

Abstract: Structural change is a complex, intertwined phenomenon, not only because economic growth brings about complementary changes in various aspects of the economy, such as the sector compositions of output and employment, organization of industry, etc., but also these changes in turn affect the growth process. Using a simple two-sector model, we highlight some driving forces behind structural change, attempt to convey the complexity of the phenomenon and identify some key issues discussed in the literature.

Structural Change

Structural change can occur as consequences of significant shocks, such as plagues, wars, revolutions, the discovery of a continent, and major technological advances. Here, however, we confine ourselves with the structural change experienced by an economy over the course of its development. It is a complex, intertwined phenomenon, not only because economic growth brings about complementary changes in various aspects of the economy, such as the sector compositions of output and employment, organization of the industry, financial system, income and wealth distribution, demography, political institutions, and even the society's value system, but also because these changes can in turn affect the growth processes.

Earlier work on the subject attempted to establish some stylized facts, i.e., the patterns of development followed by most countries. Among the most well-known are Fisher (1939), Clark (1940), Kuznets (1966) and Chenery and Syrquin (1975), who postulated that, as the economy grows, the production shifts from the primary (agriculture, fishing, forestry, mining) to the secondary (manufacturing and construction) to the tertiary sector (services). Also notable is Rostow (1960), who argued that the economy passes through various stages of development from the traditional stage to the take-off stage to the mass consumption stage. This literature is mostly descriptive, trying to provide a sweeping overview of the development process, with the emphasis on the multifaceted nature of structural change.

In contrast, recent work tends to be more analytical, using formal models designed to focus on a few specific aspects of structural change. There is also an increasing awareness that the two-way causality between economic growth and structural change can provide possible explanations for development failures.

From the Rural Agricultural Society to the Urban Industrial Society;

Structural Change Caused by Exogenous Productivity Growth:

To illustrate some driving forces behind structural change, consider a simple two-sector model, adopted from Matsuyama (1992). The j -th sector ($j = 1, 2$) produces its output with $Y_j = A_j F_j(n_j)$, where A_j is TFP, and F_j is an increasing, concave production function, and n_j is the employment share, with $n_1 + n_2 = 1$. Consumers have Stone-Geary preferences, $U(C_1, C_2) = \beta \log(C_1 - \gamma) + \log(C_2)$ with $\gamma > 0$. In competitive equilibrium, the marginal values of labor in the two sectors are equalized;

$$(1) \quad A_1 F_1'(n) = p A_2 F_2'(1-n),$$

where p is the relative price of good 2 and $n = n_1 = 1 - n_2$ is the first sector's employment share. Since the consumer demand satisfies $C_1 = \gamma + (\beta p) C_2$, the goods market equilibrium (in the closed economy) is given by $A_1 F_1(n) = \gamma + A_2 F_2(1-n)(\beta p)$. Combining the two conditions yields

$$(2) \quad F_1(n) - \beta F_2(1-n) F_1'(n) / F_2'(1-n) = \gamma / A_1,$$

which implicitly defines n as a decreasing function of A_1 , $n = N(A_1)$. By interpreting the first sector as agriculture, and the second as industry, this offers one explanation for the transformation from the decline of agriculture and the rise in industry; Engel's Law. Because the demand for agricultural goods has lower income elasticity than the demand for manufacturing goods, agricultural productivity growth helps to release labor for industry. This mechanism plays an important role in e.g., Murphy, Shleifer, Vishny

(1989), Matsuyama (1992, Section 2), Laitner (2000), Caselli and Coleman (2001), Gollin, Parente, and Rogerson (2002).

The above argument suggests that productivity gains in agriculture push the workers out of agriculture. There is entirely the opposite view that productivity gains in industry pull the workers out of agriculture. To capture this view, let us change the consumer's preferences to $U(C_1, C_2) = C_1 + pC_2$. One interpretation is that the economy has the two different techniques to produce a single consumption good. The first is traditional, land-based, craft production, and the second is modern, capitalistic, manufacturing. In this case, eq.(1) alone determines the equilibrium allocation, which means that n increases with A_1/A_2 . Thus, faster productivity growth in the modern sector (or relative stagnation in the traditional sector) induces more workers to abandon the traditional sector. This captures in essence the structural change mechanism envisioned by Lewis (1954) and many others. See Hansen and Prescott (2002) for a recent neoclassical treatment. Alternatively, this case can be interpreted as the case of a small open economy, where the two sectors, agriculture and industry, produce different goods, but the relative price p is determined exogenously in the world market. Then, a higher A_1/A_2 increases n , by shifting the country's comparative advantage toward agriculture, contrary to what Engel's law suggests.

Productivity Growth Caused by Structural Change:

Let us introduce some dynamics into the above model by making TFP of the second sector endogenous. More specifically, let $A_{2t} = A(Q_t)$, where A is an increasing function, and Q_t is the stock of the experience accumulated in the second sector through learning-by-doing, and follows the law of motion, $dQ_t/dt = H(1-n_t)$, where H is an increasing function with $H(1-n_c) = 0$. This captures the idea that, with a higher employment, the firms in the second sector can learn faster, but without a critical mass of employment, $1-n_c$, productivity declines. Let us also assume that learning-by-doing is external, so that the firms take A_{2t} as given when choosing their level of employment. For simplicity, A_1 is assumed to be exogenous and constant.

Then, the equilibrium condition in the closed economy is given by eq. (2) at any t , so that $n_t = N(A_1)$ and $dQ_t/dt = H(1-N(A_1))$, which is increasing in A_1 . In other words, a higher A_1 , by releasing labor from the first sector, leads to faster productivity growth in the second sector. This captures a version of "the staple theory of growth" (Watkins 1963), which argues that a productive primary sector triggers the growth of the industry. In a small open economy, however, the equilibrium condition is $A_1 F_1'(n_t) = pA(Q_t)F_2'(1-n_t)$, which suggests that a higher A_1 implies a higher n_t for any level of Q_t . For $A_1 < pA(Q_t)F_2'(1-n_c)/F_1'(n_c)$, $n_t < n_c$ and hence $H(1-n_t) > 0$, which leads to productivity growth in industry and a steady decline in n_t . For $A_1 > pA(Q_t)F_2'(1-n_c)/F_1'(n_c)$, $n_t > n_c$ and hence $H(1-n_t) < 0$, which leads to a productivity decline in industry and a steady increase in n_t . This suggests the so-called "staple trap," or "resource curse," the situation where the abundance of natural resources prevents the country from growing. Indeed, even a temporary boom in the resource sector could lead to a permanent decline in industry, the so-called "Dutch Disease." See Matsuyama (1992, Section 3) for more detailed analysis.

Impediments to Structural Change

The above analysis assumes perfect labor mobility across sectors, equating the marginal value of labor instantly. Many studies have modeled various impediments that slow down the reallocation of labor. In the Lewis (1954) model, the workers earn the average (not marginal) value of labor in the traditional sector, which causes its overemployment. In the Harris-Todaro (1970) model, moving to the urban area is necessary but not sufficient to find a high wage job in the modern sector, which leads to the urban-rural wage gap, offset by the risk of unemployment in the urban area. In Matsuyama (1992), only the young can migrate to the urban sector. In Banerjee and Newman (1998), credit constraints prevent some workers from moving. In Caselli and Coleman (2001) and Lucas (2004), the frictions come from the need to acquire skill or accumulate human capital. These models have implications that a reduction in such frictions accelerates structural change.

The Circular Causality between Productivity Growth and Structural Change

Even without any frictions, structural change and development may fail to materialize due to the circular causality. As pointed out above, productivity growth can cause structural change, which in turn leads to further growth in productivity. The circular causality, however, is a double-edged sword, as the lack of

productivity growth and the lack of structural change can reinforce each other, creating the vicious cycle of poverty. To illustrate this point, let us go back to a version of the above model, where the economy has the traditional and modern sectors, both producing the perfectly substitutable goods, so that the equilibrium is given solely by eq. (1). Now, modify it by assuming that the modern sector is subject to economies of scale, so that its TFP increases with its employment share, as $A_2 = A(1-n)$. For simplicity, let us assume that a higher productivity is entirely due to external economies so that the firms take A_2 as given, when choosing their level of employment. Then, the equilibrium is given by $A_1F_1'(n) = pA(1-n)F_2'(1-n)$. This could generate multiple equilibria, each corresponding to a different level of development, as shown in Figure. One of them, E, may be viewed as the state of underdevelopment, where the modern sector cannot attract much workers due to low productivity, hence it cannot take advantage of the scale economies, implying low productivity. Yet, there is another equilibrium, E', characterized by high productivity and high employment share of the modern sector. A move from E to E' implies both productivity growth and a change in the sectoral composition, generating the same observations as models of structural change with exogenous productivity growth, but, in this model, the causality goes in both directions.

The notion of underdevelopment as a low-level equilibrium generates many conceptual and methodological issues, which are poorly understood. These issues are discussed at length in Matsuyama (1991, 1995, 1997). There are also significant misunderstandings regarding its policy implications; see Matsuyama (1996a).

Other Aspects of Structural Change:

The transformation from the rural agricultural society to the urban industrial society is just one of many aspects of structural change discussed in the literature. Due to the space constraints, we mention just two.

From Old to New Industries:

The compositions of output and employment change also within the manufacturing sector. Economic growth requires a continuous shift from one industry to another, as the existing industries become older and new industries are born. Several authors have studied how the economy may succeed or fail in such structural change. The key issue is whether productivity gains in one industry help or hinder growth in the next industry. See, e.g., Stokey (1988), Lucas (1993), Matsuyama (2002), Föllmi and Zweimüller (2004).

Increasing Product Diversity and Specialization:

Productivity growth is often associated with a greater indirectness of production, as many advanced technologies require a wide variety of highly specialized inputs and services. In poor countries, the lack of local support industries forces the use of relatively simple production methods in downstream industries, which in turn implies a small market size for specialized inputs, which prevents a network of support industries from springing up in the economy. In contrast, rich countries are characterized by a network of highly specialized firms producing a wide range of products. This aspect of structural change, discussed by Young (1928), has been formalized by Romer (1987), Ciccone and Matsuyama (1996), Fafchamps and Helms (1996), Rodriguez-Clare (1996), among others. For surveys, see Matsuyama (1995, 1997). See also Saint-Paul (1992) and Acemoglu and Zilibotti (1997), who use similar arguments to model the interaction between the development of financial markets and economic growth, thereby capturing some of the issues discussed by Gurley and Shaw (1955).

Final Remark:

The majority of the existing studies on structural change, whether descriptive or theoretical, examines the experience of a country in isolation, and fails to take into account the interactions between countries. This can be misleading. (Recall that, in the above model, productivity gains in agriculture can have opposite implications on sector compositions in the closed and small open economy cases.) Of course, some notable exceptions exist; e.g., Brezis, Krugman, and Tsiddon (1993), Krugman and Venables (1995), Matsuyama (1992, 1996b, 1998), Puga and Venables (1996), Fafchamps (1997). However, more

research will be needed in this area. The central question is whether structural change in one country will slow down or speed up structural change in other countries.

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