

Lewis Two-Sector Growth Model

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This post, second in a five-part series on GEM contributions to growth theory, features Sir Arthur Lewis's celebrated two-sector model that turns out to be a comfortable fit with the Project's marketplace-workplace general-equilibrium macroeconomics. Once endowed with generalized-exchange microfoundations, Sir Arthur's analysis provides a coherent, continuous-equilibrium framework that uniquely accommodates evidence-consistent trend and cyclical behavior in employment, output, and income for low- and high-income economies.

Original model. Lewis's growth theory (1954, 1958) quickly became the benchmark analysis of the transformation of subsistence economies, for which he was awarded an early (1979) Nobel Prize. His model is best understood as a prescient special-case version of the Project's economic-venue analysis. What follows is a brief, more formal restatement of his descriptive model, an exercise simplified by his assumption of venue-specific job and labor homogeneity. Also, workers cannot borrow or save. Each of the two sets of homogeneous production functions is defined for a given state of technical knowledge. Equilibrium is understood in the modern sense of a rest period in the space of optimizing decision rules. (For elaboration, see the website's e-book, chapter 3.)

Two-sector technical heterogeneity mandates separate labor-pricing processes. Rational behavior in each venue is governed by distinct decision rules, constraints, and mechanisms of exchange. Lewis heterogeneities, like those featured in the more general GEM model class, prevent meaningful aggregation. Gustav Ranis aptly named Lewis's approach "organizational dualism".

Lewis identifies the low-productivity sector as subsistence agriculture and its high-productivity counterpart as an industrial enclave. The former is characterized by small production units, primitive production techniques, and the absence of input specificities, all captured by positing near-subsistence productivity and the absence of saving and capital accumulation. Low-productivity farming produces total real output X_S : $X_S(t) = b^S H_S(t)$, where S stands for the subsistence sector, b^S is constant labor productivity, and H_S denotes labor supply. Product pricing (P^S) is also constant.

Lewis posited, in the subsistence sector, marginal labor productivity to be zero and market institutions to be poorly developed. In place of the market, labor compensation and employment are determined by equity-based income-sharing arrangements: $W_S(t) = X_S(t)/H_S(t)$. H_S is exogenously influenced by subsistence-sector population growth. The real wage (W_S) also varies as a result of exogenous factors, such as weather and disease. The core macrodynamics here, focusing on the interaction between labor productivity and the preference to procreate, have been provided by Malthus. The high-productivity venue exploits input specialization and scale, generating total real output X_I : $X_I(t) = b^I(t) H_I(t)$, such that $b^I > b^S$, where I indicates the industrial venue and b^I is the sector's labor-productivity, assumed to be constant along with the product price (P^I , used below) and the labor-capital ratio.

Within his two-sector framework, Lewis constructed macrodynamics for saving, investment, and sectoral labor transfer that insightfully explains the process of economies breaking out of subsistence. Profits are posited to be the source of all saving, which is wholly invested in capital accumulation: $\Delta K_I(t) = \Pi_I(t-1) = P^I X_I(t-1) - W^I H_I(t-1)$, and $\Delta K_I(t)/K_I(t-1) = \Pi_I(t-1)/K_I(t-1)$. There is no depreciation, and the capital price is constant. It follows that the rate of growth of the homogeneous capital stock equals the rate of return on capital.

Reflecting Leibenstein and Stiglitz's antecedent work on efficiency wages, it is posited (although not explicitly by Lewis) that labor productivity is sufficiently increasing in nutrition and health, which in turn are increasing in the real wage paid, to motivate the rational payment of constant labor rents. The wage premium and (point-of-hire) labor homogeneity imply a horizontal labor supply for industrial establishments. Absorption of workers from subsistence farming is determined, given the constant capital-labor ratio, by the intertemporal path of the capital stock: $\Delta H_I(t)/H_I(t-1) = \Delta K_I(t)/K_I(t-1) = k(t) = \Pi_I(t-1)/K_I(t-1)$. The final source of dynamics in the Lewis model is total labor-force (H_T) growth, assumed to be a positive constant, c : $H_T(t) = (1+c)H_T(t-1)$.

An initial condition of Lewis's macrodynamics is that $H_I(0)/H_T(0)$ is near zero. A turning point will eventually be reached iff: $\Pi_I/K_I > c$. In Lewis's *turning-point hypothesis*, once surplus workers have exited the subsistence sector, market forces assert control of all labor pricing. Homogeneous wage determination signals the economy's consolidation into a single (market) venue. Lewis had little interest in post turning-point

macrodynamics, believing that in such circumstances his two-sector model was no longer useful.

Generalizing the model. GEM Project innovations permit a richer specification of Lewis's large-establishment, high-productivity venue: $X_j(t) = b_j(t)Z_j(t)H_j(t)$, such that $Z_j = E_j/H_j = Z_j^n$ and $W_j = W_j^n > W^m$. The variable $b_j = X_j/E_j$ denotes the j th sector's technical efficiency of labor. (See last week's post.) Worker productivity rises over time as a result of physical and human capital accumulation, scale economies, and technological advance. Meanwhile, production in the low-productivity, effective-labor-supervision venue is: $X_k(t) = b_k(t)H_k(t)$, such that $Z_k = E_k/H_k$, $Z_k = Z_k^m$ and $W_k = W^m$. Output per worker hour is denoted by b_k , moving in lockstep with technically-efficient labor productivity (X_k/E_k). The assumption of constant capital-intensity and technology in the K th venue simplifies the analysis.

Rational workplace exchange extends the relevance of high-productivity-venue wage rents beyond Lewis's turning point, implying that labor supply to that venue continues to be elastic. Chronic rents also imply a persisting venue productivity differential. Most critically, generalizing the Lewis model significantly enriches the turning point. Once surplus workers have been eliminated in the subsistence sector, implying the introduction of more robust labor-transfer opportunity costs, market forces replace the underdeveloped market institutions, asserting control over labor pricing in K th-venue establishments. Nonmarket labor pricing, minimizing unit labor costs, persists in J th-venue firms. Post-turning-point economies, with optimizing Z_j playing a crucial role, rationally generate downward rigid nominal wage over the stationary business cycle. Nominal-demand disturbances now play the central role in macro instability, combining with meaningful wage rigidity to induce job-loss dynamics that are consistent with the evidence on high- and low-frequency employment fluctuations. Such instability motivates rational two-way labor transfer between the two venues, still along the lines modeled by Harris and Todaro. Meanwhile, trend aggregate labor-productivity and living-standard advance continues to depend on technical change, capital accumulation, and one-way labor transfer to the high-productivity venue. The generalized Lewis model is a uniquely powerful platform for macrodynamic analysis. That it is ignored in the mainstream macro academy is unacceptable.

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