WHY U.S. RURAL RESIDENTS MAY HAVE FELT LET DOWN BY LONG RUN ECONOMIC POLICIES

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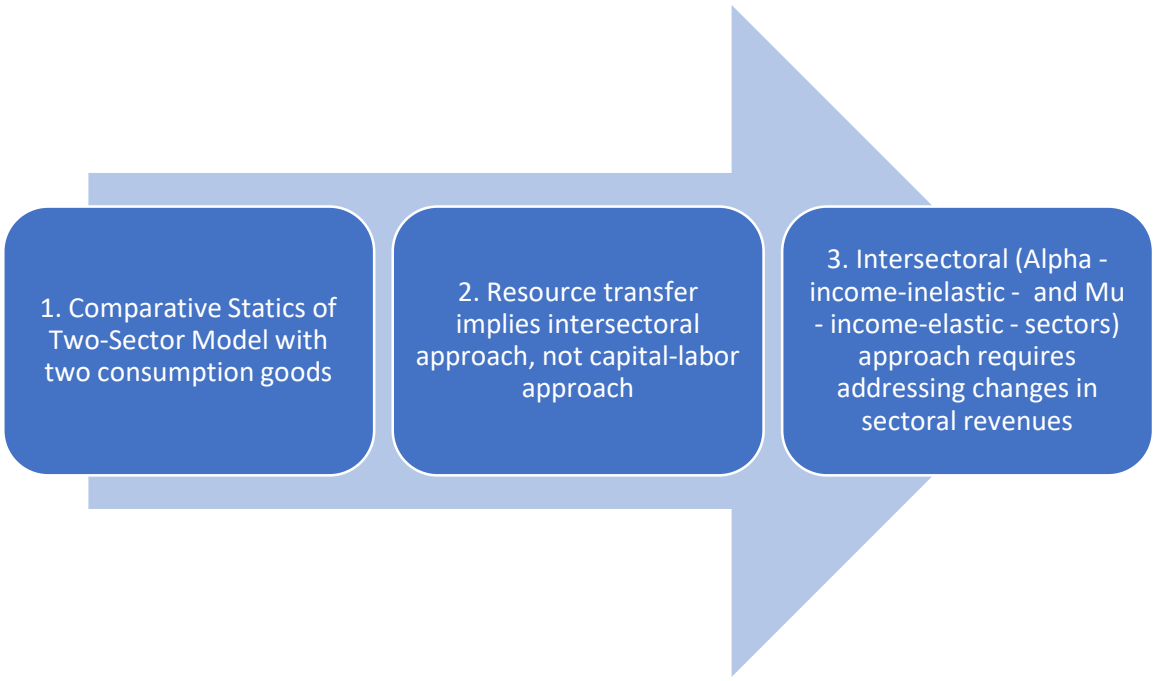
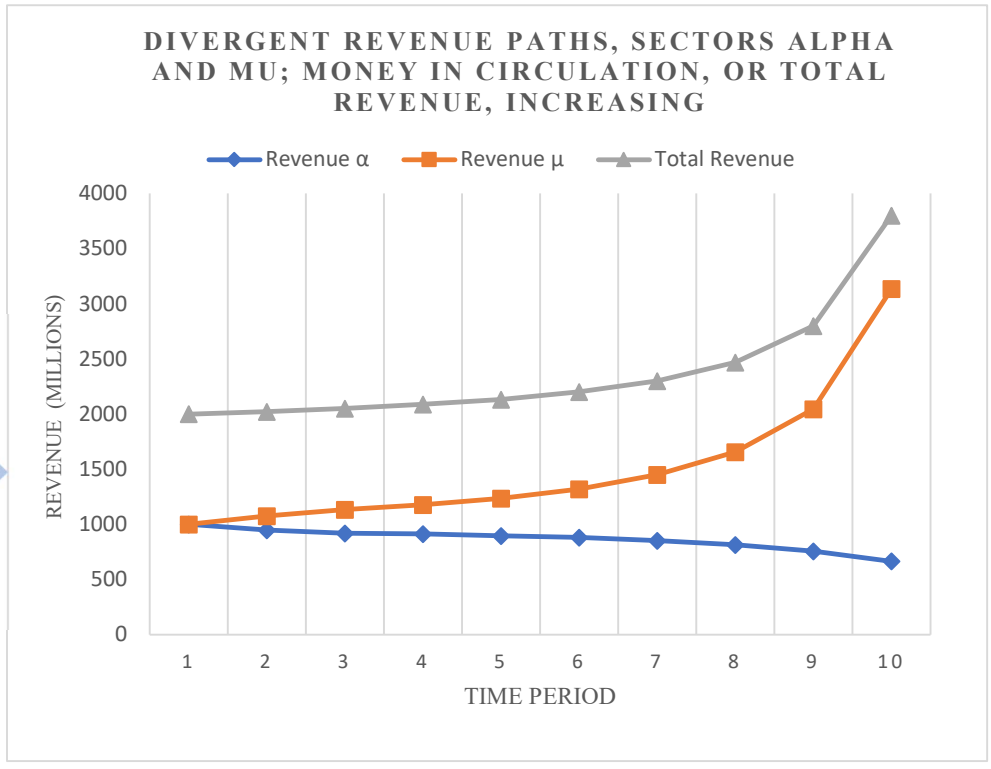
Development of a long run dynamic intersectoral growth model that explains resource-transfer data:



Sectoral revenue growth paths diverge as money in circulation (equals total revenue) increases



in such a way that necessity – income-inelastic demand - sectors (α) lose purchasing power relative to income-elastic demand sectors (μ) and do not benefit from monetary growth.

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ABSTRACT: This paper references a *long run* two-sector growth model of structural change, with two consumption goods, productivity-increase, and efficient markets. This dynamic, growth-focused, sector-focused – rather than factor-focused – departure from the comparative statics of the closed neoclassical two-sector model with productivity-increase explains how agriculture-dependent regions get left behind over the long run. An agricultural sector loses resources, including educated workers, to an advancing sector. We explain why the closed model is appropriate for both international and local markets, and we incorporate money and revenues into our long-run dynamic analysis.

We analyze demand with reference to empirical demand elasticities rather than to theoretical utility functions. We focus on the interactions of technological change with demand elasticities, and their impacts on sectoral revenues, rather than with incomes to different factors of production. Sectoral revenues determine purchasing power, putting sectors with declining revenues at a disadvantage relative to sectors with increasing revenues.

JEL Codes: O41, R10, E0

Keywords: growth, technology, dualism, productivity, jobs, farming, migration

1. INTRODUCTION:

We discuss a two-sector growth model with two consumption goods and productivity-increase. An agricultural sector loses population and resources, including educated workers, to an advancing sector. We show how intersectoral wealth inequities arise and persist. We explore several ways to mitigate intersectoral wealth inequities, including some that are not usually suggested.

The argument is in seven parts – first, a conventional analysis of the comparative statics of the neoclassical two-sector model with two consumption goods and productivity-increase; second, a break with convention, away from analyzing factor incomes (incomes to labour and capital), toward a sectoral analysis of income, in which *it is discovered that the relative price approach, in avoiding the use of money, leaves fundamental issues of actual sectoral incomes and revenues off the table*; third, an exploration of the role of sectoral income, or sectoral revenue, in a two-sector model; fourth, an argument in favor of introducing money into the sectoral analysis; fifth, clarifying notes with further applications of the model and numerical examples; sixth, a summary and conclusions; and seventh, an appendix showing other comparative static results that support the analysis.

2. A NEOCLASSICAL TWO-SECTOR ANALYSIS, WITH PRODUCTIVITY-INCREASE:

In a typical closed neoclassical two-sector model [Johnson, 1973], we can say that the labor-intensive sector represents an agricultural sector, and elasticities of demand for the agricultural good are less than unity (both own-price and income elasticities) [USDA, 2019]. [1] The capital-

intensive sector represents manufactures, and elasticities of demand for the manufactured good (both own-price and income elasticities) are greater than one. (E_d, in the present discussion, represents demand elasticity in general, being the impact of both price and income elasticities.)

Following the conventional analysis of the closed two-sector model with two consumption goods [Johnson, 1973]; other things equal, neutral productivity increase in the agricultural sector (the labor-intensive sector) causes the relative price of the agricultural product, and the relative wage to each unit of labor, to fall ($E_d < 1$). [2]

And, the above-mentioned productivity increase in the labor-intensive sector (agriculture) causes the relative price of the capital-intensive good (manufactures) to rise, the factor payment to capital to rise, and the relative income to each unit of the factor, capital, to rise.

3. THE "SECTORAL INCOME" APPROACH TO THE TWO-SECTOR MODEL:

In order to explore the interactions among sectors, we choose to organize our investigation of incomes by sector, rather than by income to factors (capital and labour).

3.1. Consider now sectoral, rather than factor, income.

Sectoral income (or revenue) is generated from selling the sector's product. We can visualize the whole sector as one large "production-entity," or sector-sized *enterprise* (technical term for business or quasi-business entity), for which total product sales generate total sectoral income, or revenue. Following a productivity-increase in the agricultural sector, we can expect a decline in the relative income (or revenue) of the whole agricultural sector. ($E_d < 1$, and the relative price of agricultural goods has fallen.) This is standard enterprise (business) supply-demand analysis. [Baumol and Blinder, 2000, 124-133].

Similarly, following a productivity-increase in the agricultural sector, we can expect a decline in the total income of the manufacturing sector. ($E_d > 1$, and the relative price of manufactured goods has increased).

Thus, referencing the conventional analysis with regard to sectoral price changes, relative income (or revenue) in both sectors appears to have declined, although productivity in the agricultural sector has increased. Therefore, total income (or revenue) accruing to *both* sectors appears to have declined. It appears to have declined in each of the two sectors and so appears to have declined overall. This is so, even as output has increased in at least one of the two sectors. We would usually expect that the sum of two things that decline would be smaller than the previous sum. Thus, it looks as though total income (revenue) has declined, even as the whole system has become wealthier (more output).

The likely cause of this paradox is the use of relative prices rather than actual prices. Without money and nominal prices in the model, such a paradox is hard to resolve[3]. We elaborate on the matter in the next section, 3.2.

Results are similar for an equivalent thought-experiment when productivity increase occurs in the manufacturing sector, and in both sectors. (See the additional discussion on productivity-increase in the manufacturing sector, in Section 7, Appendix.) When we add two things that have declined, we would expect the total to have declined also. Yet, output has increased, so wealth has increased. What does this conundrum mean, for the distribution of wealth in the real world?

3.2.Money runs to the manufacturing sector; resources follow

In Figure 1, Employment in Agriculture, 1500 to 2000, in Three Advanced Industrial Countries, we see how labor is freed up to leave agricultural employment and participate in manufacturing

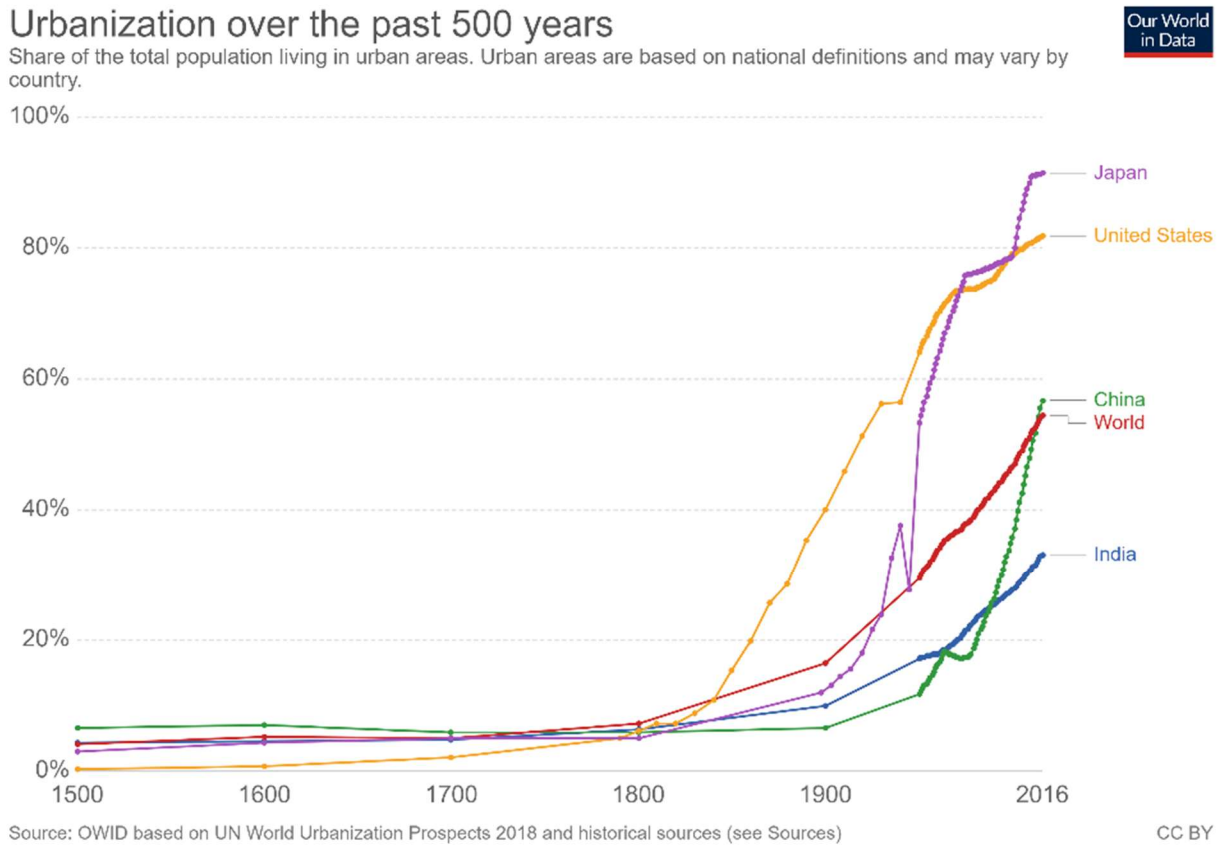
Figure 1: Employment in Agriculture, 1500 to 2000, in Three Advanced Industrial Countries.

Source: Our world in data: employment in agriculture

employment. This has long been believed to be a good result – an agricultural surplus enables technological progress and the pursuit of material comfort. Unfortunately, while inexpensive food is good for consumers, it is perhaps not so good for farmers [Wise, 2004, 20].

Figure 1 suggests that farmers are expected to do more with less money and fewer resources, as time goes by. Sachs [2005, 228-232] offers a specific example for farmers in the Sauri sublocation in Kenya. Figure 2, Urbanization is Global, suggests that farmers all over the world may experience similar challenges, as development proceeds.

Figure 2, Urbanization is Global



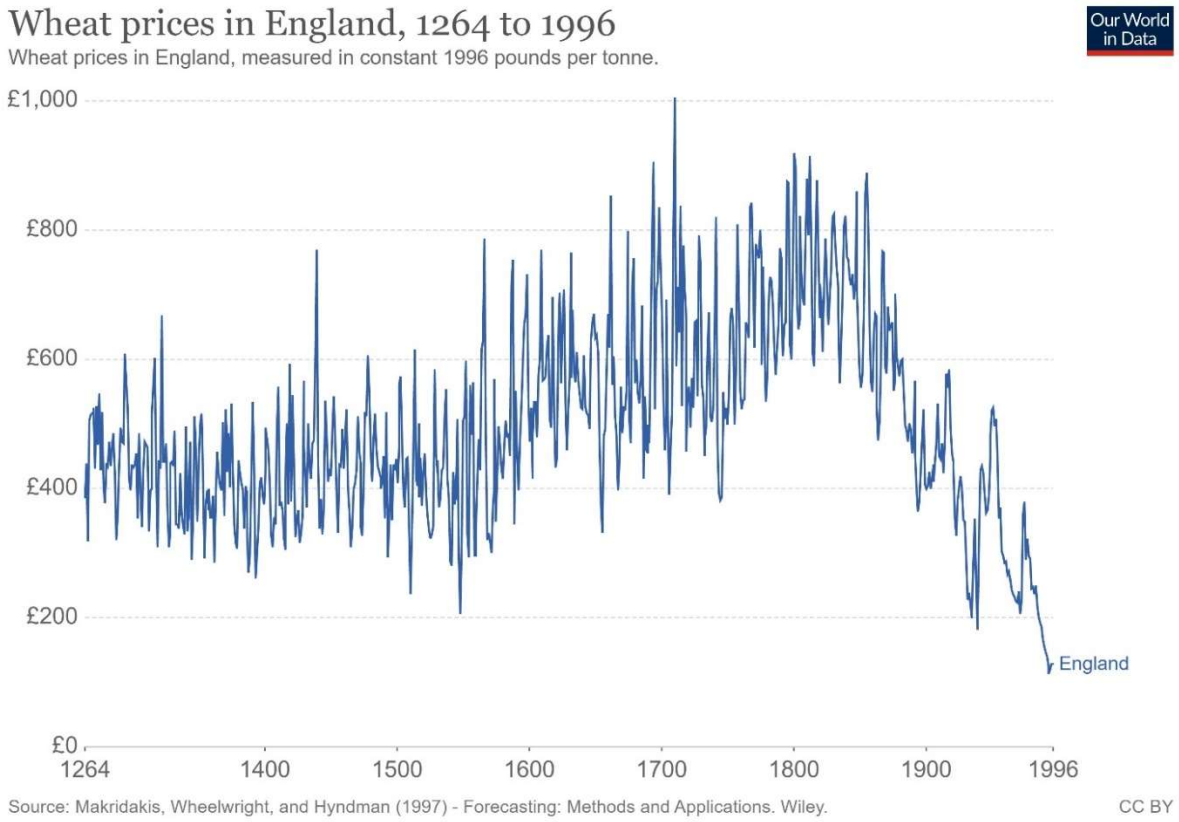
Source: Our World in Data, 2018.

Urbanization increased rapidly, between 1800 and 1900, as the push for economic development and the spread of the industrial society occurred. We can assume that financial dominance of cities and other urban regions came at the expense of rural regions [Lipton, 1980].

If increases in agricultural productivity were associated with constant prices, we could perhaps argue that productivity-increase does not harm farmers. But this is not so. See Figure 3, Wheat Prices in England, 1264 to 1996. Repeal of the Corn Laws in England opened English wheat to competitive international markets and to declining fortunes for rural landowners. The figure

demonstrates that the price of the staple crop, wheat, in England, showed a long-run secular decline around short-term volatility starting around the repeal of the Corn Laws in 1846.

Figure 3: Wheat Prices in England, 1264 to 1996



Source: Our World in Data, 1997.

We appear to be facing, empirically, the closed-economy situation, and we need a way to analyze it in a world of economies open to trade. The sectoral-income approach, different from the factor-income or open-economy approaches, offers one way to do so. For it to work, we need to resolve the relative-price conundrum presented by the conventional two-sector analysis – that is, to include money in our growth model.

In the context of leading-edge industries and their associated networks of resources [Krusell, Ohanian et al., 2000; Aghion and Williamson, 1998, 47; Ewers, 2007; Fujita and Thisse, 2002],

in the closed model, the manufacturing sector and urban regions grow, so that regional income-shares diverge and can continue to do so [Emerson 1992, 71-72; Sachs, 2005, 56, 62, 70; Lal, 2013, 111]. Equilibration does not occur because the forces for divergence run ahead of the forces for convergence [Berger, Ed., 2009].

4. WHY A TWO-CONSUMPTION-GOODS TWO-SECTOR GROWTH MODEL SHOULD INCLUDE MONEY

Let us move from the conventional comparative static analysis, with the above-mentioned conceptual challenges, to a growth model with money. The neoclassical model with comparative-static analysis does not include money, and its prices are relative prices. If the model were to include money, then, as productivity (and output) increases and the same money (holding the money supply constant, for our thought experiment) chases more goods, then the nominal prices of all goods can decline. Relative prices cannot all decline.

Adam Smith [Smith in Heilbroner, 1986, 194] explains how this can happen. "[As productivity advances, with the increasing division of labour,] 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." Thus, to paraphrase Smith, all prices can decline, but some prices change relative to others and may appear to increase.[4]

Figures 1 and 2 suggest that, as sectoral income to farming declines, the money and resources lost are drawn into manufacturing. Again, this has long been believed to be a good thing. The present sectoral approach to the two-sector model challenges this assumption, now that many of the benefits for consumers from low prices for farm commodities have been achieved.

Gale Johnson [1991, 87] points out the importance of Engel's law in agricultural economics and suggests that productivity-increase might send the industry into oblivion if food were not so important a product.

In today's world, the likely cause of productivity-increase is often technological change. Yet, in the early development of economic modeling, the proliferation of scientific knowledge was a relatively small factor. Models initially focused on capital accumulation [Spiegel, 1971]. So, as we update our thinking, we need to understand that scientific and material technological progress is a different phenomenon from Smith's specialization and exchange.[5] The economic impact of scientific and technical knowledge is different from that of specialized workers.

The sectoral analysis in this paper investigates the impact of the "new" engine of growth, technological progress and increases in productivity. Evidence for the importance of technological progress to economic growth is found in Pacey [1990], Chien [2015], Crafts [2003], and Aghion and Williamson [1998]. The idea that capital accumulation is the primary engine of growth has been losing favor for some time [Schmookler 1976, vii].

Increases in productivity are, arguably, the driving force behind long run economic growth and development. It is hard to separate the impact of capital accumulation from that of technological change, because technological change is embodied in each new wave of capital. We suggest here that societal rules promoting innovation have paved the way for *both* capital deepening *and* more technological developments. Therefore, over time, the structure of economic systems has changed significantly, while many models still refer back, conceptually, to general equilibrium theory, marginal analysis, and a capitalist-worker dichotomy.[6]

We address here specifically the role of technological change. Regarding the type and nature of technological change (or the types of knowledge that are developed and spread), Schmookler [1976], in a study of railroad patents in the U.S., shows that the possibility of economic advantage (making money) motivates inventive activities, or the types of knowledge that are created by inventors and patented. Thus, technological change is at least partly demand-driven, not only supply-driven as some economic models imply [Romer, 1990].

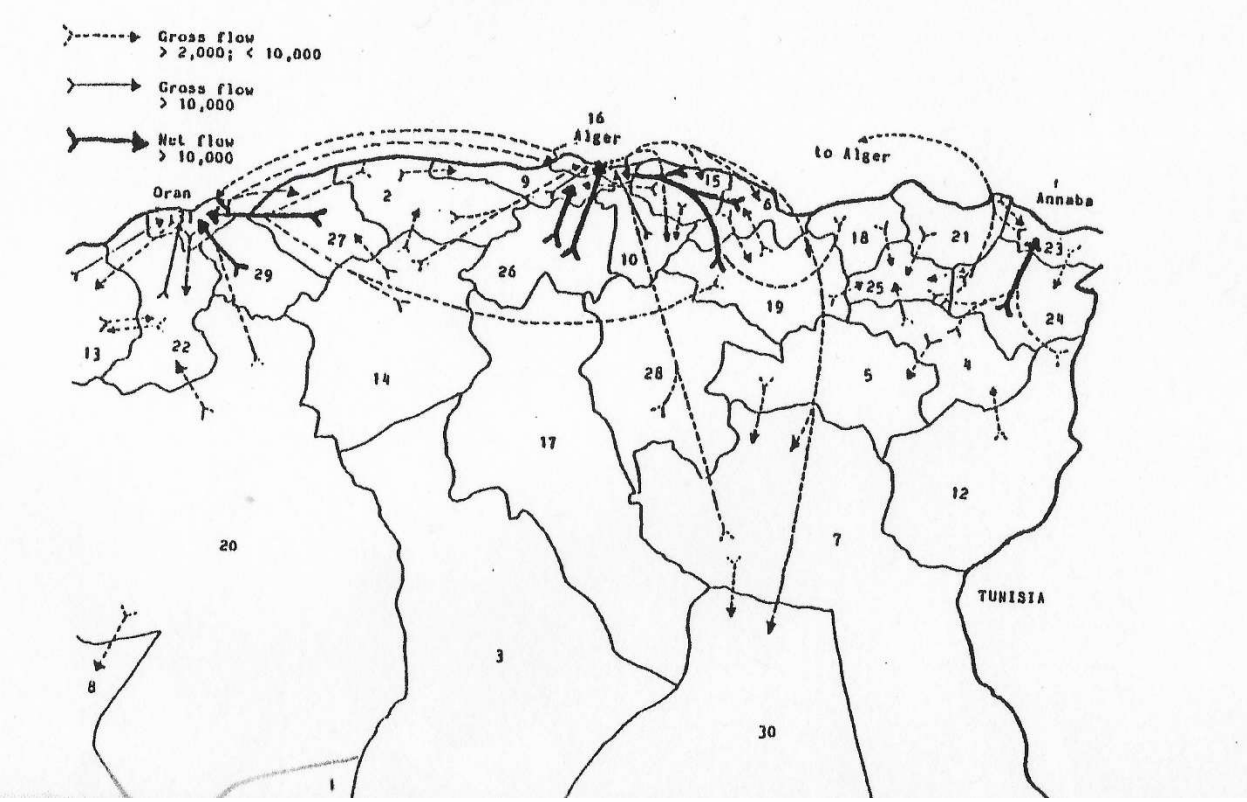
We suggest, here, following Schmookler's empirical assessment of what motivates inventive activity, that there are two main types of inventive activity that lead to economic advantage in the Western free-market or mixed-economy economic system. These are saving money for the business enterprise, and attracting money for the business enterprise. Businesses, such as farms, may be under pressure to conserve resources, or businesses may be free to grow, such as IT businesses. In this paper, we argue that the elasticity of demand for the industry's product has much to do with which type of inventive activity is pursued – saving money, or making money – and with the fortunes of the industry. We follow up on this statement in Section 5, Discussion, below.

5. DISCUSSION

The challenge was to turn the comparative statics of a two-consumption-sector neoclassical model with productivity-increase into a growth model that would explain Emerson's [1992] empirical data, including selectivity of migrant streams. Intersectoral interactions are, of course, of particular interest for the transfer of resources from one sector, or region, to another, including labor transfers such as migration. Figure 4, showing patterns of migration in Algeria, provides information on the volume of migrant streams between administrative districts in Algeria. Note in particular that migrants move from urban regions to urban regions, as well as from rural to

urban regions. This suggests both a lively urban-based economy with jobs opening in several cities, and a resource transfer from rural to urban regions.

Figure 4: Volume of Migration Between Administrative Regions in Algeria, 1966-1977



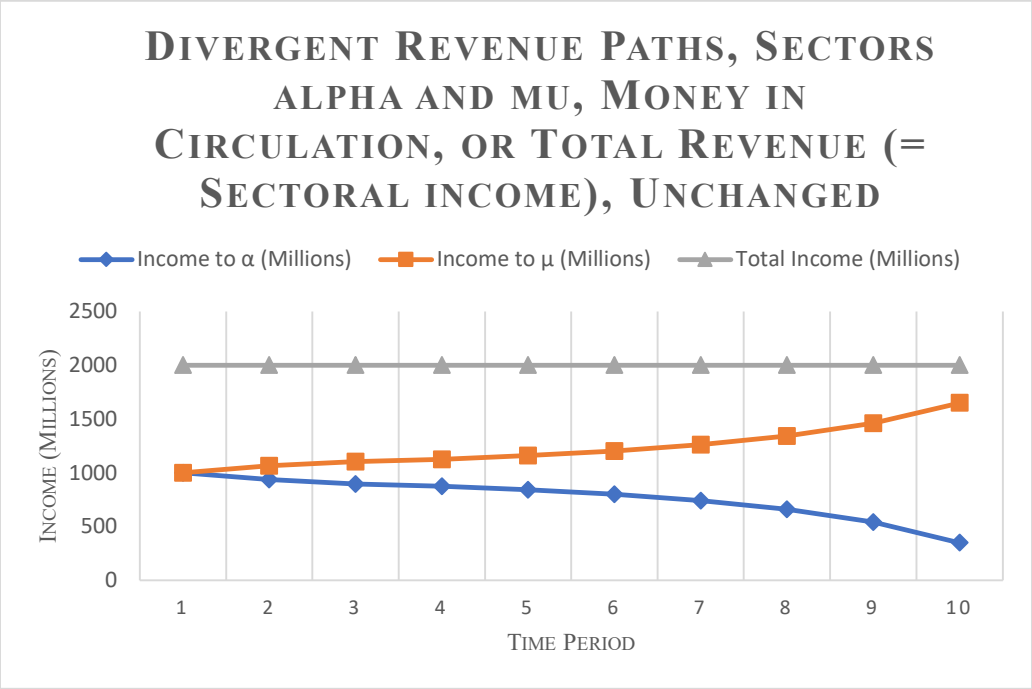
Source: Emerson [1992]. Reprinted with permission.

Migration is deterred from rural regions, suggesting that when the decision to migrate is made, the destination is usually an urban region. This is true for both rural and urban migrants. The exceptions, migration to regions 7 and 30 in the Sahara Desert, involve migrations to oil and gas fields. The question is why this pattern of migration occurs, if, as the migration literature suggests, there is little or no wage-differential across regions for workers of similar socioeconomic status [Dickie and Gerking, 1989; Emerson, 1992, 134; Bellante, 1979; Harris and Sabot, 1982].

As explained in Section 3 above, when referencing the conventional analysis of the two-sector model, unexpected challenges arose from investigating relative sectoral incomes (or revenues) rather than relative factor incomes, as is the custom. We then performed a thought experiment, adding money across two sectors to develop a two-consumption-sectors approach to urbanization and development with productivity-advance, that is consistent with the empirical data.

Numerical examples are offered in Figures 5 and 6, Divergent Revenue Paths; Figure 5 without, and Figure 6 with, increases in the money circulating, or total revenue, shared between the two sectors. The invented data for the examples are offered in Tables 1 and 2 at the end of the paper. The data were invented with declining revenue (inelastic demand) for Sector α, agriculture, and increasing revenue (elastic demand) for Sector μ, everything else; the latter is often simplified to represent a manufacturing sector.

Figure 5: Divergent Revenue Paths, Sectors α and μ, Money in Circulation, or Total Revenue, Unchanging Over Ten Time Periods

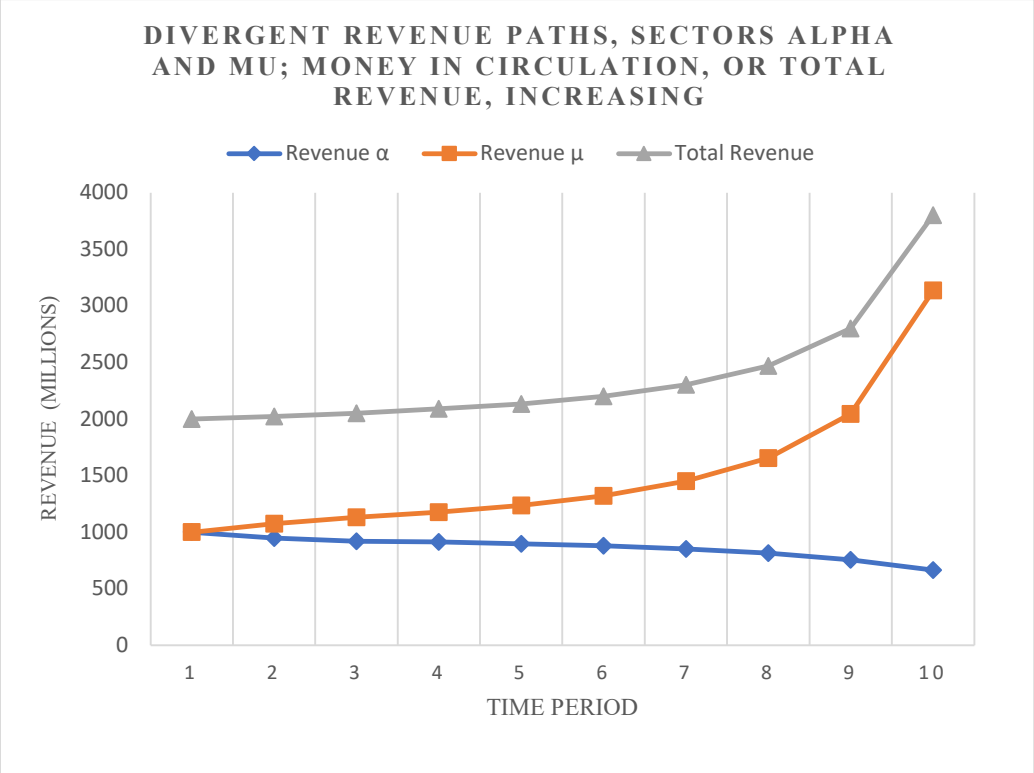


The two sectors share the total money circulating, or Total Revenue in the figures and tables, so that the revenue in Sector α plus the revenue in Sector μ together comprise the total revenue.

In Figure 5, productivity increase, interacting with demand elasticities, is sufficient to generate divergent revenue (or sectoral income) paths, for sectors α (blue diamonds) and μ (orange squares). This financial trajectory for modern advanced economies is not in doubt, as implied by Figure 1. What is new is the shared nature of the money in circulation such that revenue gains in one sector become revenue losses to the other.

Invented data for the figure may be found in Table 2 at the end of the paper. These data meet the requirements for the model, that sector α loses revenues owing to *in*elastic demand, while sector μ gains revenues owing to elastic demand, and both sectors share the total revenue.

Figure 6, Divergent Revenue Paths, Sectors α and μ, Money in Circulation, or Total Revenue, Increasing over Ten Time Periods



In Figure 6, the money in circulation, or total revenue (equals total income) shared by the two sectors, is allowed to increase. Once again, productivity advance interacting with demand conditions is sufficient to produce diverging revenue paths. What is of interest in this figure, as compared to figure 5, is that the divergence appears to be more rapid when the money in circulation increases, than when we held it constant. Needless to say, this result is of interest in view of the consequences of quantitative easing on many advanced economies during the COVID-19 pandemic.

A sectoral approach, in general, can shed light on the following:

5.1.Migrant-Selectivity

We wished to understand both why workers left rural regions for cities, and *also to offer an explanation for selectivity in migrant streams*. Connell et al. [1976] suggest that selectivity of migrant streams is two-fold: poorer migrants experience a wandering search for work, while middle-income migrants receive an education and then an urban job.

The best available basic model consistent with a transfer of labor out of agriculture has been the comparative statics of the closed neoclassical two-sector model with productivity advance. However, this model does not address migrant-selectivity, even as it can explain movement of factors between sectors.

Therefore, in building a growth model around the comparative statics of the closed two-sector model, we must speak to the role of education rather than model it explicitly. *But it is not hard to see that, since the manufacturing sector (by convention, and in the sectoral analysis of section 3.2 above) has been where the money runs, then the kinds of skills needed by that sector – technical education, for example – will proliferate, at the expense of the kinds of skills needed in*

the agricultural sector. Some authors write of "skill-biased technological change" [Acemoglu, Ed., 2004]. This is another way of explaining the same phenomenon. Other authors write of the challenges arising from having applied Western technologies (that is, using the skills learned from a Western technical education) in African economies [Pacey, 1990; Sachs, 2005, 63].

5.2. Urbanization and the Closed Model

Even though many nation states are small open economies, urbanization is a global (world-wide) phenomenon. See figure 2, Urbanization is Global. The reader may picture the many countries on Planet Earth experiencing similar economic changes, in parallel over time, so that the whole global system behaves like one large – albeit complex – multi-sectoral closed model, over time. The closed model delivers impoverishing agricultural growth, or Engel's law.

Johnson [1991] explains the importance of Engel's law for understanding global agricultural economics. He says farming might decline into oblivion if food were not so important a product [Johnson 1991, 87]. Aghion and Williamson [1998, 81] say, "…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." Figure 1, Employment in Agriculture, and Figure 3, Wheat Prices in England, are relevant here also.

We also could argue that an open country economy displays 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 low-income 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]. Probably, one or more of these explanations may be appropriate in one region or another. Yet, the overarching explanation of a low elasticity of

demand (both income-elasticity and price-elasticity) for agricultural commodities also can be expected to play a role in all of these types of situations.

5.3.Lessons for today from the COVID-19 Pandemic

The plight of lower-income workers was highlighted in the early days of the COVID-19 pandemic (summer of 2020). The challenges were reported in the popular media, and include greater exposure to the virus for people working in close, crowded environments; stress on over-extended healthcare workers; and loss of revenues for industries such as restaurants and other hospitality industries.

This paper offers an explanation for the "left-behind" narrative. That is, low-income workers may have had little access to the benefits of sectoral (or regional) wealth that accrue to higher-income workers, especially if affected by the pandemic. Sympathy handouts, including rent relief (not forgiveness) from governments likely ended up in wealthier pockets, as the money was used to pay for groceries and rent, rather than remaining among people experiencing income losses.

The challenges facing low-income workers in the U.S. have now become obscured by data appearing to suggest the opposite of the "left-behind" narrative. (Plentiful jobs, low-income wages rising.) It is time to re-examine the data in a macroeconomic, but sectoral, way. For example, a greater percent increase for low-level wages than for higher wages is not the same as a greater absolute increase.

We need to re-examine the data because too much other evidence implies the existence of poverty traps [Bowles et al., 2006; Lipton, 1980; Lal, 2013; Sachs, 2005, 56, 70], both in the U.S. and in the world. Sachs [2005, 330-1] says "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."

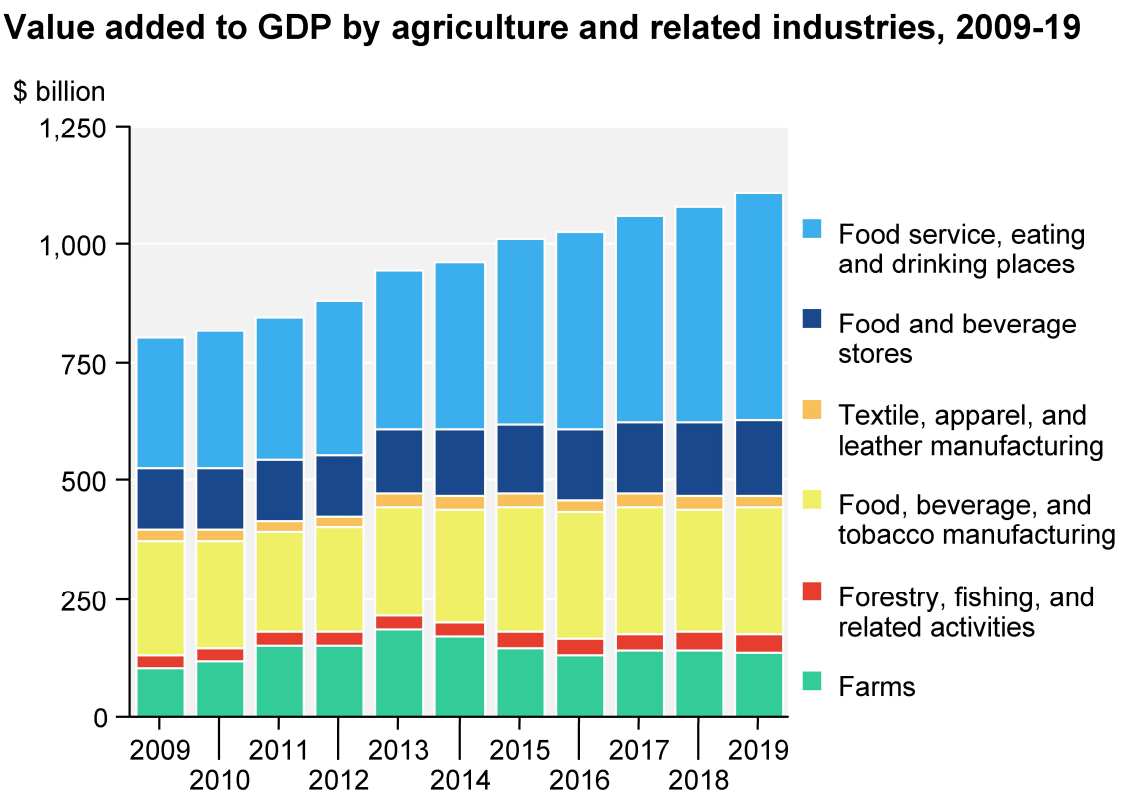
It is here suggested that incentives to innovate and invest have taken our modern societies too far; it is too easy under current laws favoring business inventions – and mistakes are too easily forgiven – to innovate in pursuit of the leading edge, and too hard to do farming, teaching, and the kinds of education or remedial work that require skilled, experienced mentors and teachers, rather than only book-learning.

5.4. Further Discussion – Other Uses of the Sectoral Approach

While a formal sectoral growth model is beyond the scope of the current paper, we can see that a sectoral-income, rather than a factor-income, approach could help analyze the following situations:

5.4.1. Service Sector: We isolated two sectors only, as explained above. Adding a service sector, with its sectoral income, could include the cost disease of services (or Baumol's Cost Disease [Baumol and Blinder, 2000, 279-284]) in the model's explanatory power. See also Figure 7, Value-Added to Farm Sectors, or Agricultural Commodities. The data in the figure suggest that value-added occurs more in the manufacturing aspect of food production than in the agricultural commodity (growing food) business. We suggest that there is little extra money in commodity-production so that services are more likely to serve manufacturing industries, or other advancing industries, than farmers. The farm sector may not benefit from an expanding service sector, with economic growth, the way other sectors do.

Figure 7: Value-Added to Farm Sectors, or Agricultural Commodities



Note: GDP = Gross domestic product.
Source: USDA, Economic Research Service using data from U.S. Department of Commerce, Bureau of Economic Analysis, Value Added by Industry, data as of September 30, 2020.

Source: USDA, Economic Research Service, 2020

5.4.2.Generalized Use of Sectoral Model: Any industry or sector with inelastic demand is likely to suffer loss of labor, including skilled labor, just as agriculture does. We could therefore identify two sectors, called *money-magnet industries* (the financial leading-edge industries, facing elastic demand), and *resource-losing industries* (the financial trailing-edge industries, including agriculture and some skilled labor services, facing inelastic demand).

Arguably, there has been little emphasis on long-run trends for changes in sectoral wealth in neoclassical economic modeling, which favors marginal analysis rather than revenue analysis.

Following this analytical habit, the consequences of intersectoral financial imbalance may not have been adequately addressed by policy-makers. Something like a dual economy could arise in an advanced society because of a lack of focus on systematic long-run changes in market systems.

5.4.3.Today's Challenges: Pursuant to the above, we might perhaps be mistaken to think that bringing back manufacturing would return U.S. heartland regions to wealth. For example, England was an Empire when the Corn Laws were repealed, but the landed gentry lost much of their wealth and power over the following decades. Thus, international trade was bad for the landed gentry, whose incomes depended much on agricultural work and workers.

And, according to the sectoral growth analysis presented here, some types of basic manufacturing today may experience a financial squeeze as IT advances. The new money-magnet industry, as intuited by people in the field, is not manufacturing, but information technology (IT).

That is, manufacturing is likely to suffer from the flight of money and resources into IT, in a similar way to the loss of relative revenue felt by agriculture after the great advance into manufacturing industry in the nineteenth century. Agricultural regions may possibly become even more disadvantaged than they have been before, as money and resources move into manufacturing that serves IT, and into IT itself. Core manufacturing businesses, especially of basic commodities such as steel and mining industries, are likely to experience downward pressure on prices unless collusion is allowed in those industries. Consider, for example, the power of the OPEC oil cartel after the initial collusion leading to the oil-price rise of 1973.

5.4.4.Policy Relevance Today: Both prices, and employment in service industries after massive infusions of money into the global financial system during the COVID-19 pandemic may have behaved in unanticipated ways. The present sectoral analysis with money can explain these phenomena. For example, quantitative easing with fiscal borrowing were designed to encourage investment and keep the economy going, yet much of the money so created was not spent right away. The subsequent inflation was predictable, as economies opened up after the pandemic.

The present analysis suggests that necessity industries would suffer more than luxury industries as a consequence of monetary expansion, and this could explain increasing social discontent, even as the macroeconomy appears to be recovering well, on average. See Figure 6 in section 5 above. This analysis can explain the "Great Resignation," perhaps manifested today as a shortage of staff in many service industries. People are not training for, and are re-training out of, jobs that cannot match the pay in leading edge sectors such as IT, or sales of IT equipment. We may also see discriminatory employment practices designed to keep people in jobs that pay too little.

If, as hinted above, we have something similar to emerging-market dualism in the U.S. or other market systems, possessed of good linkage, it is important to confront and address the matter. Gollin [2014] states that poor linkage is assumed in many models of dualism. Revising this perspective is especially important, if monetary easing designed to benefit leading edge sectors has the unintended consequence of causing increased disadvantage for necessity sectors. This includes, but is not limited to, farming.

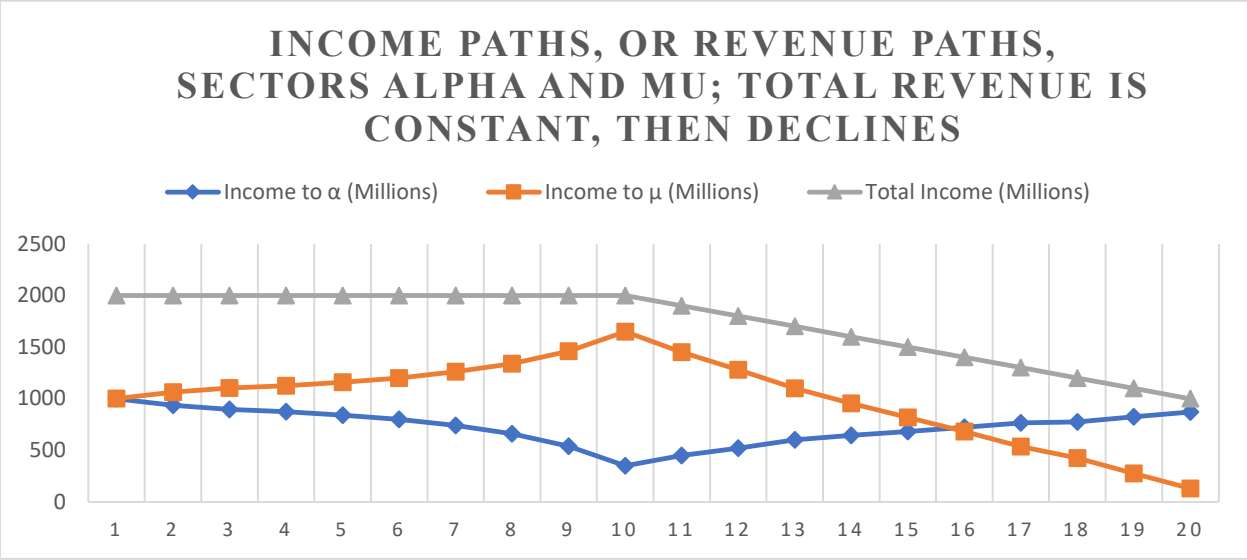
Possible Policy Solutions

5.5.1.Tight Money Might Reverse Dualism: If relative prices (and revenues) change to the disadvantage of agriculture-dependent regions, as productivity-increase with an expanding

money supply occurs, this suggests an unorthodox response of monetary policy – tighten it in a controlled fashion, rather than create more easy money. There is precedent for this idea in the basic analysis of how monetary policy should respond to the business cycle.

We submit that there has been too little reining in of the U.S. economy, when business conditions have improved after a downturn. The cumulative effect of this now necessitates a major correction, and we suggest that doing this deliberately would be better than allowing the conditions for a financial crash to develop. Figure 8 expands the numerical example of Figure 5, adding a declining total revenue, or money in circulation. In the example, revenues to sector α (agriculture) overtake revenues to sector μ (everything else), around time period sixteen. The invented data, meeting the specifications of the model as regards prices, revenues, and demand elasticities, are in Table 2 at the end of the paper.

Figure 8, Diverging then Converging Revenue Paths, Sectors α and μ, Total Revenue first held constant, then decreasing.



The figure suggests that, as technological progress produces more of all goods, income (= revenue) to the sector μ (mu) increases while income (= revenue) to the sector α (alpha) decreases. After time period 10, when we start to reduce the money in circulation (a.k.a. total revenue, shared by both sectors; gray triangles), the relative fortunes of the two sectors reverse. As economic activity slows, α (alpha, farm sector, blue diamonds) gets a larger share of the total revenue, with the cross-over occurring at around time-period 16. People prefer spending on necessity goods, α, rather than on everything else (manufactures or luxury goods). Thus, as output declines, demand bids prices up for both goods, but demand is more robust in α. (Quantities of μ decline more than of α.)

Invented data for Figure 8 are presented in Table 2 at the end of the paper. The data meet the requirements of the analysis in that revenues for the sectors change in accordance with accepted relationships among prices, demand elasticities, and revenues.

In order to reduce the money in circulation, while avoiding manipulating interest rates explicitly with a subsequent disconnect between interest rates and risk, we could change the required reserve ratio instead. This, obviously, requires further debate and discussion.

5.5.2.Investment in Agriculture-Dependent Regions: Alternatively, policy-makers could stop referencing the free market and invest, unabashedly, in agricultural regions. This leads more in the direction of economic planning and requires higher taxes in order to fund the new investments. A downside to this approach is that, absent a reallocation of the wealth accruing to agricultural-region investors, there may *still* be no trickle-down across sectors. Wessel [2021] discusses the complexity surrounding Opportunity Zones (OZs), investment zones developed in hopes of assisting impoverished regions.

We may also see intersectoral inequities in the *same* region, whereas previously, inequities may have been located in separate regions. For example, housing prices have recently increased in attractive rural regions in both the US and the UK, partly because remote work on IT jobs has become feasible.

5.5.3.Selective Application of Anti-Trust Laws: Since price-decline causes challenges for some industries or sectors (resource-losing sectors, per section 5.4.2. above), we could allow collusion in those sectors, at least enough to retain sufficient operating revenues. We would continue to regulate network monopolies in leading-edge sectors (money-magnet sectors) or, if that is not possible owing to their international operations, we could tax the monopoly profits and reallocate them, as suggested by some pro-labor advocates. This, of course, assumes we have an interest in maintaining equity and that so doing will mitigate social discontent.

5.5.4.Encourage people to buy local: If consumers spend money in the local area on a local business, the money is more likely to remain in the local area, and to work in and for the local area. Consumers can be reminded that they are paying for a service as well as for a product. Service is not free, but it may be incorporated into the price of a product. They can be reminded that money paid for products whose parent companies have distribution centers in another state or country will go primarily to enrich people in that other region, rather than in their own state.

5.5.5.International Policies: Currently favored international economic policies seem to be investment in the leading edge – that is, in IT. Under current societal rules and laws, this may maintain the U.S. as a money-magnet economy (as described in Section 5.4.2. above), ahead of its rivals. The question is, is this the most important economic imperative facing the U.S. today? According to the present analysis, such a policy is likely both to distort investment incentives

and to leave farmers and even some manufacturers far behind the financial successes of the IT industry. Trickle-down does not occur, as profits are plowed back into the leading edge.

Regardless of the extent of U.S. success at maintaining global IT leadership, such a policy is likely to perpetuate global rivalries, because many nations believe IT leadership is the path to global dominance. The challenge here may be to bring the populations along, that may be suffering from an advanced-country form of dualism. That is, *dualism* is here explained as sectoral economic wealth inequities caused by policies that encourage innovation and investment at the leading edge; these policies perhaps cost necessity industries (those with inelastic demand, especially income-inelastic demand) a certain level of material comfort, rather than encouraging trickle-down as convention used to suggest.

Protectionism may bring relief from international competition, especially unfair (government-subsidized) competition, but are tariffs the correct answer? Which types of tariffs? What will U.S. trading partners do, if tariffs are placed on many of their goods that they want to sell to the U.S.? We wish to remind readers that much of international trade theory originally developed around Comparative Advantage, rather than Competitive Advantage [Porter, 1998].

We argue that the market may work with policy-makers rather than against them, if they can find the correct policies, including some of those suggested in Section 5.5. above. There is, of course, an underlying subtext that we can only successfully implement certain policies that have a potential global impact, if we can persuade other countries to agree and cooperate. That is, other countries, or other states within the U.S., must implement similar policies, otherwise businesses and consumers will tend to move to the country or state that offers policies most advantageous to them.

If all economic agents compete to attract cutting-edge resources in clusters of money-magnet industries, then losses to resource-losing industries will be the greater, potentially undermining the necessity foundations of a healthy economy and society. Money-magnets and resource-losers were discussed in Section 5.4.2. above.

6. SUMMARY AND CONCLUSIONS

6.1. Summary

A sectoral growth analysis like this one is not found in the growth literature. It highlights behaviors of sectoral incomes during the growth process that are different from conventional two-sector model analysis. The latter, primarily, explores incomes to the factors – capital and labor. An intersectoral analysis, like this one, explores sectoral wealth and non-equilibria, as well as intersectoral resource transfers, including labor migration. To the extent that sectors and regions coincide (agriculture and rural regions, for example), the analysis can also address inter-regional, or spatial, imbalances. Based as it is on detailed inter-regional patterns of migration, but being also quite general as it addresses necessity industries, we believe this approach merits serious consideration.

We might not expect to find emerging-market dualism in an advanced economy such as the U.S., with good linkage. We suggest, here, that a similar phenomenon does indeed occur and the reason is intersectoral (or inter-regional) inequities that are not apparent if we only explore factor incomes or individual incomes. Economists and policy-makers understand that inter-regional differences occur, but addressing them has proven challenging. As mentioned above, Gollin, [2014] indicates that models exploring dualism usually assume poor linkage.

The nature of dualism could be another analytical convention that needs updating under certain conditions. In regions with flexible linkages, something like dualism could arise as a result of decades of income-inelastic demand, not primarily from poor linkage.

For example, with the sectoral approach, we can find good linkage for wages and salaries (that is, similar compensation nationwide, after allowing for differences in costs of living and other costs), economy-wide [Dickie and Gerking, 1989; Emerson, 1992, 134; Bellante, 1979; Kelley and Williamson, 1984, 6; Harris and Sabot, 1982]. Yet, we may *still* miss the impact on individuals of sectoral or regional differences in wealth. Access to the products of greater sectoral, often regional, wealth – such as doctors, hospitals, lawyers, universities, and well-endowed schools and libraries – can be challenging for individuals working in lower-income sectors.

This matters, because the convention is that industries with inelastic demand are necessities, while industries with elastic demand are luxuries. We do not want to encourage the production of luxury goods at the expense of necessity goods. Yet, according to the current intersectoral analysis, that is what our system does. Baumol's cost disease suggests a similar result, but it is harder to model as stated in Baumol and Blinder [2000, 283]: "The cost disease analysis portends a world in which the typical home contains an abundance of goods…But it is a home surrounded by garbage and perhaps by violence…"

6.2. Conclusions

The present two-sector approach to sectoral income (or revenue), can explain why agriculture-dependent regions lose resources, especially highly-skilled educated workers, to the overall growth process; the latter emphasizing, as it does, increasing productivity at the leading edge. As

we update our understanding of economic growth and development, to incorporate the pandemic and post-pandemic world, we could use a similar approach to explore the impact of investments in IT on the rest of the economic system.

The appendix explores other permutations of the comparative statics of the conventional two-sector model with productivity-increase.

7. APPENDIX: CONVENTIONAL TWO-SECTOR ANALYSIS, WITH PRODUCTIVITY ADVANCE IN THE MANUFACTURING SECTOR

This section elaborates on the challenges of conventional reasoning in the comparative statics of the neoclassical two-sector model with productivity-increase.

7.1. Productivity-increase in the manufacturing sector

With neutral productivity increase in the capital-intensive sector, the relative price of the capital-intensive good, the price of capital, and income to each unit of the factor, capital, rise ($E_d > 1$) [Johnson, 1973]. When we consider sectoral income (or revenue), from total sector sales, rather than factor income as in the conventional analysis, we would expect relative income (or revenue) to the manufacturing sector to fall. ($E_d > 1$, and the price of the manufactured good has risen).

Similarly, with neutral productivity-increase in the capital-intensive sector, the relative price of the agricultural good, the wage to labor, and income to each unit of labor, fall. Again, consider sectoral income (or revenue) rather than factor income. Relative income (or revenue) to the agricultural sector should fall ($E_d < 1$ and the price has declined.)

Thus, both sectoral incomes (or revenues) appear, if we take the conventional analysis, to have declined even as productivity in the manufacturing sector increases. This paradoxical result is hard to explain. But, if we include money in our thought-process, we can explain it.

7.2. Productivity-increase in both sectors (manufacturing and agriculture)

Moreover, we can expand the reasoning to show that, if productivity increases in both sectors, the conventional analysis will give a similar result. That is, if productivity increases in both sectors, the conventional analysis will require that product-prices (and therefore the corresponding factor-prices) either change or remain the same. The phenomenon of relative *sectoral incomes (or revenues) that change, over the long run,* in step with their elasticities of demand as output increases, will lie under the radar of this conventional relative-price analysis. That is, in this latter situation, a one-time exploration of productivity-advance, with subsequent changes in relative prices, will miss the long-run trend of declining revenues (incomes) to the necessity sector as a whole.

The long-run global impact of the closed-model outcome may not be explored in much of the literature, because analysts sometimes assume that nation-states are open economies and world prices are exogenous [Kelley and Williamson, 1984]. Therefore, the long-run impact of ongoing sectoral (and systemic) price declines and resource-loss have not found their way into the mainstream, to be explored in a two-sector (rather than capital-labour) context. To repeat, some two-sector teachings in economics may imply that a one-time advance in productivity has a one-time impact, without sufficient consideration given to an ongoing tendency for the same type of productivity-increase to distort market prices across the board.

For example, ongoing skill-biased technological change in favor of standardized luxury goods that can be widely marketed globally (such as smartphones), caused by market forces as explained in this paper, will lead to market prices being too low for the kinds of knowledge that are local and specific, such as farm knowledge and personal services.

That is, these market prices are too low in that they do not sustain a healthy industry or sector without non-market intervention. We, here, refer to prices as they represent Smith's value in use, rather than value in exchange, which is what the market price gives us.

7.3. Summary of comparative static analyses for the manufacturing sector

As in the case of productivity advance in agriculture, relative incomes (or revenues) in both sectors appear to decline when productivity in the manufacturing sector increases. We would expect that the sum of the two sectors' lower incomes would lead to a decline in total income, or revenue. Yet, the system as a whole has become wealthier – more output overall. Without money in the model, this paradoxical result is hard to explain.

And, when productivity increases in both sectors, the above-mentioned results in each sector also lead to an appearance of declining income (because relative income appears to decline in one or both sectors, as above) overall.

The present sectoral-growth approach investigates, instead, productivity advance as it interacts with the intersectoral transfer of money and resources over time. We also suggest that consumer demand has a major role in directing technological change.

The present analysis implies that – whatever happens to relative prices – if output increases in one sector or the other, or in both, there will be a shift of sectoral emphasis, via elasticity responses, in favor of increasing revenues to the manufacturing sector. We have developed a

formal two-sector growth model which offers a candidate for at what point in the development process this shift of sectoral emphasis, or take-off, begins. The formal model is beyond the scope of the current introductory paper.

ENDNOTES:

1. The USDA website: https://www.ers.usda.gov/data-products/commodity-and-food-elasticities/download-the-data/ provided the following Excel file: demandelasdata092507_1_

4/16/2019 was the download date. It had been last updated 2006. Of all the estimations in the above-mentioned USDA database, for own-price and income elasticities, respectively, a high proportion were inelastic. The results, for the empirical measures of elasticities are as follows:

Own-price elasticities of demand. For own-price elasticities of demand, of 2803 estimations of own-price elasticity for various agricultural commodities, 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 commodities, 1010 are in the inelastic range (between 0 and 1). This is 94.92% of the total (1064).

2. 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 (or revenue) to the sector will also fall, because the factor-price fell, (and the product price fell), if the conventional analysis applies ($E_d < 1$). Similarly, when the price of a product rises, if the elasticity of demand for the product is greater than one, the relative sectoral income (or revenue) will fall, because the factor-price rose, (and the product price rose), if the conventional analysis applies ($E_d > 1$).

3. The enterprise-focused impact of demand elasticity on enterprise income (or revenue) may be discussed without stating specifically whether the prices are real or nominal, but it is not usually suggested that the prices in question are relative prices. [Baumol and Blinder, 2000, 121-126]

4. Smith also speaks of the difference between value in use and value in exchange [Smith, 1994, 31]. He is familiar with how changes in productivity can cause changes in the value in exchange.

5. If we exchange an apple for an orange, we still have one person each with one apple and one orange, but if we exchange two ideas, we now have two people with two ideas each. This alters the way in which the economy values ideas and the products of ideas. Do we want the ideas currently dominating? Have we lost some other ideas, in particular the kinds that are learned from people, not books, as human skills become more expensive relative to machine skills and book-learning? Consider also Baumol's cost disease [Baumol and Blinder, 2000, 279-283].

Regarding the difference between "specialization and exchange" [Smith, 1994; Heilbroner, 1987] and "technological change," [Chien, 2015] we note that, with specialization we get worker efficiency, whereas with technological change, we get shared knowledge. As shown above, once an item has been invented, we can share the knowledge without losing it.

6. 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 reasoning of the "endogenous growth" literature applies more to the supply-side in 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.

Table 1. Data for Figure 6: Demand for Outputs of Both Sectors, Total Revenue increasing

	Alpha			Mu			
Period	**Quantity (Millions)**	**Price**	**Revenue (Millions)**	**Quantity (Millions)**	**Price**	**Revenue (Millions)**	**Total Revenue (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 1: the relationships among time period, quantity demanded, price, and revenues, for both sectors as productivity increases, Money in Circulation, or Total Revenues, also increasing

Table 2 – Data for Figures 5 and 8: Revenue to α, μ, and both; money circulating, or total revenue, is constant and then declines after Time Period 10

Income to α (Millions)	Income to μ (Millions)	Total Income or Revenue (Millions)	Quantity of α (Millions)	Price of α	Quantity of μ (Millions)	Price of μ	Time Period
1000	1000	2000	100	10	100	10	1
936	1064	2000	104	9	118	9	2
896	1104	2000	112	8	138	8	3
875	1125	2000	125	7	161	7	4
840	1160	2000	140	6	193	6	5
800	1200	2000	160	5	240	5	6
740	1260	2000	185	4	315	4	7
660	1340	2000	220	3	447	3	8
540	1460	2000	270	2	730	2	9
350	1650	2000	350	1	1650	1	10
450	1450	1900	300	1.5	967	1.5	11
520	1280	1800	260	2	640	2	12
600	1100	1700	240	2.5	440	2.5	13
645	955	1600	215	3	318	3	14
682.5	817.5	1500	195	3.5	234	3.5	15
720	680	1400	180	4	170	4	16
765	535	1300	170	4.5	119	4.5	17

775	**425**	**1200**	**155**	**5**	**85**	**5**	**18**
825	**275**	**1100**	**150**	**5.5**	**50**	**5.5**	**19**
870	**130**	**1000**	**145**	**6**	**22**	**6**	**20**

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