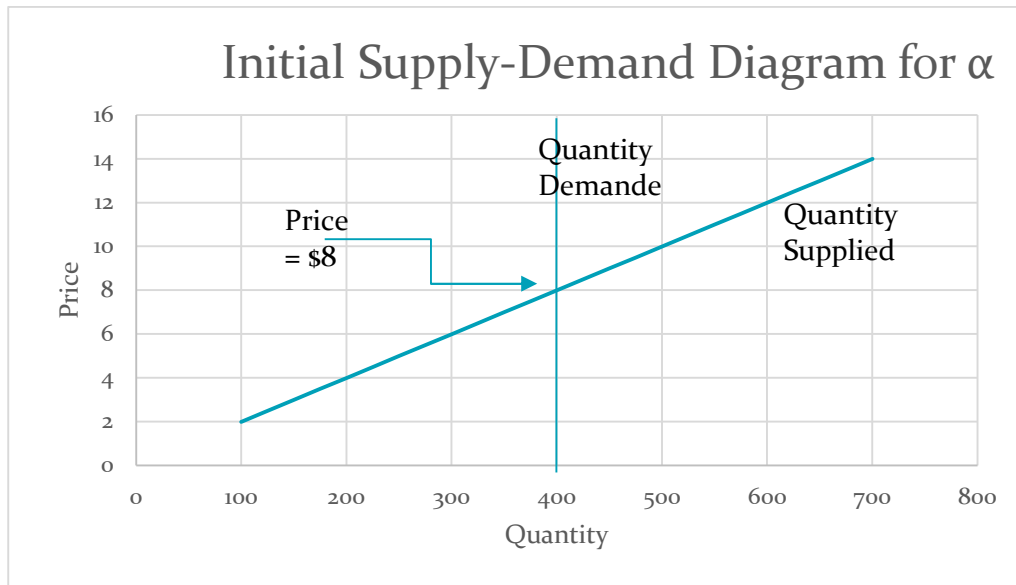


Figure 13: an example of a supply-demand diagram with inelastic demand for α.

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.

**Later Supply-Demand Diagram for α, Both Supply and Demand Shifted to the Right**
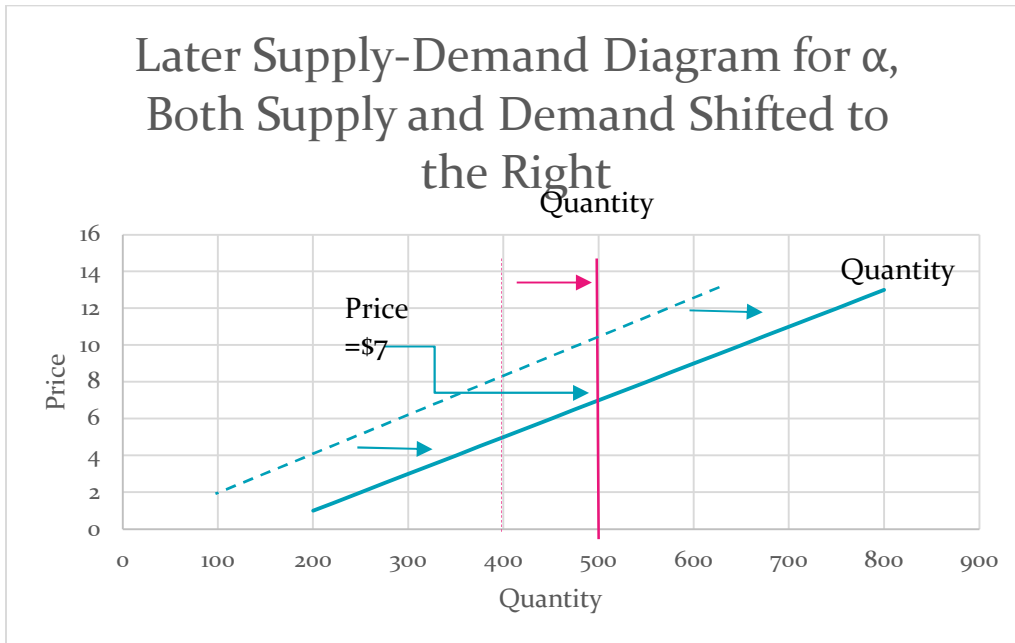
Figure 14: Supply-Demand Diagram when both the demand and supply curves shift to the right

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.

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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)

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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 ($\phi$) 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.

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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 $\alpha$ is rural and $\mu$ 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 ($\alpha$ and $\mu$) 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 $\alpha$ to $\mu$ 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 $\alpha$ to $\mu$ as described above.

Thus, the case of population increase does not alter the conclusion, that economic growth with productivity advance transfers income from $\alpha$ to $\mu$.

(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:

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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.

## Appendix II.ii.: Maps of farm-dependent counties and population-loss counties in the U.S.

Recent data from the U.S. show that the two-path income-growth scenario can apply even to a rich country. The data are presented below.

Figure 13 shows counties in the US that USDA classifies as farming-dependent, the meaning of which is explained on the figure.

## Farming-dependent counties, 2015 edition
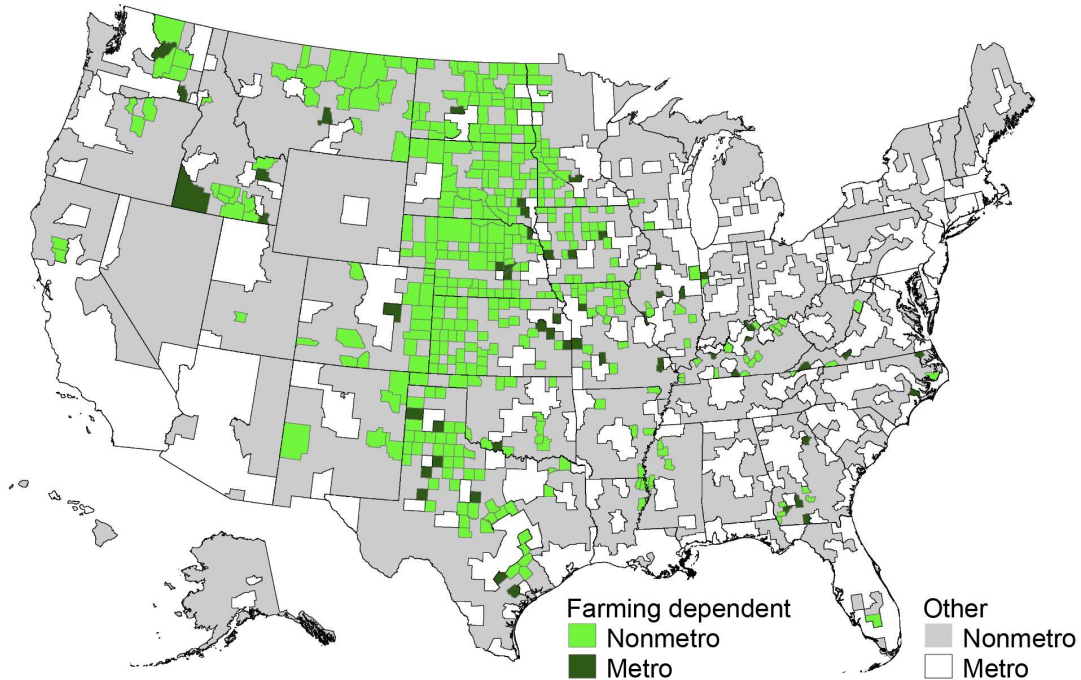


Farming-dependent counties are those where 25 percent or more of the county's
average annual labor and proprietors' earnings were derived from farming, or 16 percent or
more of jobs were in farming, as measured by 2010-12 Bureau of Economic Analysis,
Local Area Personal Income and Employment data.
Note that county boundaries are drawn for the farming-dependent counties only.
Source: USDA, Economic Research Service using data from Bureau of Economic Analysis.

Figure 13: US Farming-dependent counties, 2012

Figure 14 shows population loss counties, the meaning of which is explained on the figure. Population loss can occur when deaths exceed births within the county, or when out-migration from the county exceeds in-migration to the county, and is usually a combination of both effects. Note the close correspondence between population loss counties and farming-dependent counties. Assuming that population loss is associated with job losses, these data suggest that loss of jobs continues in agriculture, although other rural regions may not experience job losses to the same extent.

## Population loss counties, 2015 edition
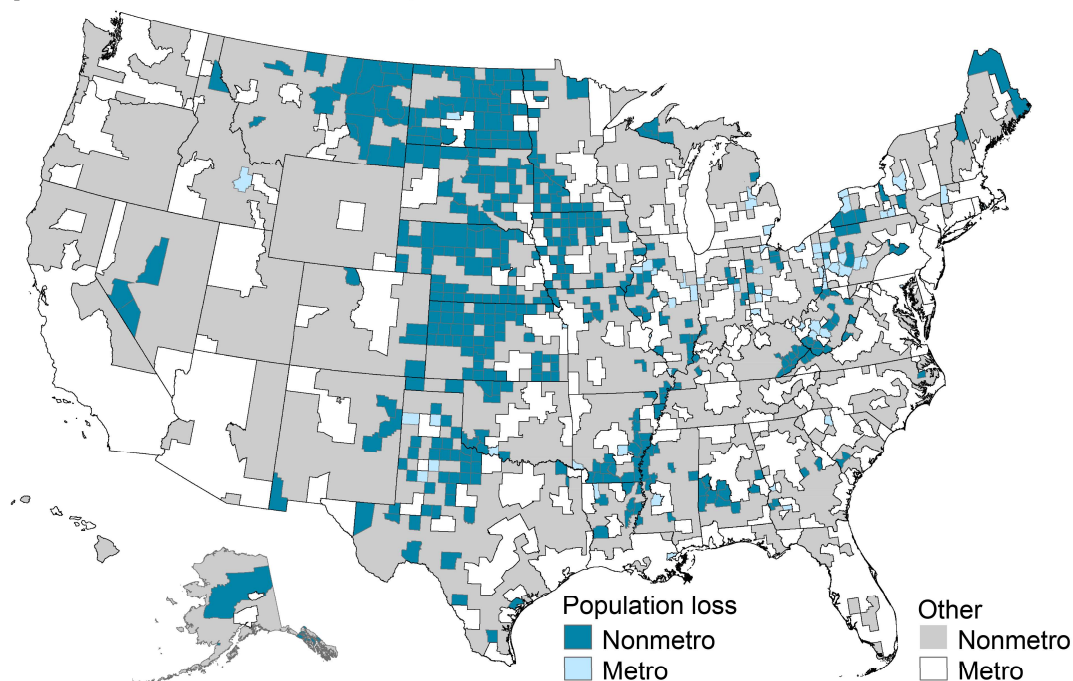


Population loss counties are those where the number of county residents declined between the 1990 and 2000 censuses and also between the 2000 and 2010 censuses.
Note that county boundaries are drawn only for the population loss counties.
Source: USDA, Economic Research Service using data from U.S. Census Bureau.

Figure 14: US population loss counties, 1990-2010

## Appendix II.iii: Employment and compensation by occupation and region

The following is a summary of some labor market data for the U.S. for dates between 2010 and 2016:

"[An] Urban-rural gap in employment growth persists. Although urban (metro) and rural (nonmetro) unemployment rates have declined at a similar pace since their peak in 2010, and both are now below their pre-recession levels, growth in employment has been slower in rural areas. Urban employment has grown steadily at about 1.6 percent per year since the fourth quarter of 2009 and had risen 8.2 percent above its pre-recession level by the second quarter of 2018. Rural employment has grown at about 0.5 percent per year, with periods of stagnation (2012-13 and 2016). Estimated rural employment in the second quarter of 2018 was still 1.8 percent below its pre-recession level. Rural America includes 14 percent of the Nation's population but has accounted for only 4 percent of employment growth since 2013."

From: USDA, Rural America at a Glance, 2018 Edition

And, some occupations are relatively more likely to include the working poor than others, although there is a range of levels of compensation in each occupation. For example:

"The likelihood of being among the working poor varies widely by occupation. Workers in occupations requiring higher education and characterized by relatively high earnings—such as management, professional, and related occupations —were least likely to be classified as working poor, at 1.6 percent in 2016. By contrast, individuals employed in service occupations, which typically do not require high levels of education and are characterized by relatively low earnings, were more likely to be among the working poor, at 10.7 percent. Individuals employed in service occupations, with 2.8 million working poor, accounted for 39 percent of all those classified as workers below the poverty level (7.1 million). Among those employed in natural resources, construction, and maintenance occupations, 5.7 percent were classified as working poor (table 4)."

From: U.S. BLS 2018

In addition, the same report shows that 9.8% of total workers in farming, forestry, and fishing were classified as working poor (table 4). This does not make the summary, above, because there are so few in this sector (1,195,000) out of a total labor force of: 152,165,000.

Also, Groshen (1991), summarizes a study by Slichter (1950) of laborers in Cleveland, thus: "Industry [earnings] differentials are consistent across skill levels, increase with proportion male, vary positively with value added[1], decrease with labor intensity, vary positively with post-tax corporate income, and are stable over time." Groshen summarizes other studies: "a strong link between industry [earnings] differentials and industrial concentration (or profit rates) is found in all studies that search for it [six studies], except [one study]."

The above data suggest a) that earnings may not be tied very closely to the value of the marginal product, if indeed this can be determined, and b) that workers earn more in industries where there is more money per worker, to share out among workers. There are certain types of industries for which this is more likely to be true, such as leading-edge industries - typically industries for which the products face elastic demand - than for other types of industries.

## Appendix II.iv: Data on Relative Prices

The figures below suggest that, even when agricultural prices increase, they increase less than other prices, so that they experience a decline in relative price.

Adam Smith (1994, 36) states that, "as a measure of quantity, such as the natural foot, fathom, or handful, which is continually varying in its own quantity, can never be an accurate measure of the quantity of other things, so a commodity which is itself continually varying in its own value, can never be an accurate measure of the value of other commodities." (He is referring to changes in quantities of silver or gold, as new mines are discovered, regarding their abilities to serve as money in the sense of a measure of value.)

Relative prices are the rate at which one commodity exchanges for another, in the absence of money. That is, one apple might trade for two oranges. The price of the apple is then two oranges, and the price of an orange, half an apple. This becomes much more difficult, when there are more than two goods. But, if the money price of food declines relative to the money price of oil, even if both prices have increased, then, in some sense, the value to the economic system, of food, has declined.

1.Gross value added is obtained by deducting intermediate consumption (i.e. costs of inputs) from gross output (i.e. PQ).

**Prices of many commodities rose**
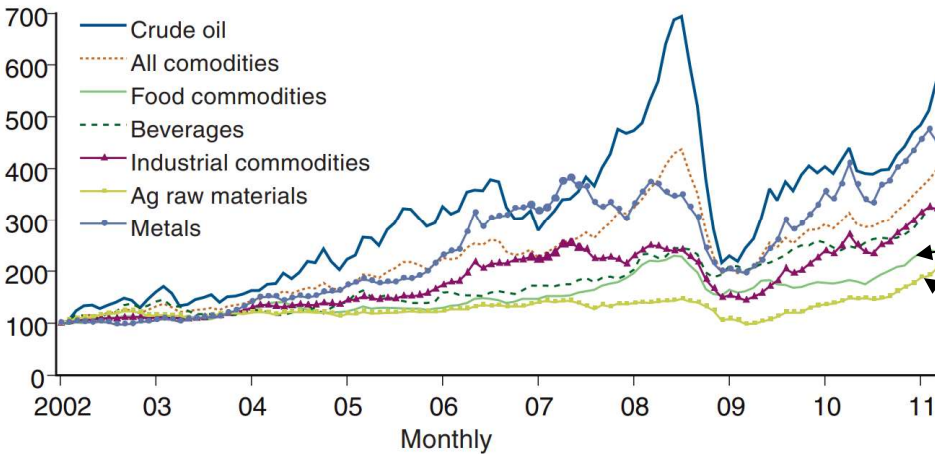
Index: January 1992 = 100
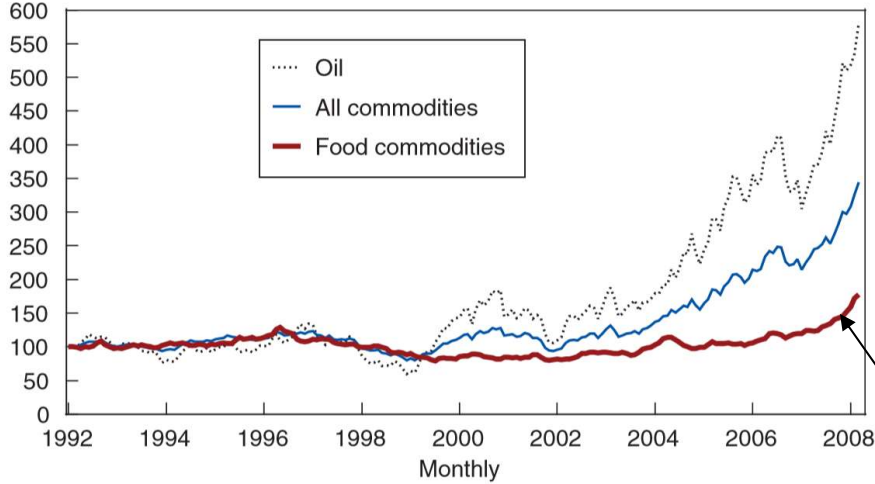


Source: International Monetary Fund: International Financial Statistics.

Figure 15, from USDA ERS (Trostle, 2008)

**Prices of other commodities have risen even more**

Index: January 2002 = 100



Source: International Monetary Fund, International Financial Statistics.

Figure 16, from USDA ERS, (Trostle, et al., 2011)

# Appendix III: Some thoughts on international trade

According to Sachs, (2005, 353-357), "The antiglobalization movement has been fueled by legitimate moral outrage, but it has often been directed toward superficial targets, in my opinion. An anticorporate animus lies at the heart of the movement, a belief that multinational corporations such as Microsoft, Coke, McDonald's…are the main villains in causing extreme poverty and environmental degradation." He states that the antiglobalization movement recommends classic protectionism, but that this is the wrong policy advice, because foreign investment and trade are associated with higher rates of economic growth, and greater increases in per capita incomes in poor countries than the alternative policies (isolationism).

The contribution of the two-path growth scenario to this discussion is to point out the difference between an "income-oriented" approach to wealth (the accumulation of money as a consequence of many years of high incomes – PQ in economists' language) and a "quantity-oriented" approach to wealth (the accumulation of material wealth as a consequence of many years of high outputs – Q in economists' language). These two approaches lead to different conceptions of the purpose of international trade.

*Mercantilism:* (the PQ approach to international trade.) This is the idea that a country needs to export a greater value of home commodities than it imports of foreign commodities, so that "the stocks of the kingdom shall increase, for the balance of trade must be returned in money or bullion." (The quotation is from Frances Bacon, 1616.) (Spiegel, 1971, 99). To Mun, another mercantilist, "trade is a means to obtain treasure, and treasure is a means to enlarge trade." (Spiegel, 1971, 115)

The mercantilists believed that, "When one country increases its share of any of them [i.e. power, trade, and treasure], another country is bound to suffer a corresponding loss." (Spiegel, 1971, 115). Spiegel states that mercantilists believed that the same is true of individuals, and that they believed in a potential incompatibility of private and public interests, and therefore in policies to mitigate the consequences. They opposed restrictions on behaviors, which restrictions might lead to the outflow of specie (treasure spent on imports), but were in favor of restrictions that encouraged the inflow of specie (treasure brought in to the country by foreign payments for exports). Mercantilists believed in population increase, because more workers would create more output. (Spiegel, 1971, 149)

Adam Smith was opposed to the mercantile system, suggesting that this system put the interest of the producer ahead of the interest of the consumer. (Spiegel, 1971, 117)

The criticism that Spiegel offers of mercantilism, which is why it was superseded in modern economic thinking, is the following: mercantilist thought included the idea that "If specie failed to return from the Indies, it could not raise prices in England and thereby bring about its eventual outflow." p.117 (Keynes on mercantilism p. 118)

"Specie" in the mercantilists' time was gold or silver. In England at the time, lacking gold or silver mines as it did, the criticism offered by Spiegel, that mercantilists did not consider the interaction of the money supply with the exchange rate and domestic prices, may have been valid. In today's global world, with manipulated exchange rates, fiat money, and electronic commerce, the matter is more complex. Also, if world agriculture is a special case, agricultural prices may fall worldwide, regardless of the interactions of the exchange rate with the general price level in one country.

The ideas of the mercantilists were discredited by advances in economic thought, including the ideas of the Physiocrats that, "The hope for national gain at the cost of other countries is an illusion, as the precarious gains are more than offset by the cost of the wars which are the result of policies harmful to other nations." (Spiegel, 1971, 185). And, the idea that production (output, or Q) is the source of wealth; gold and silver are not wealth, but "the effects of real production which has changed its form." (p.185)

Spiegel tells us that Adam Smith's economics was part of his larger belief system that the world is a harmonious machine designed by the wisdom of God. Smith believed that "the rich consume little more than the poor, and in spite of their natural selfishness…they are led by an invisible hand to make nearly the same distribution of the necessaries of life, which would have been made, had the earth been divided into equal portions among all its inhabitants; and thus, without intending it, without knowing it, advance the interest of the society." (Spiegel, 1971, 231). Spiegel also tells us that Smith believed in self-reliance, which, with the idea of the invisible hand, became the foundation of laissez-faire economics, or classical "liberalism," the idea of competition relatively unfettered by government control. (pp. 233-234)

Yet, Smith himself was "a bitter critic of [commercial society]," as evidenced by some of the quotations in the text of the present paper. Spiegel gives examples of Smith's criticisms of the commercial society, many of them having to do with the way in which people behave, in the commercial society, depending on their roles within that society. (Spiegel, 1971, 234-237.) Spiegel suggests that Smith's main endorsement of such a flawed society was for its ability to create peace instead of war, and to move many people from servile dependency to self-reliance. Smith was opposed to feudalism and the power of the church, and perhaps saw the commercial society, bringing political freedom and independence, as better than these, despite its shortcomings. (p. 237). Smith's view on trade was that it opened up a market for excess supply of goods, over domestic needs. (p.255) Nor did he believe in interfering with imports. His trade theory was based in the idea of "absolute advantage," - the idea that countries specialize in what they are absolutely better at, and trade - and could be called "free trade," with a few exceptions.

The development of the modern economic mindset may be much attributed to Ricardo. According to Spiegel, "With Ricardo, economics loses the empirical bent which had been so characteristic of Adam Smith's approach and instead becomes austere and abstract. With him economics also loses its touch with philosophy and becomes truly autonomous, that is, detached from any principles except those generated by the inner logic of its own system of thought." (p.312) Ricardo stressed the means of distribution of wealth, rather than the accumulation of wealth, which latter concerned the mercantilists and Smith. (319).

Many others contributed to the development of economic thought. By the time of Spiegel's writing, marginalism, optimization, and econometrics had become the order of the day. (Spiegel, 1971)

*Comparative Advantage*: (The Q approach to international trade.) This is the idea that countries specialize in what they are relatively better at, and trade. Then, everyone is materially better off. The problem with this approach is that, if we consider a world of many countries trading in goods,[1] then, over the long run, income is transferred from countries which produce more of the goods with inelastic demand, to countries which produce more of the goods with elastic demand.

1. Trade in the modern world is not only in goods. There is much international commerce in inputs to production, such as data call centers.

As the two-path growth scenario shows, consumers increase their purchases of goods with elastic demand more than goods with inelastic demand, as their incomes increase. Then, some types of goods, typically high-technology goods, generate income for their producers, at the expense of other types of goods, such as agricultural commodities. Producers of commodities which are behind the leading edge benefit little, if at all, in the long run, from such trade, relative to producers of commodities that are at the leading edge.

What happens when poor countries interact with the wealthy world, is that the modern sectors of the poor countries join in with the global modern sector, so that the poor country appears to be better off. If data can be collected to show how the informal or traditional sectors of those countries, relative to the modern sector, change, with globalization, it might be found that they become worse off.

Foreign investment can certainly improve the living conditions of the poor. Two questions arise: a) how much do the poor want their living conditions improved by outsiders, if they fully understand the price (i.e. dependence on outsiders who may either not understand their culture or not have their interests at heart)? and b) who will get the money raised by, say, the new, ongoing monthly supply of electricity, or by repayment of the loan that was given to enable the "investment"?

The theory of comparative advantage rejects the role of money, and hence does not consider the zero-sum property of trade with money; nor does it have a good assessment of what happens in the long run. The role of money in the global economy is complex and will be hard to discover empirically. Yet, the analysis above shows that, even when the money supply increases, the zero-sum game is true of the distribution of physical quantities of goods, in each time period. Further, as the quantity of output increases, prices adjust in such a way that those at the lower echelons of society, in every country, lose purchasing power, and those at the upper echelons of society, in every country, gain purchasing power.

Advanced countries and businesses may not recognize these problems, because trade does benefit them, and because much analysis of economic growth involves a one-path approach and a quantity focus rather than an income focus.

The role of credit in the economy – trade of income in one time period for income in another, by means of a market-generated interest rate – may complicate the matter even further. The role of the Grameen bank in lifting people out of poverty seems exemplary – some poor women were being charged such high rates of interest by local money-lenders that they could not keep enough of their output to build up their businesses. Yunus and his colleagues stepped in to create a bank that would lend to the poor, on terms and in amounts (micro-loans) that helped many of these women to develop thriving businesses. (Yunus and Jolis, 2007)

Micro-loans and other forms of credit are laudable in the short run, for the very poor, to help them enter the modern sector. The very poor need this type of intervention. Yet, the more we solve local problems such as these, the less we confront what may be a global problem – the continued and increasing production of items that are technologically sophisticated, becoming ever less expensive, that are not good for humanity or the planet.

One wonders what data the Grameen bank has, on which types of businesses thrive, and what happens when many people in a small community all set up in the same business.

*Competition:* Competition is the idea that, in an industry of small firms, where none can control the market price, the firms compete, each trying to produce the product with a more-efficient use of resources than the others, with the (desirable) result that the economy as a whole uses its resources to the best advantage.

Competition can arise in international markets just as much as in domestic markets, and some individuals may confuse competition in international markets with comparative advantage. The two concepts are different – competition among producers is not the same thing as trade among nations, each having something to offer the other.

*Discussion*: Economists of the 21st century struggle to reconcile the mathematical edifice that economic theory has become, with the real world. The methods of many are to create ever more complex mathematical models, to explain empirical deviations from conventional thinking. Calculations using such models may be useful in the investigation of specific, specialized areas.

Yet, the overall pattern of structural change, investigated in this paper, can be explained by a different type of model. This gives us a different insight into international trade.

Regardless of the theory of comparative advantage, observation of the modern world suggests that the driving force in international trade today is competition, with a mercantilist bent, on the part of large corporations. The participants in trade are businesses, increasingly large corporations, who vie for customers and try to maximize their incomes. (Conventional theory stresses the maximization of profits. The impacts of the two goals – profit vs. income – may not be very different in practice. The two-path scenario does not stand or fall on the maximization of profits. Even a corporation that may not be profitable can participate in commerce, and direct resources accordingly.)

If national governments pursue policies intending to promote free trade, believing that they are supporting the increased worldwide wealth generated by the theory of comparative advantage, they in fact benefit these large corporations, (and foreign governments with different strategies), at the expense of other economic actors, in the way that mercantilists, and the antiglobalization movement, suggest.

The two-path growth model describes a mercantilist system, in which one sector gains income at the expense of another. If it were suggested that the closed two-path system would be brought back to equilibrium by the interactions of money supplies, exchange rates, and prices (an analysis which is not often suggested for one closed economy), it might also be remembered that the two-path system does not tend toward an equilibrium, and there is no reason to suppose that any exchange rate between the two sectors will reach an equilibrium before the ongoing loss of income from the agricultural sector exacerbates the situation.

The current trade environment, that favors large corporations, need not be entirely bad. Not everyone is looking for a large income, and arguably the compensation by those with wealth, to others in return for work, can be a fair trade. Also, many people enjoy the products that result from high-tech competition. Yet, the systematic impoverishment of those who have little bargaining power, and the disruption of global ecosystems, are not good societal goals. Some sort of intervention is required.

# Appendix IV: Why the closed neoclassical two-sector model, with two consumption goods and productivity advance, will not work for the two-path growth scenario

The comparative statics of the closed neoclassical two-sector model, with two consumption goods, gives the result that the relative agricultural price declines with productivity advance, which result would seem to deliver "immiserizing growth." However, this model does not suit the purpose of investigating the growth paths of sectoral incomes.

In a closed neoclassical two-sector model, the labor-intensive sector represents the agricultural sector, and elasticities of demand for the agricultural good are less than unity (both own-price and income elasticities). The capital-intensive sector represents manufactures, for the product of which, demand elasticities (own-price and income) are greater than one. ($E_d$, in the discussion of the present section, represents the demand elasticity in general, including both price and income elasticities.)

Following the conventional analysis[1] of the closed two-sector model with two consumption goods, other things equal, neutral productivity increase in the agricultural sector (the labor-intensive sector) causes the relative price of the agricultural product, and the wage to labor, to fall. ($E_d < 1$) However, for the present purpose, consider sectoral, rather than factor, income. Then, we also might expect a decline in the income of the agricultural sector. ($E_d < 1$, and the price has fallen.)

As the second part of the conventional analysis, the above-mentioned productivity increase in the agricultural sector (the labor-intensive sector) causes the relative price of the capital-intensive good (manufactures) to rise, the factor payment to capital to rise, and the income to capital to rise. Once again, let us instead investigate the sectoral income rather than factor income. We would expect the income of the manufacturing sector to fall. ($E_d > 1$, and the price increased)

Thus, if a change in relative price has the same impact on sectoral income as an equivalent change in nominal price[2], this paradoxical result follows: income in both sectors appears to have declined even as productivity in the agricultural sector has increased. Absent money in the model, this paradox is hard to explore and resolve.

Let us now perform an equivalent thought experiment when the productivity increase occurs in the manufacturing sector.

1: The basic result is that, if neutral technical progress occurs in one industry, the relative price of the factor used intensively in that industry rises, remains the same, or falls depending on whether the uncompensated elasticity of demand for the product of that industry, is greater than, equal to, or less than, unity. (Johnson 1973, 69)

As there is a monotonic correspondence between the price of the product and the price of the factor used most intensively in the sector (Johnson 1973, 54), it may be inferred that when that factor-price falls, the product price falls. We argue here, further, that, if the elasticity of demand is less than one, in such a case, then the income to the sector will also fall.

Similarly, we argue here that, in the two-sector model, when the price of a product falls, if the elasticity of demand for the product is greater than one, the sectoral income will rise.

2. The impact of demand elasticity on producers' income is often discussed without stating specifically whether the prices are real or nominal, but one does not say one is using relative prices.

With neutral productivity increase in the capital-intensive sector, the relative price of the capital-intensive good, the price of capital and income to capitalists, rise. ($E_d > 1$) When, for the present purpose, we consider sectoral income rather than factor income, we would expect income to the manufacturing sector to fall. ($E_d > 1$, and the price has risen).

Similarly, the standard analysis predicts that, with neutral productivity increase in the capital-intensive sector, the relative price of the agricultural good, the wage to labor, and labor income, fall. Again, for the purpose of this paper, consider sectoral income rather than factor income. Income to the agricultural sector should fall ($E_d < 1$ and the price has declined.) As in the case of productivity advance in agriculture, in this case also, both sectoral incomes appear to have declined even as productivity in the manufacturing sector has increased. Again, absent money in the model, this probably unrealistic result is hard to explore and explain.

If the model includes money, then, as the same money chases more goods, the nominal prices of *all* goods can decline. Relative prices cannot all decline.

Adam Smith (Smith in Heilbroner, 1986, 194) shows how this can happen. "[As productivity advances, with the increasing division of labor,] All things would gradually have become cheaper.... But though all things would have become cheaper in reality, in appearance many things might have become dearer than before, or have been exchanged for a greater quantity of other goods." The idea of relative prices, is represented by Smith's idea that one product exchanges for a certain quantity of another product, which exchange rate (relative price) may change.

# Appendix V: the difference between per capita poverty and regional poverty

Some analysts imply that, if per capita incomes equalize across regions or improve over time, we have achieved some desirable level of equality.

For example, Lal (2013) suggests that individuals, on average, are better off in all sorts of measures of well-being, since the process of growth and development allowed many countries to escape the Malthusian trap. We do not wish to contradict him in this. Our argument that "trickle-down" does not occur is made with reference to the income of the agricultural sector as a whole, and therefore to agricultural regions, not to the average per-capita income of individuals.

Relative regional or sectoral welfares are different, when regional or sectoral total incomes are different, irrespective of per capita incomes for individuals. Nunn, Parsons, and Shambaugh (2018) state that, "One factor that can reinforce differences in economic outcomes across places is the quality of investments in local public goods. State and local governments that are struggling may have difficulty paying for such investments, which in turn limits economic opportunity for residents. In addition, places with more-limited resources will likely be less resilient in the face of negative shocks related to trade, technology, and other factors."

Rather than question Lal's conclusion for individuals, we emphasize, here, that regional incomes involve a different concept from individual incomes, which may indeed equalize across regions for

similar workers, or increase worldwide, on average, over time. The way in which individuals escape poor regions, if they can, is to migrate, and we have examined the consequences of this, and the related scarcity of other inputs, for the regions from which they depart.

Migration from a poorer to a richer region may, or may not, improve individuals' personal incomes, depending on how easy it is for them to integrate into, or benefit from, the richer region.

Thus, several observations may be made with regard to the statement that per capita incomes worldwide are higher now than in the past.

- One, the situation in the U.S. suggests that the poor benefit from the current system much less than the rich. This is so, even as many of the poor work harder than many of the rich (Bowles, 2006, 118). Poor people may no longer starve and die from easily-curable illnesses; yet, they still are, relative to the wealthy, extremely poor. Further, their needs, or perceived needs, in a wealthy society may be greater than their needs in a poor society, for various reasons.
- Two, as those who can, migrate (move away), this can leave pockets of poverty worse off for those who remain. Sampson and Morenoff (2006, 176-186) offer a description of the data for Chicago neighborhoods. For example, "poverty increased the most [by 1990] among those neighborhoods that were already poor in 1970. In this regard, neighborhood poverty appears to represent a spiraling trap." (p. 182) They also note that, "neighborhoods remain remarkably stable in their relative economic standing despite the inflow and outflow of individual residents." (p.199) They tell little about those in-migrants and out-migrants, except to suggest that, "once a neighborhood is beyond a certain threshold or "tipping point" of either percent black or percent poor—but especially the former—further change is invariably in the direction of greater racial homogeneity and more poverty." (p. 199)
- Three, high average urban per-capita incomes may hide pockets of extreme poverty and dysfunction in some urban regions.
- Four, part of the process of economic development is that non-market behavior becomes integrated into the market system, so that measures of changes in per capita income can be misleading. For example, if a community was self-sufficient before the arrival of the market, it may not have been technically poor, even if its income, as measured by market statistics, appeared to be low.

## References:

Acemoglu, Daron, ed., 2004, "Recent Developments in Growth Theory," Edward Elgar Publishing,

Acemoglu, Daron, 2002 "Technical Change, Inequality, and the Labor Market"
Journal of Economic Literature; 40, 1; 7-72. In Acemoglu, ed., 2004

Aghion, Philippe, Christopher Harris, Peter Howitt and John Vickers, 2001, "Competition, Imitation and Growth with Step-by-Step Innovation," Review of Economic Studies, 68, 467-92 (In Acemoglu, ed.2004, Vol. II Ch. 11)

Aghion, Philippe, and Williamson, Jeffrey, 1998, "Growth, Inequality, and Globalization: Theory, History, and Policy," Cambridge University Press

Anderson, Kym, 1987. "On Why Agriculture Declines with Economic Growth," Agricultural Economics, 1: 195-207

Anderson, E. 1999, "Code of the Street: Decency, Violence, and the Moral Life of the Inner City," New York: W.W. Norton

Archibald, Robert B. and David H. Feldman,2006, "Explaining Increases in Higher Education Costs," College of William and Mary, Department of Economics, Working Paper No. 42.

Azariadis, Costas, 2006, "The Theory of Poverty Traps: What Have We Learned?" In Bowles et al., 2006

Bellante, Don, 1979, "The North-South Differential and the Migration of Heterogeneous Labor," The American Economic Review, Vol. 69, No. 1, pp. 166-175.

Benabou, Roland, 1979, "Workings of a City:  Location, Education, and Production," Quarterly Journal of Economics, CVIII (3), 619-52.  (In Sattinger, 2001, Vol II Ch. 29)

Bluestone, Barry, and Bennett Harrison, 1998, "The Growth of Low-Wage Employment: 1963-86," American Economic Review, 78 (2), 124-8. (In Sattinger, 2001, Vol II Ch. 18)

Bourne, Ryan, 2019, "How 'Market Failure' Arguments Lead to Misguided Policy", Policy Analysis No. 863, Cato Institute

Bowles, Samuel, Steven N. Durlauf, and Karla Hoff, 2006, "Poverty Traps," Russell Sage Foundation.

Bowles, Samuel, 2006, "Institutional Poverty Traps," in Bowles et al., 2006

Campbell, T. Colin, and Campbell, Thomas M. II, 2005, The China Study, Ben Bella Books.

Chien, YiLi, 2015, "What Drives Long-Run Economic Growth?"  Federal Reserve Bank of St. Louis.

Clarke, Richard N., and Lawrence H. Summers, 1980, "The Labour Scarcity Controversy Reconsidered," The Economic Journal, 90, 129-139.

Connell, John; Dasgupta, Biplab; Laishley, Roy; and Lipton, Michael, 1976, "Migration from Rural Areas: The Evidence from Village Studies," Oxford University Press

Crafts, Nicholas F.R., 2003, "Quantifying the Contribution of Technological Change to Economic Growth in Different Eras: A Review of the Evidence," Working Paper No. 79/03, Department of Economic History, London School of Economics

De Muro, Pasquale, Salvatore Monni, and Pasquale Tridico, 2010, "Knowledge-Based Economy and Social Exclusion: Shadow and Light in the Roman Socio-Economic Model," International Journal of Urban and Regional Research

Dickens, William, and Kevin Lang, 1985, "A Test of Dual Labor-Market Theory," American Economic Review, 75 (4), 729-805. (In Sattinger, 2001, Vol II Ch. 20)

Dickie, Mark, and Shelby Gerking, 1989, "Inter-regional wage differentials in the United States: A Survey," SpringerLink, 1989

Durlauf, Steven N.,2006, "Groups, Social Influences, and Inequality," in Bowles et al., 2006

Edwards, Chris, 2016, "Agricultural Subsidies," in Downsizing the Federal Government, Cato Institute.

Emerson, Lesley, 1992 "Internal Migration in Algeria, 1966-77: An Empirical Analysis," Unpublished Ph.D. Dissertation, University of Maryland College Park (**University Microfilms, Ann Arbor, Michigan**)

Engerman, Stanley L., And Kenneth L. Sokoloff, 2006, "The Persistence of Poverty in the Americas: The Role of Institutions," in Bowles et al., 2006

Ewers, Michael C., 2007, "Migrants, markets and multinationals: competition among world cities for the highly skilled," Geojournal, Kluwer Academic Publishers. (Ewers, M.C. GeoJournal (2007) 68: 119. https://doi.org/10.1007/s10708-007-9077-9)

Fengler, Wolfgang, (2011), "Why do Kenyans Want to Live in Cities?" WorldBank.org

Ferguson. C.E., 1968, "Neoclassical Theory of Technical Progress and Relative Factor Shares," Southern Economic Journal, 34, 490-504.  (In Sattinger, 2001, Vol III ch.8)

Fujita, Masahisa, and Thisse, Jacques-Francois, 2002, "Economics of Agglomeration: Cities, Industrial Location, and Regional Growth," Cambridge University Press

Glaeser, Edward L., and Joshua D. Gottlieb ,2009, "The Wealth of Cities: Agglomeration Economies and Spatial Equilibrium in the United States," Journal of Economic Literature, Vol. 47, No.4

Goklany, Indur, 2001, "The Pros and Cons of Modern Farming," PERC Reports

Gollin, Douglas, 2014, "The Lewis Model: a 60-Year Retrospective," Journal of Economic Perspectives, Vol. 28, No. 3, 71-88

Gomme, Paul, 1991, "Money and Growth Revisited," Discussion Paper 55, Institute for Empirical Macroeconomics, Federal Reserve Bank of Minneapolis

Groshen, Erica L., 1991, "Five Reasons Why Wages Vary Among Employers," Industrial Relations, 30 (3), 350-81 (In Sattinger, 2001, Vol II Ch. 22)

Harcourt, G.C, 1969, "Some Cambridge Controversies in the Theory of Capital, in O.F. Hamouda, (ed.), Controversies in Political Economy: Selected Essays of G.C. Harcourt, Chapter 7, Brighton: Wheatsheaf Books Ltd. 145-206. (In Sattinger, 2001, Vol III Ch. 23)

Harris, J. and M. Todaro ,1970, "Migration, Unemployment and Development:  A Two-Sector Analysis," American Economic Review, 1, 126-142

Harris, John R. and Sabot, Richard H., 1982. Urban Unemployment in LDCs: Towards a More General Search Model. In Sabot (1982), 65-89

Harvard T.H. Chan School of Public Health, 2018, "Life in Rural America," Robert Wood Johnson Foundation/Harvard School of Public Health

Heilbroner, Robert L., 1987 "The Essential Adam Smith," Norton and Company

Hoff, Karla, and Sen, Arijit, 2006, "The Kin System as a Poverty Trap?" in Bowles, et al., 2006

Hunja, R., 2011, Conversation on World Bank blogs, in response to: Fengler, Wolfgang, (2011), "Why do Kenyans Want to Live in Cities?" WorldBank.org

Johnson, D. Gale, 1991, "World Agriculture in Disarray," St. Martin's Press, New York

Johnson, Harry G., 1973, "The Theory of Income Distribution," Gray-Mills Publishing, Ltd., London

Jones, Ronald W., 1965, "The Structure of Simple General Equilibrium Models," Journal of Political Economy, Vol. 73, No. 6, pp. 557-572

Kanbur, Ravi and Hillel Rapoport, 2005, "Migration Selectivity and the Evolution of Spatial Inequality," Journal of Economic Geography, Vol. 5 Issue 1

Kelley, Allen C. and Williamson, Jeffrey G., 1984, "What Drives Third World City Growth?" Princeton University Press

Kerr, Sari Pekkala, William Kerr, Caglar Ozden, and Christopher Parsons, 2017, "High-Skilled Migration and Agglomeration," Annual Review of Economics, Vol. 9: 201-234

Krusell, Per, Lee E. Ohanian, Jose-Victor Rios-Rull and Giovanni L. Violante, 2000, "Capital-Skill Complementarity and Inequality: A Macroeconomic Analysis," Econometrica, 8 (5), 1029-53 (In Acemoglu, 2004, Vol II Ch. 17)

Lal, Deepak, 2013, "Poverty and Progress: Realities and Myths About Global Poverty," Cato Institute

Layard, P.R.G. and A.A.Walters, 1978, "Microeconomic Theory" McGraw-Hill, Inc., New York

Lipton, Michael, 1980 "Why Poor People Stay Poor: Urban Bias in World Development," Harvard University Press

Lowry, Ira, 1966 "Migration and Metropolitan Growth," Chandler Publishing Company, San Francisco (1966)

McCloskey

Mehlum, Halvor, Karl Moene, and Roger Torvik, 2006, "Parasites," in Bowles et al., 2006

Nelson, Harold D., ed., 1979, "Algeria: A Country Study," American University

Nunn, Ryan, Jana Parsons, and Jay Shambaugh, 2018, "The Geography of Prosperity," The Hamilton Project

OECD, 1996, "The Knowledge-Based Economy." GENERAL DISTRIBUTION OCDE/GD(96)102, Paris

Olson, Mancur, 1977, "The Logic of Collective Action: Public Goods and the Theory of Groups," Harvard University Press

https://ourworldindata.org/

Our World in Data, 2019: urbanization https://ourworldindata.org/

Our world in data, 2019: structural transformation and deindustrialization https://ourworldindata.org/

Our World in Data, 2019: economic growth   https://ourworldindata.org/

Our World in Data, 2019: technological progress (https://ourworldindata.org/technological-progress)

Pacey, Arnold, 1990, "Technology in World Civilization: A Thousand-Year History," MIT Press

Patterson, James T., 2010, "Freedom is Not Enough: The Moynihan Report and America's Struggle over Black Family Life from LBJ to Obama," Basic Books

Robinson, Joan, 1954, "The Production Function and the Theory of Capital," Review of Economic Studies, XXI (2), 81-106 (In Sattinger, 2001, Vol III Ch. 19)

Romer, Paul M., 1990, "Endogenous Technological Change," Journal of Political Economy, vol. 98, no. 5, pt. 2

Sabot, Richard H., ed. 1982, Migration and the Labor Market in Developing Countries, Westview

Sachs, Jeffrey D. 2005, "The End of Poverty," The Penguin Press

Sampson, Robert J., and Jeffrey D. Morenoff, 2006, "Durable Inequality: Spatial Dynamics, Social Processes, and the Persistence of Poverty in Chicago Neighborhoods," (in Bowles et al., 2006)

Sattinger, Michael, ed. 2001, "Income Distribution," Edward Elgar Publishing, Cheltenham, UK and Northampton, MA, USA

Schmookler, Jacob, 1976, "Invention and Economic Growth," Harvard University Press, Cambridge and London

Sjaastad, Larry A., 1962. "The Costs and Returns of Human Migration," Journal of Political Economy, Supplement on Investment in Human Beings, 70:5 (part 2), 80-93

Slichter, Sumner H., 1950, "Notes on the Structure of Wages," Review of Economics and Statistics, XXXII (1), 80-91.  (In Sattinger, 2001, Vol II Ch. 14)

Smith, Adam, 1994, (Erwin Cannon, ed.), "An Inquiry into the Nature and Causes of the Wealth of Nations." Random House

Sobel, Michael E., 2006, "Spatial Concentration and Social Stratification: Does the Clustering of Disadvantage "Beget" Bad Outcomes?" in Bowles et al., 2006

Spiegel, Henry William, 1971, "The Growth of Economic Thought," Duke University Press

Streeck, Wolfgang, and Kozo Yamamura, 2001, "The Origins of Nonliberal Capitalism: Germany and Japan in Comparison," Cornell University Press

Temin, Peter, 1971, "General-Equilibrium Models in Economic History," The Journal of Economic History, Vol. 31, No. 1, The Tasks of Economic History, 58-75

Trebous, Madeleine, 1970, "Migration and Development: The Case of Algeria," OECD.

Trostle, Ronald, 2008, "Global Agricultural Supply and Demand: Factors Contributing to the Recent Increase in Food Commodity Prices," USDA.gov

Trostle, Ronald, Daniel Marti, Stacey Rosen, and Paul Westcott, 2011, "Why Have Food Commodity Prices Risen Again?" USDA.gov

U.S. BUREAU OF LABOR STATISTICS, BLS Reports: A profile of the working poor, 2016, July 2018 | Report 1074

USDA, Economic Research Service

USDA: https://www.ers.usda.gov/data-products/commodity-and-food-elasticities/download-the-data/

USDA, Rural America at a Glance, 2018 Edition

Webb, Patrick and Steven Block, 2012, "Support for agriculture during economic transformation: Impacts on poverty and undernutrition," Proc Natl Acad Sci U S A.; 109(31): 12309–12314.

Wilson, W.J., 1987, "The Truly Disadvantaged," Chicago: University of Chicago Press.

Wise, Timothy A., 2014, "The Paradox of Agricultural Subsidies: Measurement Issues, Agricultural Dumping, and Policy Reform," Global Development and Environment Institute, Working Paper No. 04-02

Yap, Lorene L., 1977, "The Attraction of Cities: A Review of the Migration Literature," Journal of Development Economics, 4, 239-264

Yunus, Muhammad, and Alan Jolis, 2007, "Banker to the Poor: The Story of the Grameen Bank," Penguin Books India