40

Center for Latin American Development Studies

A POLICYMAKER'S GUIDE
TO COMPARATIVE ADVANTAGE

Daniel M. Schydlowsky
Boston University

A POLICYMAKER'S GUIDE TO COMPARATIVE ADVANTAGE

Daniel M. Schydlowsky

Center for Latin American Development Studies

Boston University

Contents

I

Fundamental Principles

A. The Essence of Comparative Advantage

For a country to follow its comparative advantage means widely differing things to different people. For some it is tantamount to virtue and rational policymaking, to others it implies sacrificing a country's independence, to others still it means that free trade should rule, to even others it implies that markets should be allowed to work unhampered. All these views contain elements of the truth; however, all of them are also misstatements or misuses of the essential meaning of comparative advantage for a good many situations.

At bottom, for a country to produce those things in which it has a comparative advantage means nothing more than the country is doing what it can do best. Hence the fundamental concept of comparative advantage is that of micro and macroeconomic efficiency. In itself, such efficient choice of production activity implies neither the functioning of a competitive free market nor the imposition of rigid planning; it does not imply adoption of free trade nor the imposition of protection. It simply means that a country chooses to produce those things which it can produce best in whatever manner is most effective to achieve that very simple and straightforward efficiency goal.

The policy of free trade (i.e. no tariffs, licenses, exchange controls, quotas, export taxes, etc), is often regarded as equivalent to a policy

of production according to comparative advantage. This result comes from the analysis of perfectly competitive economies in which under free trade full price flexibility will assure optimal choice of activities for small countries that cannot influence their terms of trade. However, this conclusion holds only when the international terms of trade are given, i.e., when the country can influence neither the prices at which it buys nor the prices at which it sells, and when externalities in production and consumption are absent and learning by doing either does not occur or can be financed by a perfect capital market. In other words, the equivalence between a free trade policy and a comparative advantage policy only holds under very restricted and idealized conditions. In most real world situations, market prices do not fully reflect social scarcities, countries can affect some prices to some extent, externalities and learning by doing exist, and markets are not fully competitive. Evidently, under such real world conditions, a free trade policy is no longer equivalent to a policy of production according to comparative advantage. Under such realistic conditions, therefore, the policymaker needs to adopt an explicit comparative advantage oriented policy if he wishes the country to produce what it can do best. Later sections of this paper present the building blocks upon which such a policy can be based.

B. Foreseeing the Future

Unless one postulates a static, unchanging world, what a country can produce best changes over time. For one thing, endowments of capital, labor, and skills change as a result of numerous factors (including production

decisions in the present) and therefore relative costs of different outputs change. For another, world prices change. in response to changing endowment and taste conditions in the rest of the world. Hence production decisions which commit the country for more than a short period of time need to take into account future comparative advantage as well as present comparative advantage.

If determining a country's comparative advantage at present is difficult, it will be doubly difficult to determine its future comparative advantage. Yet, an intelligent comparative advantage oriented policy needs to take the future into account or it will lead the country to incur the high costs of myopia.

Indeed, the need to take the future into account is one of the reasons why competitive spot markets by themselves are unlikely to lead to a comparative advantage outcome. Individuals' capacity to forecast the future is limited and hence in the absence of competitive futures markets based on institutionalized forecasting, individuals are likely to misjudge the future due to the cost (impossibility) involved in acquiring the necessary information for proper forecasting. Moreover, the future is shaped in part by the actions of the present; it is not something that happens exogenously (even if it has elements independent of the country's own actions in the present). Thus proper forecasting involves detailed knowledge of present actions, an unlikely requirement for individuals to be able to meet.

A further element which needs to be borne in mind is the change of technology which invariably occurs and which, while shared with the rest of the world, may well shift the relative advantage of producing one or another good depending on whether the technical change makes production easier or harder under local conditions.

C. Exploiting the Past

While theoretical constructs of comparative advantage start from a "tabula rasa" assumption, i.e., they make believe that everything is flexibile, policymaking in the real world requires taking into account the conditions which obtain at the moment when the policy is put into force. This consideration has special relevance to the extent that capital stock exists in place, since for such capital goods, the marginal cost of their utilization is much lower than the cost of installing new machinery. Thus the heritage from the past creates a short run comparative advantage which is significantly different from the medium or long run.

In comparison to foreseeing the future, exploiting the past is quite easy. It merely requires information on the existing stock of equipment and its potential output as well as the marginal cost of production on such equipment.

D. In Sum

The principle of comparative advantage implies nothing more than maximizing the welfare of the country, given the initial conditions, the

resource endowment of the country and the likely future facing it. It is a simple efficiency criterion which by itself implies neither the operation of the free market nor the institution of a free trade policy nor strict government regimentation and full central control of the economy.

A comparative advantage oriented policy aims at choosing to produce those things which the country can produce best. It involves making such a choice on the basis of present production and cost alternatives, the likely development of such options and costs in the future and the consequence of present actions for that future. It also requires taking into account the heritage of the past in the form of the existing capital stock, on which marginal costs are relevant since the investment has already been made and paid for.

In the presence of non-competitive markets, prices that do not reflect social scarcities and/or economic agents that are not maximizers, a comparative advantage policy is likely to depart significantly from the conventional competitive market free trade prescription. However such departure will not be haphazard but will be directly related to the static and dynamic considerations previously mentioned.

II

Static Comparative Advantage

A. Contemporary Comparative Advantage Theory

The existing theory of comparative advantage derives its roots from the writings of David Ricardo and of Eli Heckscher and Bertil Ohlin. These thinkers were concerned with explaining why countries trade and by implication what is the best specialization for them to adopt. Ricardo put the emphasis on differences in the technology used for production in different countries. Heckscher and Ohlin put the emphasis on differences in factor endowments, i.e., in the relative abundance of capital and labor between countries. Evidently both elements play a role. So may differences in tastes between countries. From a production planning point of view, however, it is the difference in the technology and the differences in factor endowment which are the crucial elements which concern us. An operational measurement of comparative advantage must incorporate both these elements.

B. Ricardo's Theory of Comparative Advantage

Ricardo illustrated his theory of comparative advantage and trade with a simple example of transactions between England and Portugal in a world in which he assumed that only labor was required to produce output. He assumed that in England it was possible to produce a bale of cloth in five man hours whereas a keg of wine would take eight man hours to produce;

on the other hand, in Portugal a bale of cloth would take ten man hours to produce and a keg of wine twelve man hours. These data are shown in Table 1.

In Ricardo's example, he assumed that England was more efficient in producing both commodities: it had an <u>absolute</u> advantage over Portugal. However, continued Ricardo, this did not mean that Portugal would import both commodities and that England would buy nothing from Portugal. Evidently, if that happened, Portugal would soon run out of foreign exchange or gold to pay with and trade would stop. Rather, England and Portugal would each specialize in that commodity in which it was <u>relatively</u> more efficient, i.e., in that commodity in which it had <u>comparative</u> advantage.

Which commodity this is for each country can be worked out rather readily. In England, the labor it takes to produce one keg of wine buys 1.6 bales of cloth; in Portugal, the labor required for one keg of wine buys only 1.2 bales of cloth. It follows therefrom that it makes sense for England to produce and export cloth to Portugal and for Portugal in return to send wine to England.

The rationality intrinsic in this can also be illustrated in a different way. Suppose England wishes to consume one keg of wine. It then has the option of investing eight man hours in its production or alternatively it has the option of investing six man hours in cloth which would produce 1.2 bales of cloth. These 1.2 bales, when shipped to Portugal, would enable

Table 1

<u>Ricardian Comparative Advantage</u>

	<u>England</u>	<u>Portugal</u>
	Costs of Production in Man-hours	
Bale of cloth	5	10
Keg of wine	8	12

the acquisition of 12 man hours worth or work in Portugal which are exactly equal to one keg of wine! Thus England has the possibility of producing a keg of wine directly through the allocation of eight man hours to its vineyards or alternatively of producing the same keg of wine indirectly by allocating only six hours to the production of cloth and then trading that cloth for Portuguese wine. Evidently, acquiring the wine through trade is more efficient.

The converse is true for Portugal. Assume Portugal wishes to consume a bale of cloth. It has the option of producing that bale in Portugal through the use of ten man hours or alternatively it has the option of allocating seven and a half man hours to the production of wine which will yield five-eighths of a keg. This amount of wine when shipped to England will allow the purchase of precisely one bale of English cloth. Clearly it pays Portugal to obtain the bale of cloth through the allocation of seven and a half man hours to the production of wine rather than the allocation of ten man hours to the direct production of cloth.

In consequence, the pattern or specialization which emerges from comparative advantage is <u>simultaneously beneficial to both trading partners</u>, with the gains from specialization divided between them according to the international terms of trade which will settle somewhere between the two domestic price ratios.

It should be noted that trade here is caused by the differences in the relative productivity per man hour in cloth and wine production in England

and Portugal respectively, i.e., by <u>differences</u> between the production functions. If the man hours required to produce cloth and wine in Portugal were ten and sixteen, respectively, i.e. if they were twice those of England, all that would happen is that Portugal would have half the per capita income of England but no trade would occur. Thus it is a difference in relative efficiency which produces trade. However, since only one factor of production exists in this hypothetical world, relative factor endowments are not an issue.

To move from the simple Ricardian example to something more useful for the analysis of contemporary real countries and for the design of a comparative advantage oriented policy, the simple Ricardian framework needs to be expanded in several directions: the number of goods must be increased from two to a large number; the number of countries must be expanded from two to a multiplicity; the number of factors of production must be raised from one to at least several; and, it must be recognized that intermediate inputs are needed in addition to factors of production in order to produce output. In introducing these extensions, which will be done in the following subsections, attention must also be paid to the Hecksher-Ohlin source of trade, i.e., difference in the relative availability of factors across countries.

C. Ricardian Comparative Advantage with Multiple Goods

The existence of more than two goods causes a problem because binary comparisons may well no longer give a clear overall answer. It may turn out

that in comparing cloth with wine, Portugal has a comparative advantage in wine, whereas when comparing cloth with sewing machines, Portugal has a comparative advantage in sewing machines while between wine and sewing machines the comparative advantage lies again in wine (See Table 2). [1] Does it then follow that Portugal has first a comparative advantage in wine, next in sewing machines and not at all in cloth? or does it have comparative advantage only in wine?

What is needed to resolve this problem is to have a comparable unit which allows standard comparisons to be made between the productivity of Portugal as related to England in different lines of endeavor. Such a standard can be developed if we define cost of production in terms of man hours not per physical unit, i.e., per bale of cloth or per keg of wine, but rather per dollar's worth of purchase price of cloth, wine, or sewing machines. Assume for a moment that in England the man hours cost $1.00, then in our simple world, a bale of cloth would cost $5.00 in England and a keg of wine would cost $8.00. Correspondingly, in Portugal a dollar's worth of production of cloth would cost two man hours (10 man hours produce one bale worth $5) likewise, a dollar's worth of production of wine would cost one and a half man hours (12 hours produce one keg worth $8). Since on this scale the unit of output is standardized, i.e., a dollar's worth of imported commodity, the man-hour cost of a dollar's worth is also comparable . Thus it is possible now to rank them in the unique ordering from the lowest cost in terms of man hour per dollar to the highest cost.

––––––––––––––––––––

[1] This problem was long ago recognized and extensively analyzed by Edgeworth.

Table 2

Ricardian Comparative Advantage

	England	Portugal
	Costs of Production in Man-hours	
Cloth	5	10
Wine	8	12
Sewing machines	15	25
	Comparative Advantage	
Cloth-wine	C	W
Cloth-s. machines	C	S
Wine-s. machines	S	W

The resulting ranking is the simplest version of the measure of comparative advantage known as the "domestic resource cost of foreign exchange". It is useful to summarize this criterion in a simple formula:[1]

$$\text{domestic resource cost} = \frac{\underline{\text{man hours of labor per unit}}}{\text{import cost per unit}}$$

or

$$DRC = \frac{LHrs}{p^{CIF}} \tag{1}$$

D. Ricardian Comparative Advantage with Multiple Goods in Multiple Countries

The real world evidently consists of more than Portugal and England. Indeed, there are now over 100 members of the United Nations, all of which trade to some extent with each other. Under such circumstances, is it appropriate to take England as a standard of comparison, or should it be Japan, or should it be Burundi?

The standard economist's answer is that it does not matter since the existence of world trade will make all prices equal in the world market and therefore any single country's prices will do just as well as any other's, because in dollar terms they will all be equal. Unfortunately, however, this standard answer arises from international trade theory in the absence of tariffs and transportation costs. It turns out not to hold in a world containing transportation costs, import restrictions, export promotion policies, imperfect access to market information and markets which frequently fail to function in the manner assumed by competitive theory. Under such circumstances, we are likely to find quite different prices if we look at

---

[1] Note that when export products or activities are being evaluated the relevant price for the denominator is the FOB price.

the possibilities of importing from Japan, from England or from Burundi. Which price then shall we choose?

The policy analyst's answer is that we should choose the price from that country from which we are likely to import the commodity in question. Note that this may not necessarily be the country having the lowest price, since it is not always true that purchases will in fact occur from the cheapest source. The reason for this simple rule is that we need to have a measure which reveals to us the alternative which the country is in fact likely to use, not those which it might theoretically have available to it.[1] Thus what we will have as our benchmark for a dollar's worth of product is a list of commodities with their associated supplier countries, each item having a price per physical unit which is used as the basis for the calculation of the cost in terms of man hours per dollar's worth in that line of output.

The only difference then between the domestic resource cost of foreign exchange in a case in which there is only one supplying country and those in which there are many is that the price used to standardize our domestic resource costs is taken in the latter case from the country from which supplies in fact will appear. In consequence our formula continues unchanged:[2]

$$DRC = \frac{LHrs}{p^{CIF}}$$

---

[1] One might well ask why countries do not always buy from the cheapest source. The answer lies at least in part with the imperfection of the markets for goods and for information.

[2] See p. 11, footnote 1.

E.   Comparative Advantage with Multiple Factors of Production

When labor is not the only primary factor contributing to domestic resource costs but capital is used as well, and indeed when there may be different kinds of labor (e.g. skilled and unskilled), the calculation of comparative advantage indices of the Ricardian type become much more complicated. Now it may well be that in terms of man hours Portugal has a comparative advantage in wine rather than cloth, but that in terms of machines, it turns out to be the opposite, because wine presses are very expensive. In such a case, it would be incorrect to use any one of the indices: in the presence of additional factors of production, Portuguese costs in terms of man hours per dollar's worth of output would not indicate comparative advantage, nor would machine hours per dollar's worth of output, or any other single factoral measure. The only kind of measure that could correctly capture relative costs under such conditions is a measure of total factor costs. Such a measure, however, implies summing up the cost of each of the primary inputs. In order to do that, the relative prices of each of the inputs are needed, i.e. the price of unskilled labor, the price of skilled labor, the price of capital, etc. With such prices, it is possible to convert physical units of primary inputs into the value of such units, thus deriving a total cost index.

The prices used to sum up the physical units of inputs can have two different but interconnected interpretations. One way of looking at them is to think of them as representing utility foregone. Thus, for example, the

price of labor represents the marginal utility of leisure given up; the price of capital measures the marginal social utility of either the consumption foregone to generate the savings or the output foregone by not investing these savings elsewhere, and so on for the other relevant factors. Looked at this way, the prices used for summing factor costs measure the marginal social costs of these factors, in utility terms.

The second way of looking at prices is to think of them as reflecting the relative scarcities of the inputs. Obviously, the more plentiful a factor the lower would be its relative price and also the lower the utility cost of using it. Hence this interpretation is fully consistent with the previous one. Naturally those commodities intensive in lower priced (plentiful) factors would have lower domestic resource costs. Hence the inclusion of these prices integrates the Heckschen-Ohlin view of trade into the Ricardian one.

The domestic resource cost of foreign exchange in the presence of multiple input factors, then, represents a combination of the technology factor addressed by Ricardo, which is given by the physical factor intensities, and the relative scarcity of factors of production emphasized by Heckscher and Ohlin and represented by the relative shadow prices. At this point, therefore, we have a fully integrated index of static comparative advantage.

Our formula now needs to be modified as follows: [1]

$$DRC = \frac{LHrs \times cost\ of\ labor + KHrs \times cost\ of\ capital + \ldots}{p^{CIF}} \qquad (2)$$

F.   Incorporating Intermediate Inputs.

So far, we have been able to standardize units of output by taking commodities at their international prices and talking about dollars' worth of output. Most products, however, are produced not only by primary inputs such as capital and labor but also by raw materials. Thus the production of a given commodity domestically really means the generation of "value added", i.e. the production of value equal to the difference between the value of the product and the costs of the intermediate goods or raw materials necessary to produce it. Evidently this "value added" also has a world price, it is the difference between the world price of the product and the cost at world prices of its intermediate material inputs. Similarly, the costs of production of this value added are the costs incurred in the activity of transforming the inputs into the finished products.

In the presence of intermediate goods, therefore, it is necessary to find first the value added in production and next to price this value added in accordance with the world prices of the output and the intermediate inputs

---

[1]   Again footnote 1 of page 11 is relevant.

involved. The domestic resource cost of foreign exchange under those circumstances then becomes an index of the relative efficiency of producing dollars' worth of value added in given processing activities rather than being the cost of producing dollars' worth of given commodities. While it is apparent that the modification of base from commodities to value added has no conceptual complexity, it has great empirical importance and obviously important statistical and computational implications. Some of these are discussed in the appendix to this chapter.

Incorporating these concepts into our formula yields:

$$DDRC = \frac{LHrs \times cost\ of\ labor + KHrs \times cost\ of\ capital + ...}{_pCIF - Inputs\ required \times _pCIF} \quad (3)$$

The additional "D" before the DRC indicates "direct domestic resource costs", i.e. those incurred at the stage of processing under consideration.

G. The Cut-off Point Between Comparative Advantage and Comparative Disadvantage

With the DRCC index calculated for all relevant activities we obtain an ordering from best (i.e. smallest) to worst (largest). However it is useful in many instances to divide this list into two groups; those activities in which we have comparative advantage and those in which we have comparative disadvantage.

To define this cut-off point it is useful to recall what the DDRC index measures: the cost in terms of domestic welfare of producing a dollar. Naturally, it will be worthwhile undertaking such production whenever the welfare value of having such a dollar is at least as large as the cost of producing it. In such activities we will have a comparative advantage. However the welfare value of an additional dollar is by definition the shadow price of foreign exchange. We can therefore state a very simple rule:

> "A country will have comparative advantage in all those activities in which the domestic resource cost of production, taken at shadow prices, is less than or equal to the shadow price of foreign exchange."[1]

---

[1] It is worth noting that under the perfectly competitive assumptions, activating all sectors with comparative advantage will also yield full employment for all factors of production.

APPENDIX

DIRECT VERSUS TOTAL DOMESTIC RESOURCE COST OF FOREIGN EXCHANGE

A.   The Conceptual Problem:

Most stages of production in an economy buy inputs from previous stages of elaboration located in the same country. Thus for example the clothing industry may buy domestic cloth as an input. Under such circumstances, is it appropriate to calculate a DRC for clothing alone, as if it were importing all inputs, and then calculate a separate DRC for cloth production on the same basis, or is it more correct to calculate a DRC for clothing on the assumption it buys cloth domestically, thus in effect integrating both industries into one and obtaining a joint DRC? Evidently if clothing taken alone is an industry with comparative advantage, but cloth is not, calculating a joint DRC (or total DRC as it is usually called) may well make clothing appear as an industry with comparative disadvantage. Thus the question is one of considerable practical import.

The solution to the problem appears to lie in the principle of reality: if an increase in clothing production will lead to greater purchases by the industry of domestic cloth, with greater ensuing production, then a joint DRC must be calculated. If greater cloth output leads to greater domestic cotton production, then the DRC must consider clothing, cloth and cotton taken together.

In other words the DRC should be calculated at the level of vertical integration in fact found or expected in reality.

B.   Determining Sourcing

It is tempting to derive conclusions regarding the extent of vertical integration in an economy from the proportion of a given market supplied by the domestic producers. Thus in the example above, if the domestic cloth makers provide 60% of the cloth used in clothing manufacture, it is tempting to conclude that 60% of additional demand will be met by local producers. However, such a conclusion is very questionable. Indeed, if 40% of the cloth used is imported it may well mean that domestic capacity is already fully utilized by the first 60% and so any additional demand would have to be met fully from imports.

Which situation reflects reality requires careful analysis with market structure, quality differences of goods and level of aggregation all playing a role. Historical proportions of usage, however, are rarely a reliable guide to adjustments when increments are at issue.[1]

---

[1] By the same token the import coefficients for goods produced in the country are among the least reliable elements in Input-Output tables.

III

Dynamic Comparative Advantage

A.   Why the Future Constrains the Present.

If decisions taken today could be easily undone tomorrow our planning horizon would not need to be more than one day long and life would be very simple: we would minimize each day afresh in view of the opportunities of the day. No preparations for the events of tomorrow would be needed. Such is the world of infinite flexibility and infinitely short recontracting periods of static economy theory.

As soon as a decision taken today can no longer be undone tomorrow without costs, the future needs to be taken into account in taking action in the present. One such situation arises with regard to the formation of fixed capital. In that case, the machine bought and installed today will last for fifteen, twenty, or perhaps thirty years; moreover, it can be used only to produce the range of output for which it is designed. Thus, it only makes sense to install a particular kind of machine if conditions over its lifetime justify it. To look only at the first instant, or year, of the life-time of the machine is obviously not a complete nor sufficiently comprehensive view, rather it is necessary to look ahead a number of years so that as much as possible of the present value of the future effects be captured.

What occurs with the investment decision in fixed capital also occurs with all other kinds of asset formation, such as production skills, marketing

skills, etc., i.e. all the assets called human capital, so long as they are particularly useful for a specific kind of economic activity. However, since investment decisions on the creation of physical and human capital are at the heart of development policy making, and most production activity generates training (human capital) as a by-product, the future must always affect present decision making. Hence, a dynamic framework is essential and a complete understanding of comparative advantage cannot stop with the consideration of static comparative advantage as outlined in the previous section.

B. Ways in which the Future is Different from the Present:

The future is likely to differ from the present in a number of significant ways, which affect the comparative advantage ranking. It is useful to classify these changes into three kinds: i) world environment changes, ii) internal environment changes, iii) technological changes.

i) World Environment Changes: From a comparative advantage point of view, the world environment consists of the prices at which a country can buy or sell on the world market. These prices naturally change with time and at different rates. This is true even in the context of world inflation. However, if the prices of mineral products rise faster than those of agriculture, a country's comparative advantage will be shifted towards mining. If the prices of steel products fall relatively to general inflation, a country's comparative advantage will shift away from steel produc-

tion and perhaps towards steel transformation activities. Changing world prices then are an essential element in changing comparative advantage.

ii) Domestic Environment: An essential element of the comparative advantage situation is the cost of domestic factors of production. These costs are unlikely to stay unchanged over time. To begin with, the availability of resources changes: the savings process raises the stock of physical and human capital; the biological reproduction process changes the stock of labor available; the institutional evolution modifies the markets in which factor prices get formed, and thus the manner in which shadow prices need to be calculated. Moreover, it is often action taken in the present which causes these circumstances to be different in the future. However, if the marginal social costs of factors change in disparate ways, modifying the relative scarcity values, this will have an impact on the comparative advantage ordering, changing it from one period to the next, since different activities have different factor intensities. The time path of the shadow prices of domestic factors is thus an intrinsic component of dynamic comparative advantage.

iii) Changing Technology: The technology of production is not static over time and as it changes, it modifies the required inputs to generate a certain output, thus changing the domestic resource cost in the activity concerned. If these changes are not proportional across economic activities, a likely situation, then the ranking by comparative advantage will also change over time.

Changes in technology may be exogenous to the country, in which case they may be offset in part by price movements in the rest of the world, or they may be endogenous, resulting from either increased assimilation of existing world technology or from learning-by-doing, i.e. increased experience with production in certain lines of activity. Either way, technical change will significantly affect comparative advantage over time. However note that if technology changed due to learning-by-doing, it is today's production which modified tomorrow's comparative advantage.

C. The Simple Dynamic Analogue to the Static Domestic Resource Cost Measure

The most straightforward way of incorporating the dynamic elements discussed in the previous sections into a DRC calculation is to perform such a static calculation for each relevant time period and then to take the weighted sum of the annual calculations, using social time preference discount rate as weights. In terms of our previous notation such a "dynamic" DDRC would look as follows:

$$(4) \quad \text{Dyn DDRC} = \sum_{t=0}^{t=n} \frac{1}{d^t} \left(\frac{\text{LHrs}_t \times \text{cost of labor}_t + \text{KHrs}_t \times \text{cost of capital}_t \ t \ldots}{\text{Net foreign exchange earned}_t} \right.$$

These present value DRC's can be ranked in exactly the same way as a static one is ranked and would give an indication of the "average" comparative advantage of the different sectors over the planning horizon. Correspondingly, they are comparable to the average shadow price of foreign exchange for the period, thus allowing separation between the group of activities in which the country has comparative advantage and those in which it has comparative disadvantage.

$$\text{Dyn DDRC} \gtreqless \sum_{t-0}^{t=n} \frac{1}{d^t} \quad \text{Shadow Price of Foreign Exchange}_t$$

The approach outlined above has the great advantage of simplicity, however it does not take into account the full complexity of the dynamic situation since it assumes that no year's DRC's, i.e. the technology and prices underlying them, are affected by the production choices of previous years. However, one of the characteristics of the dynamic problem is that factor prices in any one year depend on level and mix of output in previous years through the savings decision. Likewise, any one year's technology depends on previous production decisions since learning-by-doing takes place. As a result we cannot consistently forecast a particular year's DRC's unless we know what activities the economy operated in previous years. At the same time that earlier activation should depend on what happens in the present. Thus past and present need to be simultaneously determined. The simple analogue must therefore be recognized to be an approximation to a simultaneous calculation requiring much more complex mathematical procedures.[1] How good an approximation it is depends on the empirical situation as well as on the quality of the nonsimultaneous estimates used as inputs into the DRC calculation.

---

[1] See Lucas, Manove, Schydlowsky, and Wan . . . for a discussion. Dynamic Comparative Advantage: Towards an Empirical Approach, June 1978.

D.   Bringing in the Past

The past has left a heritage in the form of existing fixed assets and a stock of human capital. Whether the accumulation and installation was in accordance with the comparative advantage of the country or not, this heritage constitutes the starting point for a comparative advantage-based policy at the present.

Assimilation of the heritage of the past into the Dynamic DDRC calculations is straightforward: where installed capacity exists costs are taken on a marginal basis, in other words, installed capital is regarded as a sunk cost.[1]

The result is likely to be that a country's comparative advantage will differ markedly while past investment is being worn out compared to what it will be when it is exclusively based on new capital put in place.

---

[1] Notice that in some cases a user cost may be appropriate.

Comparative Advantage and Structuralism: A Digression

Comparative advantage policy is well known in Latin America, but not by that name. Rather it is called industrialization policy, associated with structuralism, and CEPAL, and Prebisch. The comparative advantage policy of this paper is both more general in that it does not presume a preference for industrialization before looking at the numerical results, and more specific, in that it indicates which industries are preferred. It is worth relating some of the well-known propositions of structuralism to the approach of this paper.

Structuralism emphasizes imperfections in the functioning of markets in Latin America and the consequent need for government intervention. In this it coincides with the approach of this paper, where the role of shadow prices of factors of production is given a central function, while simultaneously providing a quantification to the malfunctioning of markets.

Structuralism argued that market forces tending to encourage specialization and trade by exporting primary products and importing manufactured goods, were working against Latin America's long-run interest and long-run advantage was seen as historically declining terms of trade. From these observations structuralism derived its policy program supporting industrialization. In this paper we regard changes in world prices as one of the elements of dynamic comparative advantage, however, several other elements also enter to determine the outcome, among them (i) learning by doing, (ii) changes in domestic shadow prices (iii) changes in technology.

Moreover, it should be noted that the historical evidence regarding long-run decline in the terms of trade of primary producers is very much in doubt. Price trends of different primary products are so divergent as to render any broad generalization virtually impossible. Furthermore, even if the historical record of declining terms of trade could be firmly established, its usefulness as a guide to future price trends is doubtful. This is so because the recent popular observation that the world is entering an era of increasing resource scarcity argues for a break with past trends in favor of improving terms of trade for primary producers.

In sum, comparative advantage analysis, as exposited in this paper not only incorporates the elements central to industrialization policy, as proposed by the structuralist school, but sets the problem in a broader context as well as one capable of quantitative assessment. It should be noted that some structuralist critics of neoclassical economics have criticized comparative advantage policy as synonymous with pro-free trade policy. But this is not correct.

V

Operating Principles

A development policy based on dynamic comparative advantage is obviously complex and would require fine tuning in excess of what can reasonably be expected in any economy, let alone of one where information is scarce, data arrives late and the information content is often subject to dispute. In such a situation, it is necessary to distill some basic operating principles which allow the policy maker to take advantage of the concepts of dynamic comparative advantage while not being required to subject himself to the constraints of precise and detailed planning. In the following, we attempt to list the main principles which constitute the guidelines for such a policy.

A. Short to Medium Term Statics

The static DRC for existing industries is easy to calculate. It shows the relative costs of operating different productive activities in which the country has productive capacity. The calculations enable the policy maker to assess the relative efficiency and desirability of these activities. Beyond this, however, it is useful to distinguish between the short run DRC, i.e. one in which production proceeds from existing installed capacity and capital costs can be regarded as sunk, and the medium term DRC, in which new investment is required. Making this distinction permits a time frame which may well cover some three to five years for existing industries.

B.   Dynamics of Sensitivity Analysis:

Moving into a longer term dynamic context involves incorporating

three elements:

1)   Non existing industries: This involves essentially undertaking

DRC calculations based on coeficients borrowed from other countries. Such

calculations can then be fit into the medium term results on the existing

industries.

2)   Incorporating "efficiency" growth for existing industry as well

as for newly established industry. The potential effect of such change in

production functions can be derived by recalculating the DRC's at the input

coefficients representing best technology available internationally, and

seeing to what extent and in what magnitude recrderings occur.

3)   Incorporating changes in the shadow prices, which can be estimated

exogenously as a result of the macroeconomic policy changes adopted.

C.   Policy Testing by Sensitivity Analysis

A major lesson of dynamic comparative advantage is that it may be

advisable to incur efficiency losses in the short run in order to benefit

from training effects in the long run. Such considerations justify protec-

tion. However, such protection can easily get out of hand. Hence sensitivity

analysis should be used to calculate what increase in efficiency must result

from the protection given in order to justify the incentive.

D. Sectoral Coverage.

The approaches described above can be applied to the industrial sector
alone or to additional sectors as well depending on data availability as
well as policy purposes.

BOSTON UNIVERSITY
CENTER FOR LATIN AMERICAN DEVELOPMENT STUDIES

DISCUSSION PAPER SERIES

(*) ___ 1. Project Evaluation in Economies in General Disequilibrium:
An Application of Second Best Analysis
March 1973   46 pages   - Daniel M. Schydlowsky

(*) ___ 2. Methodology for the Empirical Estimation of Shadow Prices
April 1973   49 pages   - Daniel M. Schydlowsky

(*) ___ 3. A Note on Distributional Considerations in Social Benefit/
Cost Analysis
April 1973   17 pages   - Daniel M. Schydlowsky

___ 4. Chile Under Allende
May 1973   20 pages   - P.N. Rosenstein-Rodan

___ 5. International Trade Policy in the Economic Growth of Latin
America
May 1973   38 pages   - Daniel M. Schydlowsky

___ 6. Influencia del Mercado Financiero sobre la Utilización de
Capacidad Instalada
May 1973   23 pages   - Daniel M. Schydlowsky

___ 7. Discussion on Chile: Diagnosis and Prognosis
November 1973   7 pages   - P.N. Rosenstein-Rodan

___ 8. Consistency in Measuring Capacity Utilization
March 1974   30 pages   - Patricio Millan

___ 9. Multiple Shifts in the Pure Investment Decision
December 1974   95 pages   - Patricio Millan

___10. In Support of Democracy in Latin America
April 1975   10 pages   - Carlos Lleras Restrepo

___11. Price and Scale Obstacles to Export Expansion in LDC's
April 1975   31 pages   - Daniel M. Schydlowsky

___12. La Ampliación de Turnos en la Industria Chilena: La Factibil-
idad de una Política de Empleo Productivo
April 1975   69 pages   - Joseph Ramos

___13. Guidelines for Policies to Increase the Use of Capital
Through Multiple Shifts in Industrial Plants
June 1975   28 pages   - Patricio Millan

___14. The Theory of Capital Utilization: Some Extensions
October 1975   31 pages   - Christopher Clague

(*) Available also in Spanish

(*) ___ 29. Design of Benefit/Cost Analysis of Investment Projects in Peru:
A Country-Specific View.
October 1977   118 pages   - Daniel M. Schydlowsky

___ 30. A Monetary Approach to the Crawling-Peg System: Theory and
Evidence
January 1979   33 pages   - Mario I. Blejer
                                          Leonardo Leiderman

___ 31. Strike Activity and Wage Determination Under Rapid Inflation:
A Quantitative Study of the Chilean Case
January 1979   22 pages   - Mario I. Blejer

___ 32. The Anatomy of an Economic Failure: Peru 1968-78
February 1979   116 pages   - Daniel M. Schydlowsky
                                            Juan J. Wicht

___ 33. The Effects of Unanticipated Money Growth on Prices, Output
and its Composition in a Fixed-Exchange-Rate Open Economy:
The Mexican Experience
July 1979   38 pages   - Mario I. Blejer
                                       Roque B. Fernandez

___ 34. Relationships Between Macroeconomic Time Series in a Fixed-
Exchange-Rate-Economy
July 1979   52 pages   - Leonardo Leiderman

___ 35. Inflation and Relative Price Variability in the Open Economy
September 1979   41 pages   - Mario I. Blejer
                                            Leonardo Leiderman

___ 36. Containing the Costs of Stabilization in Semi-Industrialized
LDC's: A Marshallian Approach
December 1979   102 pages   - Daniel M. Schydlowsky

___ 37. Why an Initial Increase in Exports of Labor Intensive Manu-
factured Goods May Not Create Much Additional Employment:
A Hypothesis
June 1980   25 pages   - David Morawetz

___ 38. Production Efficiency and the Transferability of Input-Output
Coefficients
June 1980   39 pages   - David Wheeler

___ 39. Benefit-Cost Analysis Methodologies: Untangling Their
Equivalences and Discrepancies
June 1980   86 pages   - Luis Ramirez

(*) Available also in Spanish

(*) ___ 40. A Policymaker's Guide to Comparative Advantage
            June 1980   34 pages   - Daniel M. Schydlowsky

    ___ 41. The Vulnerability of Small Semi-Industrialized Economies to
             Export Shocks: A Simulation Analysis Based on Peruvian Data
             June 1980   27 pages   - Daniel M. Schydlowsky
                                                   Martha Rodriguez

    ___ 42. The Short Run Potential for Employment Generation on Installed
             Capacity in Latin America
             June 1980   7 3 pages   - Daniel M. Schydlowsky

Institutional exchange may be arranged or single copies purchased as noted below.
Send check or money order made out to: Boston University, CLADS; attention
Librarian, 745 Commonwealth Avenue, Boston, Massachusetts 02215. Prices:

10-30 pages $1.00
31-60 pages $2.25
61-100 pages $3.50
101-200 pages $4.50

(Papers will be sent surface rate unless request is made for first-class or
 air-mail delivery, in which case an additional charge will be made.)

(*) Available also in Spanish

Boston University

Department of Economics
College of Liberal Arts
270 Bay State Road
Boston, Massachusetts 02215
617/353-4440

Cable: BUECONOMIC

BOSTON UNIVERSITY DEPARTMENT OF ECONOMICS

DISCUSSION PAPER SERIES

The following Discussion Papers are available for a nominal charge of $1.00 each. Orders or inquiries should be addressed to: Librarian, Department of Economics, Boston University, 270 Bay State Road, Boston, Massachusetts, 02215. Please make checks payable to Boston University, Department of Economics.

1. Capital Utilization, Growth, Employment and Balance of Payments and Price Stabilization
March 1977
      - Daniel M. Schydlowsky

2. Hedonic Wage Equations and Psychic Wages in the Returns to Schooling
March 1977
      - Robert E. B. Lucas

3. Is There Excess Health Insurance? Comments on Feldstein
March 1977
      - Thomas G. McGuire

4. National Health Insurance and the Market for Private Psychiatric Services
March 1977
      - Thomas G. McGuire

5. The Black Market for Foreign Exchange and the Domestic Demand for Money: Some Theoretical and Empirical Issues
March 1977
      - Mario I. Blejer

6. The Subsidy and Countervailing Duties Negotiations and the Developing Countries
March 1977
      - Daniel M. Schydlowsky

7. Economic Growth, Income Distribution, and the Political Process in Less Developed Countries *
June 1977
      - Gustav F. Papanek

8. Variances in Returns to Human Capital
June 1977
      - Robert E. B. Lucas

9. Measurement of Private Efficiency Under Diverse Technologies in Indian Agriculture *
June 1977
      - Prem S. Vashishtha

10. Sharing, Monitoring and Incentives: Marshallian Misallocation
    Reassessed
    June 1977
                                                    - Robert E. B. Lucas

11. A Human Capital Quandary
    June 1977
                                                    - Robert E. B. Lucas

12. The Stabilization of a World Economy: A Simple Model
    June 1977
                                                    - Henry Y. Wan, Jr.

13. Three Variations on a Theme of Samuelson
    June 1977
                                                    - Henry Y. Wan, Jr.

14. Shumpeterian Waves of Innovation and Infrastructure Development in
    Great Britain and the United States: The Kondratieff Cycle Revisited
    June 1977
                                                    - David Wheeler and
                                                      Raymond S. Hartman

15. Budget-Maximizing Agencies and Efficiency in Government
    December 1977
                                                    - Thomas G. McGuire,
                                                      Michael Coiner, and
                                                      Larry Spancake

16. Sex, Marriage, Children and Statistical Discrimination
    May 1978
                                                    - Paul Osterman

17. Racial Differentials in Male Youth Unemployment
    May 1978
                                                    - Paul Osterman

18. Education and Labor Markets at the Turn of the Century
    May 1978
                                                    - Paul Osterman

19. Expectations and Output - Inflation Tradeoffs in a Fixed Exchange
    Rate Economy
    June 1978
                                                    - Leonardo Leiderman

20. I Waive My Right to Read This Recommendation: A Theoretical Analysis
    of the Buckley Amendment
    (Bell Laboratories and New York University)
    June 1978
                                                    - Michael Manove and
                                                      J. Ordover

21. On the Theory of DRC Criteria
    August 1978
                                                    - Robert E. B. Lucas

22. The Real Value of International Financial Assets: An Application to
    Non-Oil LDC Debt
    August 1978
                                                    - Millard Long and
                                                      Frank Veneroso

23. The Debt-related Problems of the Non-Oil Less Developed Countries
    September 1978
                                                    - Millard Long and
                                                      Frank Veneroso

38. Output Supply in the Open Economy: Some International Evidence
    July 1979
                                              - Leonardo Leiderman

39. Unanticipated Movements in Aggregate Demand and the Business
    Cycle: Results From Variance Decompositions
    July 1979
                                              - Leonardo Leiderman

40. Black Youth Unemployment: A Review of the Evidence and Some
    Policy Recommendations
    July 1979
                                              - Paul Osterman

41. Moral Hazard, Bandwagon Effects and Psychiatrists' Influence
    on Demand: An Empirical Study of Insurance and Demand for
    Private Psychiatric Care
    August 1979
                                              - Thomas G. McGuire

42. Optimal Patents with Compulsory Licensing
    August 1979
                                              - Pankaj Tandon

43. The Corporation Tax and Incentives to Undertake Risky Investments
    August 1979
                                              - Pankaj Tandon

44. Rivalry and the Excessive Allocation of Resources to Research
    August 1979
                                              - Pankaj Tandon

45. The Rate of Technology Diffusion to Developing Countries -
    Yugoslavia and Mexico
    August 1979
                                              - Peter Cory

46. Education, Training and Employment in Worcester
    Part I - Objectives and Methods
    May 1979
                                              - Donna Olszewski and
                                                Hubert Smith

47. Education, Training and Employment in Worcester
    Part 2 - High School Evaluation
    May 1979
                                              - Donna Olszewski and
                                                Hubert Smith

48. Education, Training and Employment in Worcester
    Part 3 - Education and Training History
    May 1979
                                              - Donna Olszewski and
                                                Hubert Smith

49. Education, Training and Employment in Worcester
    Part 4 - Job Characteristics
    May 1979
                                              - Donna Olszewski and
                                                Hubert Smith

50. Improving School-to-Career Linkages: Policy Options for
    Occupational Education and Training
    August 1979
                                              - Bruce Vermeulen

51. Projecting Labor Market Trends for Education and Training
   August 1979   - Susan Hudson-Wilson

52. Private Sector Employment Strategies: How Employers Hire and
   Train
   August 1979
                                    - Michael Diggins and
                                      Bruce Vermeulen and
                                      Susan Hudson-Wilson

53. Career Paths and Vocational Education
   August 1979
                                    - Donna Olszewski

54. The U.S. System of Occupational Education and Training:
   Profile, Performance and Policy
   August 1979   - Patricia Flynn Pannell

55. International Migration: Economic Causes, Consequences,
   Evaluation and Policies
   August 1979   - Robert E. B. Lucas

56. Budget-Maximizing Governmental Agencies: An Empirical Test
   September 1979   - Thomas G. McGuire

57. On the Non-Existence of Index-Linked Corporate Debentures
   July 1979   - Paul Beckerman

* These Papers also are available through the Center for Asian Develop-
ment Studies Discussion Paper Series.