

Learning, Growth and
Development: A Lecture in Honor
of Sir Partha Dasgupta

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Celebrating Partha Dasgupta's Contributions to Economics

- More than four decades of contributions
- In a vast range of areas
 - Population
 - Natural resources — “father” of modern theory of the economics of natural resources
 - Linking environment and natural resources
 - Public finance
 - Cost-benefit analysis
 - Taxation

- Social Capital
- Technological Change
- Game Theory/Incentives
- Forcing us to rethink many widely held beliefs

Schumpeterian economics (economics of innovation)

- Since Solow, we have recognized that the most important determinant of growth is technological change
 - So our focus should be on the impact of policies on technological change
 - In case of developing countries, focus on diffusion of knowledge
 - From developed to developing country
 - Within developing country
- Since Arrow, recognized that markets by themselves do not yield efficiency in the production of knowledge
 - Knowledge as a public good
 - Spillovers/externalities

- Still, there persisted the “hope” that Schumpeterian competition would “work”
 - Competition for the market rather than competition in the market
 - A succession of “temporary” monopolists

- We showed that this hope was misplaced
 - Firms could engage in entry deterrence policies that would enable monopoly power to persist
- Hope was that deterrence would take form of more rapid innovation
 - We showed that that might not be the case
 - That deterrence could be achieved by simply getting sufficiently ahead of potential competitors

Broad Question

- What should governments in developing countries do to promote growth through technological progress?
 - Markedly different perspective than standard question, which focuses on static efficiency, moving countries to “frontier”
 - Question is especially salient because the two policies may be in conflict
 - Intellectual property restricts use of knowledge (a distortion—knowledge is a public good), and even can contribute to monopoly

This paper can be viewed as a sequel to

- P. Dasgupta and J. E. Stiglitz, “Industrial Structure and the Nature of Innovative Activity,” *Economic Journal*, 90(358), June 1980, pp. 266-293;
- Dasgupta and Stiglitz, “Uncertainty, Market Structure and the Speed of R&D,” *Bell Journal of Economics*, 11(1), Spring 1980, pp. 1-28

- Dasgupta and Stiglitz, “Potential Competition, Actual Competition and Economic Welfare,” *European Economic Review*, 32, May 1988, pp. 569-577
- Dasgupta and Stiglitz, “Learning by Doing, Market Structure, and Industrial and Trade Policies,” *Oxford Economic Papers*, 40(2), 1988, pp. 246-268

- Based on joint work with Bruce Greenwald
“Helping Infant Economies Grow,” *AER*, May, 2006
- Forthcoming book from Columbia University Press, *Creating a Learning Society: A New Paradigm for Development and Social Progress (An Essay in Honor of Kenneth Arrow)*

Key macroeconomic issue

- What determines growth?
- Relationship between growth and globalization
- Orthodoxy:
 - Trade, foreign investment drives growth
- Alternative view:
 - Growth (productivity increases) drive trade, investment
 - Two-way relationship—but it is even possible that effect of trade on growth is negative
- Answer has important policy implications

- Trade, investment opportunities are universal: so if they were driving force, then would expect to see similar patterns everywhere
- But growth differs markedly, suggesting it is *particular* forces that are driving growth

Contrasting perspectives

- Standard theories
 - Focus on comparative advantage
 - One time gain from liberalization, opening up markets
- Technology-based theories
 - Focus on diffusion of technology from developed to less developed countries
 - And **spill-overs** from one sector to other
- Infant industries—economies of scale
 - Losses during “learning phase” serve as entry barriers, putting developing countries at disadvantage

- Infant industry argument

- Critiques

- Government can't pick winners
 - Infants never grow up
 - Better ways of providing assistance than protection—
direct and transparent subsidies

– Replies

- Almost every successful country has had “industrial policies”
 - US from 19th century (telecommunications, agriculture)
 - » Today mostly through defense department
 - Successful countries learned how to manage “political economy” problems
- Point of industrial policies is not to pick winners, but to identify externalities and other market failures
 - With imperfect capital markets, can’t borrow to finance initial losses
 - Imperfections of capital markets are endemic (asymmetries of information)
 - » Especially in developing countries

- In fact, learning by doing itself provides little basis of industrial policy
 - Consider a two-country, two-product Ricardian world with Cobb-Douglas utility functions, with one product with learning and the other stagnant (learning internalized in country)
 - Consider equilibrium in which “developed” country specializes in dynamic sector
 - With competition, full benefits of learning are shared with developing country through price declines

- Central then is understanding the structure of learning within an economy—including across sectors
 - Many processes, practices, and institutions entail cross-sector learning/increases in productivity
 - Inventory control processes
 - Labor management processes
 - Computerization
 - Financial services

Central conclusions

- The industrial sector may not only exhibit a larger learning elasticity, but also more spillovers to the rural/agricultural sector
- It is therefore desirable to encourage the industrial sector
- Broad-based export subsidies (as in East Asia) may be a desirable way of doing so
- But WTO has restricted the use of such subsidies

- Exchange rate policy may be an effective alternative
 - Avoids the problem of “picking winners”
- Even pays to have a *perpetual* current account surplus
 - Surprising — “capital” that one never uses
 - But learning benefit exceeds the opportunity cost of funds

- But even if it were not desirable to do it *forever*, it may be an important element of development strategy
 - Problem with using steady-state models

Closed Economy

- Learning external to the firm
 - Failure to take into account learning benefits to industry as well as spillovers
- Learning limited to the firm
 - Natural monopoly
 - If there were no cross-sectoral spillovers, rational firm would take into account all learning benefits
 - But distortion from monopoly power
- In both cases, in general, market equilibrium not efficient

External to the firm/competitive equilibrium

Two-period model

Social welfare problem is to maximize

$$(1) \quad W = U(\mathbf{c}_1) - v(L_1) + \delta [U(\mathbf{c}_2) - v(L_2)],$$

where

$$(2) \quad c_{1j} = L_{1j}$$

$$(3) \quad c_{2j} = L_{2j} H^j[\mathbf{L}_1] ,$$

where $\partial H^j / \partial L_{1k} > 0$, $j \neq k$, if there are learning externalities.

First-order conditions

$$(4a) \quad U'_{1j} = v'_1 - \delta \sum U'(c_{2k}) L_{2k} H^k_j$$

$$(4b) \quad U'_{2j} H^j = v'_2$$

Optimal production entails producing in the first period beyond the point of the static efficiency condition, where marginal rate of substitution equals the marginal rate of transformation.

Interpretation with lump-sum taxation

$$(5) -\sum \tau_i (\partial x_i / \partial p_j)_U = \rho \Phi_1 + k,$$

where Φ_1 is the total net marginal learning benefit from subsidizing the consumption of sector i , taking into account potential effects on other sectors, both through induced learning in other sectors (as a result of cross elasticities of demand) and as a result of learning spillovers

- Optimal subsidies lead to expansion of those sectors which have larger societal learning benefits, taking into account both direct learning and cross sectoral spillovers.
 - If the learning elasticity of some sector is much larger than that of others, and there is some sector which is a substitute for the high-learning sector, then it may pay to tax that sector, in order to encourage learning in the high-learning sector.

- Optimal to impose some subsidies, even if taxes are distortionary

Special cases

- (i) With no learning spill-over, subsidy increases with learning elasticity
- (6) $\tau_i/p_i = \rho g_i + k$
- (ii) With full symmetry and zero elasticity of labor supply, market equilibrium is efficient
- (iii) With full symmetry and positive elasticity of labor supply, there is too little learning
 - Subsidy (paid for by tax) encourages more work, with more work, more learning

Monopolistic Competition

- Recognition of learning benefit increases labor demand
 - Increased labor demand leads to higher wages first period, partially offsetting effect of monopoly power, which leads to lower wages
- (i) With full symmetry and zero labor supply elasticity, equilibrium both periods is efficient
- Monopoly power affects distribution

- (ii) But with positive labor supply elasticity, monopoly power suppresses wages from efficient level, leading to less labor supply, lower output first period, less learning, lower growth, and less learning, and lower output second period
- Effects can be partially offset by subsidies
 - Can derive optimal subsidy formula similar to earlier formula

Open Economy: Basic model

- Two economies, developed (D) and less developed (L)
- Labor as only input, CRTS
- Two sectors: Industry (I), Agriculture (A)
- C^D_I (C^D_A) \equiv amount of labor per unit of industrial (agricultural) output in the developed economy (similarly for L)

Basic model

- Developed economy enjoys absolute advantages in the production of both goods
 $C^D_I < C^L_I$ and $C^D_A < C^L_A$
- But comparative advantage in the production of industrial goods
$$\frac{C^D_A}{C^D_I} > \frac{C^L_A}{C^L_I}$$
- Developing country small relative to developed economy

Free trade equilibrium

- Developing country specializes in agriculture
- LDC's composition of consumption is determined by the real price in the developed country
- Composition of output in the industrial economy is determined by the global demand (its own demand plus the imports of the less-developed economy) for industrial goods
- All the gains from trade accrue to the less-developed economy.

Dynamic development

- Productivity improvement affects the industrial and agricultural/craft sectors equally

$$-\frac{1}{C_I} \cdot \frac{dC_I}{dt} = -\frac{1}{C_A} \cdot \frac{dC_A}{dt}$$

- Which implies no changes in comparative advantage over time

$$-\frac{d}{dt} \left[\frac{C_I}{C_A} \right] = -\frac{C_I}{C_A} \left[\frac{1}{C_I} \cdot \frac{dC_I}{dt} - \frac{1}{C_A} \cdot \frac{dC_A}{dt} \right] = 0$$

Technology generation

Focused on industrial sector

- Large—high returns to scale
- Long lived—high returns from continuity (learning to learn)
- Stable—high returns from completion
- Concentrated—high rates of diffusion

Strong industrial sector provides basis for

- More research—
 - More resources and incentives for research and development
 - More internalization
 - Greater ability to support public research and development
 - More human capital formation, including public support for human capital accumulation
- The development of a robust financial sector
- Learning to learn and cross-border knowledge flows

Implication: Rate of productivity increase related to (relative) size of industrial sector

Growth equation

Learning related to (relative) scale of industrial sector

$$(2) \quad g = -\frac{1}{C_I} \cdot \frac{dC_I}{dt} = -\frac{1}{C_A} \cdot \frac{dC_A}{dt} = f\left(\frac{Q_I}{Q_I + Q_A}\right), f(0) = 0, f^1 > 0$$

Development implications

- With free trade, developed economy grows, less developed economy stagnates
- With high tariffs
 - Less developed suffers slightly in short run (higher cost of industrial goods)
 - Grows over time

Advantage of high uniform tariffs

Infant **economy** argument for protection

- No picking winners
- No entrenched narrow interests

Revenues can be used to finance education,
infrastructure

Analogous in effect to exchange rate
depreciation

Historical policies

- US (late 19th century, early 20th century)
- Common market (post World War II)
- East Asia—Korea, Taiwan
 - Export-led growth
 - But protected nascent industrial sector
- China (pre-WTO)
- Note: India's growth related to “internal” liberalization, not external liberalization
 - May be trade-off in presence of learning

Optimal trade intervention

- Static-dynamic trade-off
- Depends on interest rate
 - Benefits from higher GDP in future
 - Losses from inefficiency today
- Benefit depends on
 - Elasticity of learning with respect to size of sector
 - Elasticity of spill-over from industrial to agricultural sector
 - Learning-to-learn effects—dynamic improvement in learning

Static utility

$$\begin{aligned}(3.1) \quad \ln U &= z \ln I + (1 - z) \ln A \\ &= z \ln (\beta\gamma + (1 - \beta)\lambda) + \\ &\quad (1 - z) \ln ((1 - \lambda) (1 - \beta)) \\ &= \ln U^*\end{aligned}$$

Where

β = fraction of labor allocated to industrial sector

λ = fraction of agricultural output traded for industrial goods

γ = effective comparative disadvantage in manufacturing

In static model, easy to show that $\beta = 0$

In dynamic model,

$$\text{Max } W = U^*/\delta - g$$

where g is rate of growth: $g(\beta)$, $g' > 0$.

Now, optimum may entail $\beta > 0$

$\beta > 0$ if (a) γ is not too small; (b) the elasticity of learning $g' \beta/g$ is large enough; and (c) g is close enough to δ .

The fact that the country's industrial sector *never* becomes competitive (the infant never grows up) is not necessarily an argument against industrial policies, when the learning spillovers are great enough.

Non-tradables

- Results extend to a three-good model with non-tradables
- If learning is faster in export (industrial) sector and spillovers are large enough, then $\Delta\beta > 0$.
- Optimal intervention entails exchange rate policy (affecting the price of tradables and non-tradables) and industrial policies (encouraging industrial sector, even when it is not *static* comparative advantage)

- If industrial policies are precluded (e.g. as a result of trade agreements), only instrument may be exchange rate policy
- Lowering exchange rate below “equilibrium” (trade balance) leads to larger industrial sector *and* faster learning *and* trade surplus

- With homotheticity and constant elasticity learning functions trade-offs same every year
- So it may be optimal to build up reserves year after year and *never* use them, because learning benefits exceed opportunity cost of unused funds

Extensions of Analysis

- We have focused on “learning”; but even more important is “learning to learn.”
- Industrial and trade policy can enhance an economy’s learning capacities

Extensions of Analysis

- We have focused on a Ricardian model
- Arrow's work focused on learning through investment
- Trade policy can affect factor prices, and therefore the level of investment, and therefore the level of learning
- More than offsetting the social costs of distortion

General lessons

- Another example of 2nd best economics
- But whenever one talks about innovation, one is in the world of 2nd best economics
 - Credit/revenue constraints are also likely to be particularly important
 - Imperfect competition/increasing returns to scale
 - Risk, with imperfect risk markets
 - All elements of standard Schumpeterian economics
 - Should be at the center of endogenous growth theory and growth policy

Revision is part of new trade framework

- Old trade-and-growth orthodoxy
 - Trade liberalization leads to more trade
 - More trade leads to more growth
 - Growth results in everyone being better off

New trade framework

- (i) Trade liberalization often does not lead to increased trade
- (ii) Trade liberalization may not lead to increased growth or increased welfare
- (iii) Increased growth induced by trade may not make everyone better off
 - There may be large losers
 - And they may be among the poorest

(i) Trade liberalization often does not lead to increased trade

- Experiences with EBA
- Share of least developed countries in global trade declining

(ii) Trade liberalization may not lead to increased growth and well-being

– Growth related to technological progress
(Solow, 1957)

- Even more important for developing countries—closing knowledge gap
- Central question is how does liberalization affect diffusion of knowledge
- Trade liberalization may have adverse effects

(ii) Trade liberalization may not lead to increased growth and well-being

- High adjustment costs
 - Some of which are not just temporary (increased exposure to risk, lower tariff revenues)
 - With imperfect risk markets, trade liberalization may be Pareto Inferior (Newbery-Stiglitz, 1982)
- Much larger for many developing countries than for advanced industrial countries
 - Developing countries are vulnerable to policy shocks because their export industries are least diversified
 - Developing countries need to make the largest changes to comply with regulations
 - The trade structure is most distorted in the industries of importance for developing countries, so reform will impact on them disproportionately
 - Developing countries have weaker markets and suffer from greater imperfections
 - Developing countries have weaker social safety net

(ii) Trade liberalization may not lead to increased growth and well-being

- Fiscal losses
 - Trade liberalisation reduces tariff revenue
 - Tariff revenue is around 1% of government budgets in rich countries, and around 30% in LDCs
 - Shifting to VATs will have adjustment costs
 - And may be administratively inefficient
 - May increase economic distortions
 - And have regressive distributional impacts
- Implementation costs
 - For poor countries, trade liberalisation involves large costs which should be weighed among other development expenditure priorities – taking away resources needed elsewhere
 - The Uruguay Round imposed large implementation costs on developing countries
 - New trade facilitation regimes will be expensive

Particular countries hurt

- Net Food Importing Countries
 - Will suffer as the world price of food rises following the elimination of export subsidies
 - Urban poor people (net consumers of food) will be the hardest affected
- Preference Erosion
 - Net losses from MFN liberalisation for preference recipients depend on the difference between lost trade diversion, and gained trade creation as global tariffs come down
 - Will severely affect a small number of industries in a small number of products

(iib) Absence of causal relationship between trade liberalization and growth

- Consistent with empirical study focusing on relationship of trade liberalization (not trade) on growth
 - Most often cited studies flawed, problems of causality, focus on wrong question
- Consistent with historical experiences noted earlier
 - As well as more recent experiences

(iii) Trade generated growth may not make everyone better off

Distributive Consequences

- Trade liberalization may lead to increased inequality
 - Distributive effects are inherent (Samuelson-Stolper)
 - Adverse effects even in developing countries
 - Especially with asymmetric trade liberalization
 - Capital more liberalized than labor
 - Agricultural subsidies retained
 - Standard analysis only said that with trade liberalization, gainers *could* offset losses of losers, not that they would
 - In fact, globalization has resulted in pressures to weaken safety nets, compounding problems

General lesson

- Policies often based on simplistic models
 - Simplistic models consistent with simplistic ideologies
 - And used by special interests to advance particular policy agenda
- “Political economy” objections
 - Ideal government intervention might improve matters
 - But real world interventions do not

- May be true—but conclusion based on political analysis, not economic analysis
 - Political analysis often more simplistic than economic analysis
 - Moreover liberalization is also a political agenda
 - Not “perfectly applied”
 - Asymmetric application can have adverse welfare effects

- Mixed historical record
 - Question is: are problems inherent in political processes, or can political processes be improved
 - Historical record suggests not inevitable
- But historical record does suggest caution

Growth and Innovation: To what end?

- Much of innovation in advanced industrial economies has been directed towards saving labor
 - But in many developing countries, labor is in surplus, and unemployment is the problem
 - Labor saving innovations exacerbate this key social problem

- It is natural resources/the environment which is “underpriced”
 - And innovation needs to be directed at saving resources and protecting the environment
 - Cannot just “borrow”/adapt technology from the North
 - Need a new “model” of innovation

- These environmental impacts are important for all countries, but especially for developing countries, as Dasgupta's work repeatedly emphasizes.

- This brings me back to one of the central themes in Dasgupta's work.
- What matters is not GDP, but the quality of life, "well-being."
- What that entails—and how it can be increased— should and can be a subject of rational inquiry.

- Dasgupta has led the way in showing us how that can be done. For that, and for all of his other contributions, we are all grateful.