Structural Change and Development

- Basic and Augmented Solow Growth Model;
- Convergence;
- Growth Regression;
- The Interaction between Rural and Urban Sectors (Lewis Model);
- Urban Informal Sector and Migration (The Harris-Todaro Model);
Solow Growth Model

Relates differences in per-capita income and long run growth of counties to their savings rate, labor force growth rate, and technical progress.

Analyzes a mechanism (growth process) through which countries grow over time (convergence).

**Key Concepts:** Steady State, Convergence, Total Factor Productivity (TFP)
Solow Growth Model

Solow Growth Model With No Technical Progress: Assumptions

- Constant returns to scale production technology, \( Y = F(K, L) \);
- Diminishing marginal productivity of capital and labor;
- Constant rate of saving \( (s) \), thus total savings is \( S(t) = sY(t) \);
- Constant labor force growth rate \( (n) \); \( \frac{dL(t)}{dt} = \dot{L} = nL(t) \);
- Constant depreciation rate \( (\delta) \);
- Competitive markets;
- No technical progress (Temporary Assumption).
Solow Growth Model With No Technical Progress

The growth rate of capital stock is given by

$$\dot{K} = I(t) - \delta K(t) \quad (1)$$

Now define capital-labor ratio as, $k = \frac{K}{L}$. Then, one can derive a non-linear differential equation in the capital-labor ratio, $k$, which characterizes Solow growth model.

$$\dot{k} = sf(k(t)) - (\delta + n)k(t). \quad (2)$$
The steady state points satisfy

\[ sf(k(t)) = (\delta + n)k(t). \] (3)

Under the assumptions that the production function is such that \( f(0) = 0, \lim_{k \to 0} f_k(k) = \infty \) & \( \lim_{k \to \infty} f_k(k) = 0 \), there exists two steady-states: one at \( k^* = 0 \) and other at \( k^* > 0 \).
Implications of Solow Model Without Technical Progress

- In the long run economy reaches a stable steady state equilibrium.
- There will be no growth in per-worker output, $\frac{Y}{L}$, consumption, $\frac{C}{L}$, and capital stock, $\frac{K}{L}$, in the long run.
- Output, $Y$, consumption, $C$, and capital stock, $K$, will grow at the rate of work-force growth, $n$, in the long run.
- Per-worker output, $\frac{Y}{L}$, consumption, $\frac{C}{L}$, and capital stock, $\frac{K}{L}$, depend on savings rate, $s$, and work force growth rate, $n$. An economy with higher savings rate and lower work force growth rate will have higher steady-state per-worker output, $\frac{Y}{L}$, consumption, $\frac{C}{L}$, and capital stock, $\frac{K}{L}$. 
Suppose that production depends on capital, $K$, and effective labor, $EL$ defined as

$$EL(t) = E(t)L(t)$$

(4)

where $E(t)$ is the total factor productivity (TFP). Thus, the production function is

$$Y(t) = F(K(t), E(t)L(t)).$$

(5)

Suppose $E(t)$ evolves as follows

$$\dot{E} = \gamma E(t), \quad \gamma > 0.$$ 

(6)
Now define capital-effective labor ratio as, $\kappa = \frac{K}{EL}$. Then, given constant returns to scale, output per effective labor unit can be written as

$$\frac{Y(t)}{EL(t)} = F\left(\frac{K(t)}{E(t)L(t)}, 1\right) = f(\kappa(t)).$$  \hspace{1cm} (7)

The Solow growth model with technical change is characterized by:

$$\dot{\kappa} = sf(\kappa(t)) - (\delta + \gamma + n)\kappa(t).$$  \hspace{1cm} (8)
Implications of Solow Model With Technical Progress

- Ultimately economy converges to the balanced growth path just as in the case of no technical progress.
- On the balanced growth path, output, $Y$, consumption, $C$, and capital stock, $K$, grow at the rate of $\gamma + n$.
- At the steady state per-worker output, $\frac{Y}{L}$, consumption per worker, $\frac{C}{L}$, and capital stock per worker, $\frac{K}{L}$, grow at the rate of $\gamma$.
- Per-effective labor output, $\frac{Y}{EL}$, consumption, $\frac{C}{EL}$, and capital stock, $\frac{K}{EL}$, depend on savings rate, $s$, work force growth rate, $n$, and rate of technical progress, $\gamma$. An economy with higher savings rate and lower work force growth rate and rate of technical progress will have higher steady-state per-effective labor output, $\frac{Y}{EL}$, consumption, $\frac{C}{EL}$, and capital stock, $\frac{K}{EL}$. 
Growth Accounting

Suppose the production function is

\[ Y(t) = F(K(t), E(t)L(t)) = Y = K^\alpha(EL)^{1-\alpha}. \]  

(9)

By differentiating (9), we can derive

\[ \frac{\dot{Y}}{Y(t)} = \alpha \frac{\dot{K}}{K(t)} + (1 - \alpha) \frac{\dot{L}}{L(t)} + (1 - \alpha) \frac{\dot{E}}{E(t)}. \]  

(10)
Cross-Country Income Differences

Suppose that production function in country $i$ is $Y_i = K_i^\alpha (E_iL_i)^{1-\alpha}$. Let lower case letter denote log of per worker variable e.g. $y = \ln(\frac{Y}{L})$. Let $d$ denote developed countries and $u$ denote underdeveloped countries. Then the log difference of output per worker between these two groups of countries can be written as

$$y_d - y_u = \alpha(k_d - k_u) + (1 - \alpha)(e_d - e_u). \quad (11)$$

We can also use variance-decomposition method to get an estimate of the contribution of various factors in explaining the cross-country productivity differences. Using the production function, real income per worker at time $t$, $y_{it}$, can be written as

$$y_{it} = \alpha k_{it} + (1 - \alpha) e_{it}. \quad (12)$$

Then, the variance of real income per-worker can be written as

$$\text{var}(y_{it}) = \alpha^2 \text{Var}(k_{it}) + (1 - \alpha)^2 \text{Var}(e_{it}) + 2 \text{cov}(\alpha k_{it}, (1 - \alpha) e_{it}). \quad (13)$$
Augmented Solow Growth Model

Assume that the production function is given by

$$Y = K^\alpha H^\beta (EL)^{1-\alpha-\beta}$$  \hspace{1cm} (14)

where $H$ is the level of education of the labor-force. (14) includes education as a factor of production. One can also use health as a factor of production. In this case, (33) becomes

$$Y = K^\alpha H^\beta I^\mu (EL)^{1-\alpha-\beta-\mu}$$  \hspace{1cm} (15)

where $I$ is the indicator of health.
The notion of unconditional convergence can be tested by estimating the following regression model:

\[ y_{iT} - y_{i0} = a + by_{i0} + \xi_i \]  \hspace{1cm} (16)

where \( y_{iT} \) and \( y_{i0} \) are the per-worker income in the terminal period and the initial period respectively and \( \xi_i \) is the error term. If \( b < 0 \), then it indicates unconditional convergence.

For conditional convergence, we estimate the following regression model:

\[ y_{iT} - y_{i0} = a + by_{i0} + \text{Other Explanatory variables} + \xi_i \]  \hspace{1cm} (17)

Other explanatory variables such as human capital, financial development, legal institutions determine country-specific steady state.
Deep Determinants

**Geography:** e.g. Latitude, Average Temperature, Access to Coast

Geography is destiny (Sachs)
Mortality Rate and type of institutions (Acemoglu)
Latitude and the diffusion of technology (Diamond)
Deep Determinants

**Legal Origin**: Property rights and enforcement, Common Law (British), Civil Law (French), Socialist (Schleifer, A., Vishny, R. W. etc.)

**Ethnic Heterogeneity**: Ethnic Conflict, Civil Wars, Political Instability (Alesina, Easterly etc.)
Structural Transformation

1. The interaction between rural and urban sectors;
2. The role of agriculture in the development process;
3. The Lewis model;
4. The role of the informal sector;
5. The Harris-Todaro Migration Model;
6. Policy implications;

**Key Concepts:** Dual Economy, Surplus Labor, Disguised Unemployment, Informal Sector, Rural and Urban Sectors
Role of Agriculture in the Development Process

In developing countries (except for Latin America), agriculture accounts for 60-80% of the total employment and between 15-25% of GDP. In general, the per-capita income in agriculture sector is lower than the per-capita income in non-agriculture sector. Most of the poor work in the agricultural sector.

Two views on the role of agriculture

1. Agriculture plays a supporting role in the development process. It is a source of cheap labor and food for urban (formal/industrialized) sector (Lewis and Todaro Models).
2. Opposing view is that agriculture and rural development play critical role in the development process. Apart from providing food and labor, agriculture supplies raw-materials for industries and important source of demand for industrial goods.

The second view is the predominant view currently.
Some Basic Features of Agriculture in Developing Countries

1. Low productivity
2. Low growth rate
3. Low level of input use (except of labor)/ technological backwardness
4. High inequality of land holding
5. Predominance of family farms (in numbers and employment)

Low productivity and growth of agriculture in developing countries can be traced to a great extent to adverse agrarian systems and imperfect input markets prevalent in these countries.
Lewis Model: Key Issues

1. Interaction between agriculture (traditional sector/rural) and industry (modern sector/urban) in the development process
2. Role of capital investment in industry, rural-urban migration, and agricultural surplus in the development process
3. Behavior of industrial wages, agricultural wages, agricultural surplus, and terms of trade and employment in agriculture and industry over development process
Lewis Model

Lewis model is based on a particular view of the underdeveloped economy and the development process. Lewis viewed development process as a structural change involving transformation of primarily agricultural economy to an industrial one. The engine of development is industry and development requires rapid growth of industry. The growth of industry depends on three things:

1. Capital accumulation and investment in industry
2. Availability of labor to industry
3. Availability of food to industrial workers
Lewis Model: Main Assumptions

- Two-Sectors (two goods): Agriculture and Industry.
- Diminishing marginal productivity of labor in both sectors.
- **Dual Economy**: Underdeveloped economies are characterized by dualism which is coexistence of traditional and modern sectors.

**Traditional sector** is characterized by backward or traditional technology and low capital intensity. The production is normally organized on the basis of family labor with overall output distributed not in the form of wages and profits, but in the form of shares that accrue to each family member. Producers in this sector maximize family income and not profit.

**Modern sector** on the other hand is characterized by advanced technology and relatively high-capital intensity. Producers in this sectors are profit maximizers.
Lewis Model: Main Assumptions

▶ Interaction between agriculture and industry: Agriculture supplies labor to industry and the surplus food which sustains nonagricultural labor force. In the Lewis model, agricultural sector was assumed to be the traditional sector and industry to be the modern sector. The flow of labor and food from agriculture to industry are known as two fundamental resource flows.

▶ Surplus Labor: Central to the Lewis model is the idea of surplus labor in the agricultural or traditional sector. Lewis assumed that a significant section of agricultural workers can be shifted to industry or modern sector without adversely affecting agricultural output. More formally, workers in the agricultural sector are employed even though there marginal product is zero.
Lewis Model: Main Assumptions

- **Income Sharing and Surplus Labor**: Existence of surplus labor in agriculture raises the question why such labor is employed particularly when agricultural wage is not zero. Existence of both surplus labor and positive wage is reconciled by the fact that the organization of production in agriculture is different. Agriculture is dominated by family farms where the objective is to maximize family income rather than profit. Farm output is shared by family members and thus wage is equal to the average product and not the marginal product.

- Full employment in the economy

- Closed economy. In particular, no foreign trade in agricultural goods.
Lewis Model: Main Assumptions

Two extensions of surplus labor concept:

1. **Disguised Unemployment**: This phenomenon occurs when the marginal product of labor in traditional sector is lower than the marginal product of labor in modern sector. It is measured by the difference between the existing labor input in the traditional activity and the labor input that sets marginal product equal to the wage. Surplus labor is a special case of disguised unemployment when the marginal product in the traditional sector is zero.

2. **Surplus labor versus surplus laborers**: Labor input depends on number of workers as well as how much each worker works. If one reduces number of workers, agricultural output may not decline if remaining workers work more. In addition, agricultural wage will remain unaffected if the marginal cost of labor is constant. In this case, removal of workers from agricultural neither reduces output nor increases agricultural wage. In this sense, agricultural sector exhibits surplus laborers.
Three Phases of Agricultural Development

Let $MPLA$ be the marginal product of labor in agriculture and $\overline{W}^A$ average output (or wage) in agriculture at the initial period.

Surplus Labor Phase: $MPLA = 0$ and Agriculture Surplus Per-Worker = $\overline{W}^A$.

Disguised Unemployment Phase: $\overline{W}^A > MPLA > 0$ and Agriculture Surplus Per-Worker = $\overline{W}^A - MPLA > 0$.

Commercialization of Agriculture: $MPLA \geq \overline{W}^A$ and Agriculture Surplus Per-Worker = $\overline{W}^A - MPLA < 0$. 
Lewis Model: Mechanics

**Development Process**: Development process involves expansion of industry and transferring workers from agriculture to industry. Since industry can draw on surplus labor in agriculture, they have virtually unlimited supply of labor. The industrial growth is constrained by investment in industry and thus capital accumulation in industry is the engine of growth. According to Lewis the central problem of development is to enhance domestic saving in underdeveloped countries from 4-5% to 12-15%.

Lewis model characterizes the behavior of agricultural surplus, agricultural output and employment, agricultural wage, industrial output, employment, and wage over the development process. It essentially asks what happens when there is capital accumulation in industrial sector. The development process is characterized by three phases and two turning points.
Lewis Model: Mechanics

1. **First phase**: This is the phase when there is surplus labor. Removal of workers from agricultural sector does not affect agricultural output, surplus, wage, and industrial wage.

2. **Second phase**: This phase starts when there is no surplus labor, but there is disguised unemployment. The point at which the economy transitions from the first phase to the second phase is known as the first turning point. In this phase, agricultural output and surplus start to fall and industrial wage start to rise. Terms of trade moves against industry. But agricultural wage remains constant.

3. **Third phase**: This phase starts when there is no disguised unemployment. The point at which the economy transitions from the second phase to the third phase is known as the second turning point. In this phase, agricultural output and surplus start to fall and industrial wage start to rise much more rapidly compared to the second phase. Agricultural wage starts to rise. Commercialization of agriculture starts.
Lewis Model: Criticism

1. Does surplus labor really exist?
2. Limited role of agriculture in the development process
3. Wage determination in agricultural sector
4. How to transfer agricultural surplus from agriculture to industry: (i) agricultural taxation; (ii) agricultural pricing policy?
5. Role of foreign trade
6. Absorption of industrial goods
7. Simplistic urban labor market: No unemployment and informal sector
Urban Labor Market

Some Salient features of urban labor market:

1. Open unemployment
2. Large urban informal sector
3. Non-competitive formal labor market due to institutional features, imperfect information etc.
4. Large and persistent wage gap between wages in formal urban sector and informal urban wage sector with wages in formal sector being much higher
5. Large and persistent wage gap between wages in formal urban sector and agricultural wage
Urban Informal Sector

One striking feature of the urbanization in developing countries is the presence of a large informal (unorganized, unregulated, unregistered) sector. Between 30% to 70 % of urban labor force works in the informal sector. The main characteristics of the urban informal sector jobs are:

1. low skill
2. low productivity
3. self-employment
4. lack of complementary inputs particularly capital
5. small scale measured in terms of sales, assets, employment etc.
6. favored by recent migrants
7. ease of entry
Role of Urban Informal Sector: Three Views

One view of the urban informal sector is that it is a residual sector. According to this view, it is a reflection of limited industrial development. With industrialization and development this sector will disappear.
Second view envisages more positive role for urban informal sector in the development process. According to this view, this sector allows excess rural labor to escape from extreme rural poverty and underemployment. It is also a cheap source of inputs and services for the formal sector (backward linkage). Also by increasing the income of poor it increases the demand for goods and services produced by the formal sector. Over time the second view has gained popularity and the urban informal sector is now considered to be vital for reducing poverty and inequality of income.
A significant part of informal sector, in particular micro-entrepreneurial sector, is not disadvantaged or inferior sector. Most workers engaged in this sector voluntarily join this sector and prefer it over jobs in the formal sector. We will discuss this view in depth towards the end of this lecture.
Harris-Todaro Model: Key Issues

1. Rural-Urban Migration and the determination of urban labor supply.

2. Allocation of urban labor force between informal/traditional/subsistence sector (unemployment) and formal/modern urban sector.

3. Policy experiments.
Harris-Todaro Model: Key Ideas

1. Migration is stimulated primarily by rational economic considerations of relative benefits and costs, mostly financial but also psychological.

2. The decision to migrate depends on expected rather than actual urban-rural real wage differential. Expected urban-rural real wage differential depends not only on the actual differential, but also on the probability to find jobs in the urban sector.

3. Rural-Urban migration is an equilibrium phenomenon which equates rural real income to expected urban real income.

4. Policies designed to reduce urban unemployment may increase it.

5. Migration rates in excess of urban job opportunity growth rates are not only possible but also rational.
Critical Assumptions

- Two-Sectors (two goods): Rural and Urban. Rural sector produces agricultural goods and the urban sector produces manufactured goods.
- Marginal product of labor in both agriculture and manufacturing is positive and depends on the amount of labor employed in both the sectors. Diminishing marginal productivity.
- Producers in both sectors are profit maximizers.
- Full employment in the rural sector.
- In the urban sector, employers must pay at least the mandated minimum wage. Introduces the possibility of unemployment in the urban sector (source of inefficiency).
Critical Assumptions

- Migration is positively related to the urban-rural real income differential.
- Migration is an increasing function of the probability of obtaining an urban (formal) job.
- Duality in urban labor market (co-existence of formal and informal labor markets).
- Migration is a two-stage process. In the first stage, migrant workers find jobs in the informal sector. In the second stage, they move to the formal sector.
Notations

\( S \) = Existing size of the urban labor force
\( \dot{S} \) = Time derivative of \( S \)
\( N \) = Total modern sector employment
\( \pi \) = Probability of finding urban (formal) job
\( E \equiv \frac{N}{S} \) = Proportion of the urban labor force employed in the modern sector
\( T \equiv 1 - E \) = Proportion of the urban labor force employed in the informal sector
\( Y_i \) = Net real income in sector \( i = R, U \)
Model

Law of motion of urban (formal) jobs:

\[ N(t) = N_0 \exp^{\gamma t}. \]  \hspace{2cm} (1)

The probability of finding urban job, \( \pi(t) \), is given by

\[ \pi(t) = \frac{\gamma N(t)}{S(t) - N(t)}. \]  \hspace{2cm} (2)

The law of motion of the urban labor force is given by

\[ \frac{\dot{S}}{S(t)} = \beta + \pi(t)F \left[ \frac{Y_U(t) - Y_R(t)}{Y_R(t)} \right] \]  \hspace{2cm} (3)

where \( \beta \) is the natural rate of increase of the urban labor force and \( F() \) is an increasing function of the urban-rural real wage differential.
Letting \( \alpha(t) \equiv \frac{Y_U(t) - Y_R(t)}{Y_R(t)} \) and using (2), (3) can be written as

\[
\frac{\dot{S}}{S(t)} = \beta + \frac{\gamma N(t)}{S(t) - N(t)} F(\alpha(t)). \tag{4}
\]

Given the definition of \( E \), we have

\[
\frac{\dot{E}}{E(t)} = \frac{\dot{N}}{N(t)} - \frac{\dot{S}}{S(t)}. \tag{5}
\]

Under the assumption that \( \alpha(t) \) is constant, the equilibrium (steady-state) is given by the condition that

\[
\frac{\dot{E}}{E(t)} = 0. \tag{6}
\]
Model

Using (1), (4), (5) and the definition of $E$, we can write the equilibrium condition as

$$
\frac{\dot{E}}{E(t)} = \gamma - \beta - \frac{\gamma F(\alpha) E(t)}{1 - E(t)} = 0.
$$

(7)

The solution is

$$
E^* = \frac{\gamma - \beta}{\gamma F(\alpha) + \gamma - \beta}.
$$

(8)

$$
T^* = 1 - E^* = 1 - \frac{\gamma - \beta}{\gamma F(\alpha) + \gamma - \beta}.
$$

(9)

(8) implies $\frac{dE^*}{d\alpha} < 0$ and $\frac{dE^*}{d\gamma} > 0$. 
Policy Implications

1. Urban bias in the development policy aggravates the urban unemployment problem.
2. Faster job-creation in the urban formal sector is insufficient solution to the urban unemployment problem.
3. Providing wage subsidy to the urban formal may increase urban unemployment.
4. Optimal policy requires either a mix of wage subsidy to the urban formal sector and restriction on migration or wage subsidy to both the urban formal sector and agriculture.
Extensions

1. Calculation and financing of subsidy
2. Risk aversion and migration
3. Social Capital and migration
4. Family structure and migration
Main Idea: A significant part of informal sector, in particular micro-entrepreneurial sector, is not disadvantaged or inferior sector. Most workers engaged in this sector voluntarily join this sector and prefer it over jobs in the formal sector. This perspective goes against the conception of informal sector which underpins both the probabilistic models and labor market segmentation models of migration.

Micro-entrepreneurial Sector: Firms and businesses employing equal to or less than five workers.

Informal Sector: Unregulated sector where government labor and social security laws do not apply.

Focus: Self-employed in informal sector in Latin American Countries
Characteristics of Self-Employed

About 40 percent of male work-force in Latin American countries is self-employed.

1. Most of the informal self-employed workers left their previous jobs voluntarily – primarily motivated by desire to be their own boss or greater earnings.
2. Most self-employed workers would not like to get formal sector jobs.
3. Most of the individuals who enter self-employment have previous job experience.
4. Most of the unemployed are from informal sector rather than formal sector.
5. Incidence of women in self-employment is very high primarily due to flexibility in hours worked.
Earnings

1. Self-employed workers in Mexico who voluntarily left formal sector jobs earned more on average.
2. Informal salaried workers earned less than comparable formal salaried workers.
3. Informal workers, both self-employed and salaried tend to be drawn disproportionately from the poor.
4. Negative relationship between self-employment and educational level.
Reasons for giving up formal jobs

1. Informal support network may substitute for formal protections such as unemployment insurance, health insurance, pension plan etc.
2. The quality of formal sector protection may not be high.
3. Formal sector may not reward talented workers adequately.
Some Further Characteristics of Self-Employed

1. There is wide range of sizes among long standing firms. Persistence of small firms does not imply labor market rigidities and lack of credit.

2. The failure rate of informal businesses is very high.

3. Only a minority of informal self-employed firms are affiliated to large firms. Thus, the emergence of this sector is not due to large firms subcontracting production out to unprotected workers in order to reduce legislated or union induced rigidities and high labor costs.

4. Presence of large informal sector does not necessarily imply large labor market distortions.