

Sustainable Trade Relations in a Global Economy*

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Abstract

This paper illustrates, how experimentation with a system dynamics model may be used to determine the terms of trade for meeting long term contentions for sustaining global economic relations and environment. It has two parts, a review of empirical evidence that describes the trends in the volume and the nature of international trade over the past decade, and an exploratory analysis of their implications for the emergent contentions for global development and environment. The first part draws on secondary data and literature. The second part attempts to reinterpret in the global context an existing model I developed originally to understand valuation and income distribution processes in a dualist economic system within a developing country. The exploratory nature of the second part should be accented since the model it draws on was developed for a different purpose and the analysis of this paper only addresses its relevance to the global context without modifying any component of the model structure, hence it has some limitations. The original model focused, however, on the determinants of value accrued to the parties contributing to the production process, which is relevant both to income distribution within a country and the transfer of value and environmental costs through trade between countries. The experimental process adopted in the paper is seen to be of value for designing global agreements committing concerned parties to complex roles.

Key Words: trade, environment, economic development, contract design, global modeling, system dynamics, computer simulation

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Introduction

Trade, competition and specialization are the cornerstones of the neo-classical concept of economic efficiency now being extended to the global economic system, although without adequate consideration of its structure. In contrast to the protectionist policies applied at the time the industrialized countries were developing, free enterprise and free world trade are emphasized at this time. Unfortunately, the terms of this trade arrived at through the adversarial processes currently applied are likely to be biased by the bargaining power of the concerned parties rather than being cognizant of the stated development/environment contentions. Indeed, the current terms of trade remain unfavorable to the developing countries, creating a net transfer of value from the developing to the industrialized world. The evolving patterns of regional composition of production and trade are also poised to transfer a wide range of environmental costs from the industrialized to the developing countries. The specializations of production emerging in this system are characterized by the developing countries covering highly competitive market niches dealing with products with a high resource content and low added value while the industrialized countries cover monopolistic niches with a high added value content. The manufacturing processes involved in these niches are, likewise, more taxing to the local environment for the former than for the later group [Todaro 1994, Saeed 1996]. Such patterns can create much conflict and confusion in the future. It appears a bit ludicrous, therefore, to issue appeals for global cooperation on developmental/environmental issues while concomitantly pressing for free trade without considering the economic structure in which this trade is conducted.

Using the experimental procedure of system dynamics modeling, this paper illustrates that free trade policies applied at the global level will not yield the objectives of sustaining world development and environment stated by their proponents. The analysis of the paper has two parts, a review of the empirical evidence that shows the trends in the volume and the nature of global production and trade over the past decade, and an exploratory analysis of their implications for the control of global resources and the preservation of environment. The first part draws on secondary data and literature. The second part attempts to reinterpret in the global context an existing model I developed originally to understand the income distribution processes in the dualist economic system of a developing country. The second

part is posited as an exploratory exercise since the model it draws on was developed for a different purpose and the analysis of this paper only addresses its relevance to the global context without modifying any part of its structure, hence it has limitations. The original model focused, however, on the determinants of value accrued to the parties contributing to the production process, which is relevant both to income distribution within a country and the transfer of value and environmental costs accrued to the concerned parties through trade between countries. The experimental approach adopted in the paper is seen, albeit, to be of value to drawing functional agreements involving the commitment of parties to new and untried roles to be played in a complex global system [Saeed and Brooke 1996].

Patterns of production and trade

Given that global integration involves both specialization in production and a free exchange of commodities and production factors, both production and trade flows should be examined to discern the emerging patterns. At the outset, the global economy can be divided into the industrialized and the developing country blocks which are intrinsically different in terms of their markets, motivations, enablements and access to production resources and technology. The former block consists of profit maximizing coalitions operating in established niches and controlling a major part of the global production as well as its technology. The later constitutes fringe producers competing in small market segments often with the responsibility to maximize consumption rather than profit. The global economy, therefore, can be viewed in the aggregate to have a dualist economic structure, with a formal sector consisting of the industrialized countries and an informal sector comprising the developing countries. With an increasing interaction occurring between the subeconomies of this dualist system, the resource base of one country often extends to other countries. Thus, trade pricing structure and the nature of trade flows cannot be divorced from the environmental agenda.

Figure 1 compares the fractional and absolute growth rates in the two blocks. While the fractional growth rates are higher for the developing countries, they remain insignificant in absolute terms

compared to the industrialized countries. Figures 2 and 3 compare respectively cumulative changes over 1975-1990 and the absolute levels of production [UNIDO 1992].

Evidently, irrespective of the high fractional growth rates in the developed countries, the absolute amount of their production as well its cumulative growth continue to be small compared with the industrialized countries. Another point to be noted is that the absolute amounts do not represent quantities but the accrued values, which are not independent of the basis for pricing the inputs applied and the goods produced.

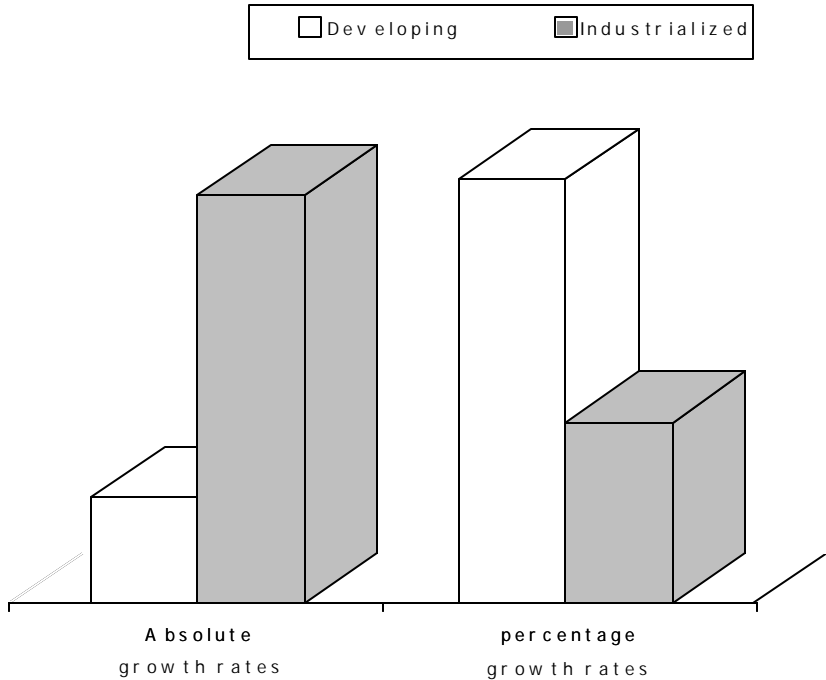


Figure 1 Absolute and fractional rates of growth in world production
data source: UNIDO 1992

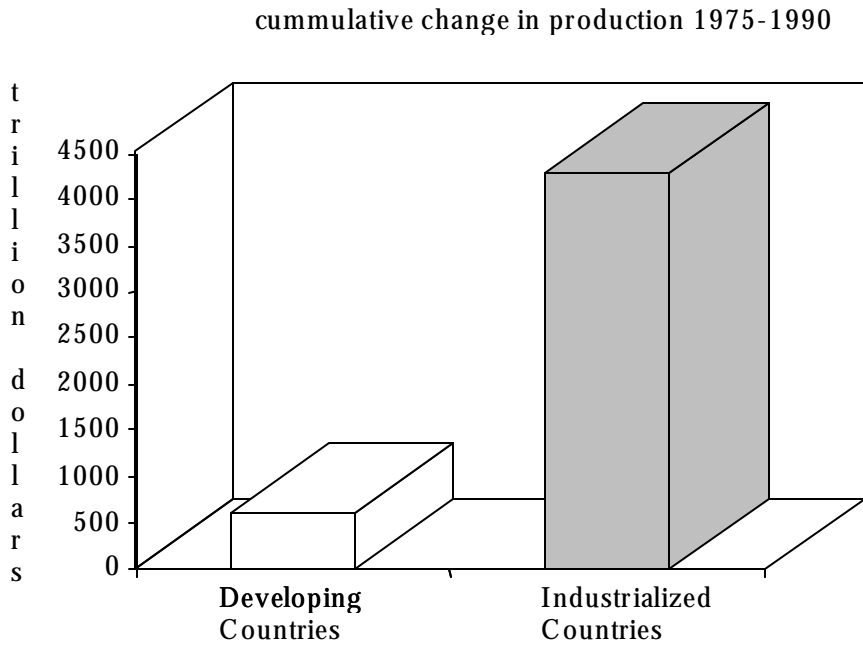


Figure 2 Estimate of cumulative change in World production 1975-1990
data source: UNIDO 1992

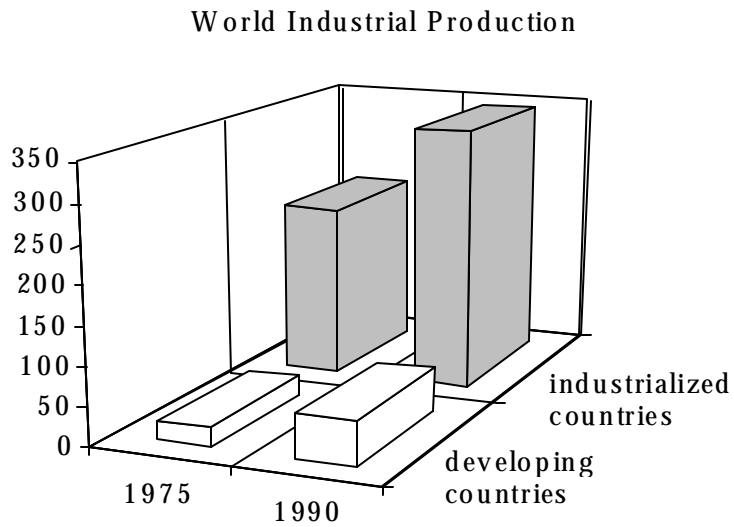


Figure 3 Developing and industrialized country shares in world industrial production
data source: UNIDO 1992

A comparison of the composition of production in the various country groups is shown in Figures 4 and 5. These figures illustrate that the composition of the output for the two categories of economies is different. Industrialized economies have moved to producing a larger share of services and goods with high value added content, while developing economies continue to concentrate on primary production and manufacturing with low value added content. It should again be noted that value added measurement is not independent of the criteria underlying the valuation process, which needs to be clearly understood before any judgments can be made on how the two groups should engage in trade and be held responsible for preserving the exclusive as well as shared parts of their common environment.

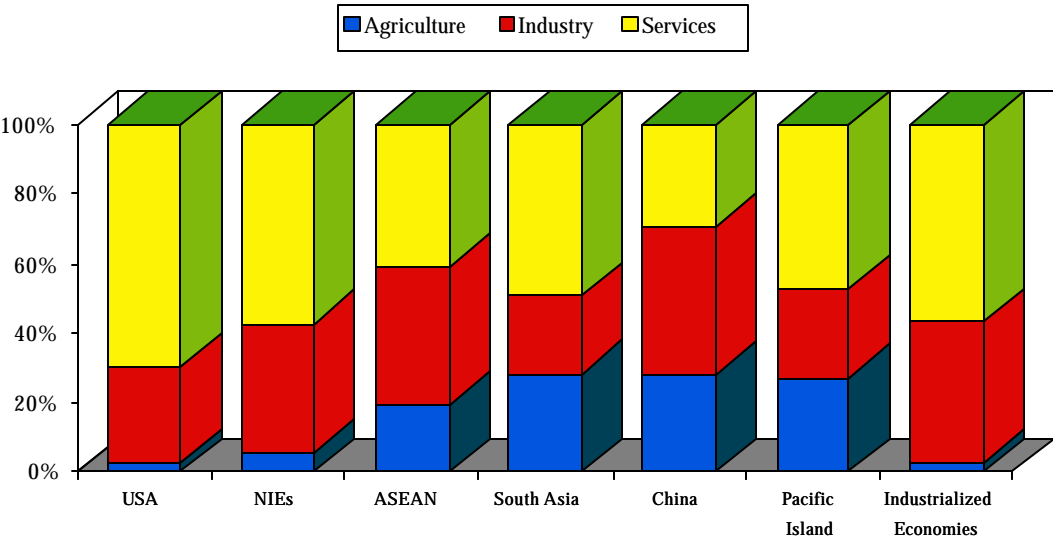
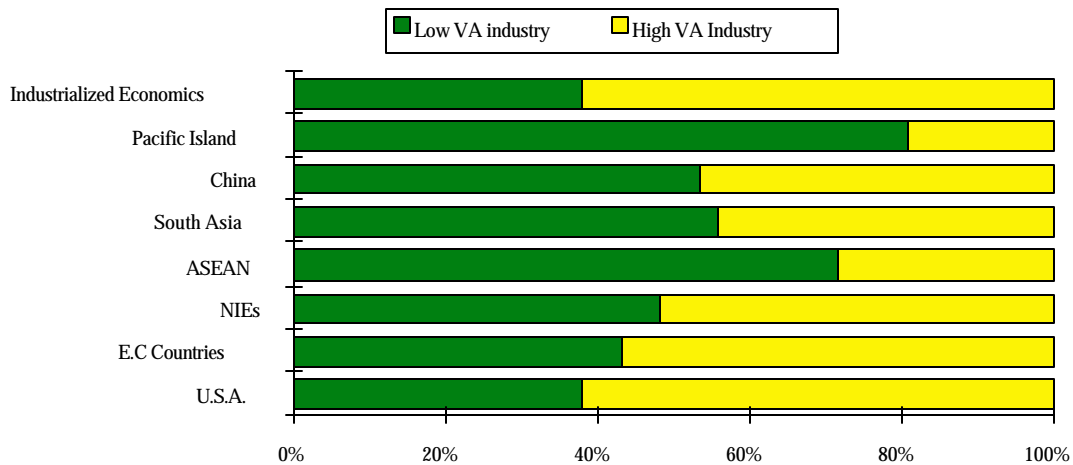


Figure 4 GDP composition in 1990
 source: United Nations (1992). National Accounts Statistics, Main Aggregates and Detail Tables 1990. New York



Sources: UNIDO. (1992). Industry and Development, Global report 1992/93. Vienna

Figure 5 Industrial production by value added categories

Figure 6 shows worker productivity in manufacturing for a sampling of country groups belonging both to the industrialized and the developing categories, measured in terms of value added per worker, which is consistently lower in the developing countries than the industrialized ones. Since value added is determined in terms of money by market considerations, rather than by the cost of inputs, whose determination also does not have an absolute basis, market distortions would often determine what is produced, where it is produced and how it is priced [Bhagwati 1977, Robinson 1979, Von Uexkull 1992]. Thus productivity measurements are also not independent of the valuation process.

Figure 7 illustrates the world trade volume over the decade 1980-1990. It is observed that the trade flows have almost doubled over this period. This increase is accompanied, however, by a worsening of the terms of trade for the developing countries. The import quotas, the favored nation status, the regional trade agreements, while advocating the free trade paradigm on surface, appear to have promoted the trade advantage of the industrialized countries at the cost of the developing countries. According to Jakob von Uexkull,

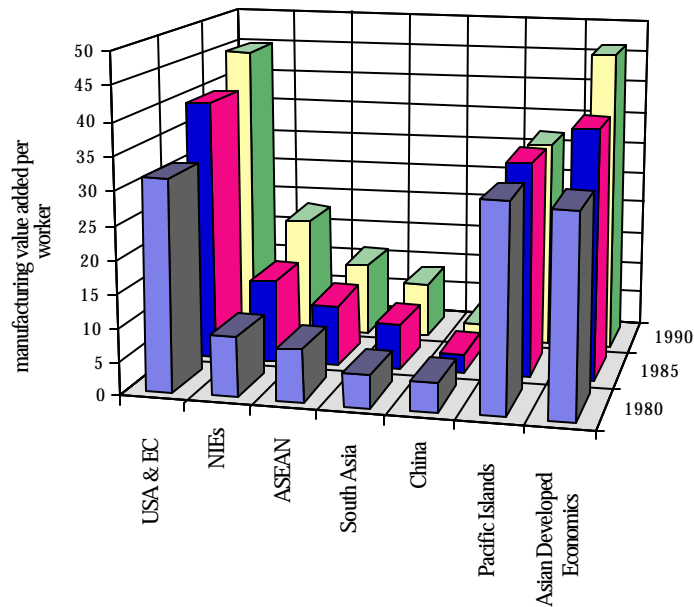


Figure 6 Manufacturing value added per worker
source: Saeed and Acharya (1995)

"The present global order appears to recognize only those needs it can satisfy and to see as real only those problems *for which it can offer solutions*. Its amazing shortsightedness is exemplified by the current GATT negotiations, which will create a framework for the global economy – totally at odds with the poor and the environment and designed to circumvent democratic institutions. Laws for the protection of people and environment are to be restricted and localized, while laws for the protection of corporate profit will be globalized. The opportunity to band weak pollution controls and other externalization of environmental causes as unfair trading practices has been missed – thus insuring that any national problems will be globalized and more difficult to repair." [Von Uexkull 1992].

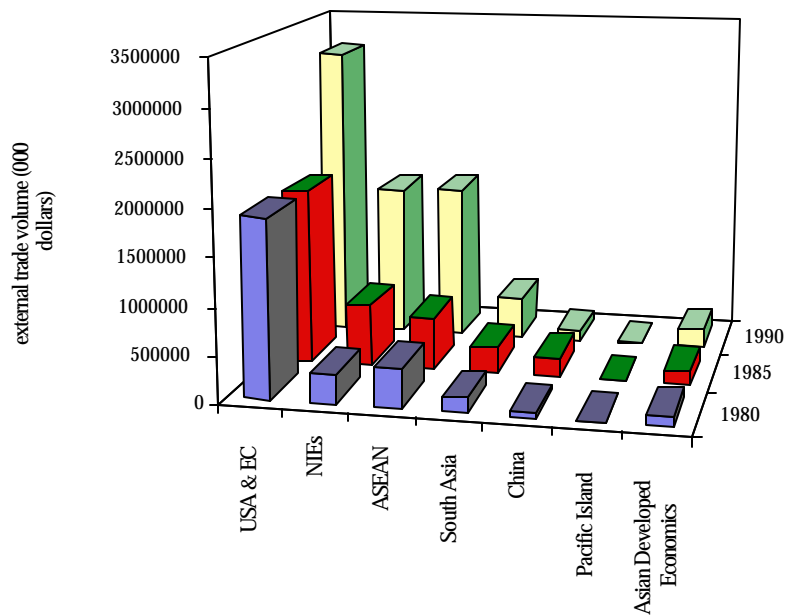


Figure 7 External trade volume
source: Saeed and Acharya (1995)

Figure 8 shows the composition and the growth of trade flows between a sampling of industrialized trade blocks (USA, EU, Asian developed countries) and developing regions (South Asia, ASEAN, China). Figure 8 also registers an alarming increase in the trade of environmentally unfriendly commodities, mostly industrial chemicals and hazardous waste in both directions. Although, desegregate data giving the composition of environmentally unfriendly products traded is not available, there is growing evidence that both hazardous industrial chemical production and the import of hazardous waste are on the rise in the developing countries [Saeed and Acharya 1995]. Either way, the risk of potential environmental damage in the developing countries is rising. Needless to add that some economists see this process to be appropriate for achieving economic efficiency on a worldwide scale, irrespective of its discriminatory nature [Chichilinsky 1994, Walter 1982].

■ resource intensive ■ low VA ■ high VA ■ envi unfriendly

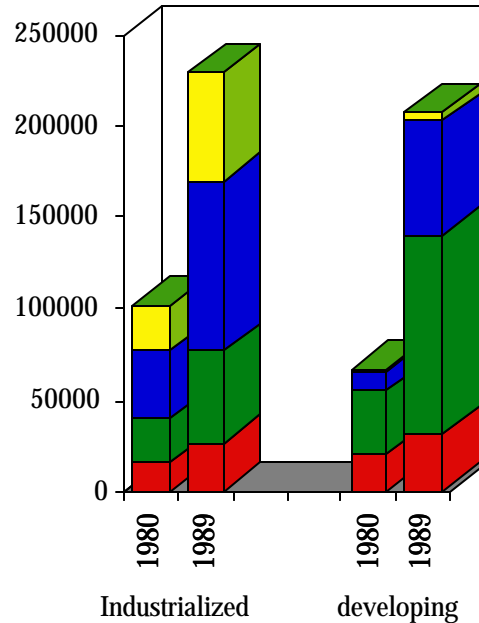


Figure 8 Composition of trade between industrialized and developing countries
source: Saeed and Acharya (1995)

An industrial structure responsive to international trade would indeed tend to transfer environmental costs to the countries with lower economic and political muscle, unless a dispassionate consideration of the environmental costs and benefits to the trading partners enters international trade negotiations [Chichilinsky 1994, Copeland and Taylor 1994]. While export oriented industrial development has become an important economic strategy, the construction of sophisticated trade instruments have regulated this trade in a way that the developing countries must buy more of the high-priced and technologically sophisticated imports while competing fiercely to meet the demand for the resource intensive and technologically unsophisticated exports with low value added content. Distortions in trade and investment policies, such as tariffs, quotas and restrictions on foreign capital movement can result in some countries gaining at the expense of the others. When the environment is treated as a common

property resource on which costs can be freely externalized, the resources of one country can be freely depleted by another through trade flows distorted by an unrealistic price structure.

The trade flow data presented in this section has demonstrated that the developing countries have been compelled by the global market to rely heavily on their natural resource endowments to support their real income and earnings of foreign exchange. The industrialized countries, on the other hand, have undergone a change from raw material processing and heavy manufacturing towards knowledge intensive products and services. The trade relations between the two understate the true economic worth of natural resources while overstating the value added through knowledge intensity. This trend is poised to create serious environmental damage in the developing countries. The correction of price distortions in world trade is, therefore, an important issue for achieving sustainable development patterns.

Understanding trade relations in a dual global economic system

The prices of both factor inputs and commodities traded in a dual economic system may not have any relevance to their true worth since claims to income depend on the bargaining position of the contributors to production and supply and demand conditions of the market rather than being determined by a fair valuation process. I have earlier proposed a model of the valuation process in a dual economic system in a national context, which I will attempt to extend to the global context to explain the trends delineated in the last section [Saeed 1988, 1994]. The original model is summarized below for reference. An interactive computer program for experimentation with the model is available on request.**

A model of the valuation process in a dualist economic system

** Send orders for the computer program to either of the following two vendors:

- The Purrington Foundation, 36 Main Street, P. O. Box 303, Matapoissett, MA 02739-0303, USA.

My original model incorporates the broad decision rules that underlie resource allocation, production, and income disbursement processes in a dualist economic system consisting of a formal capitalist sector and an informal self-employed sector. Capital, labor and land (which may also be assumed as a proxy for natural resources) are used as production factors. The decisions of the formal sector are driven by the profit motive while the informal sector strives to maximize consumption for its members. Figure 9 shows how production factors are allocated to the various economic activities in this model and Figure 10 how the income of the economy is disbursed.

The changes in the quantities of the production factors owned or employed by each sector are governed by the decisions of the producers and the consumers of output and by the suppliers of the production factors acting rationally according to their respective motivations within the roles defined for them by the system. The value of production is shared by households on the basis of the quantity of the production factors they contribute and the factor prices they can bargain for.

The wage rate depends on the consumption foregone by the workers when one of them leaves self-employment to accept wage-work, which can be interpreted as the opportunity cost of supplying a unit of labor to the formal sector. Since this opportunity cost varies with the amount of capital resources owned by the workers, which may support self-employment, the wage rate is strongly affected by the distribution of ownership of land and capital assets. It is assumed that formal ownership is protected by law but land and capital assets can be freely bought, sold and rented by their owners. Each buying and selling transaction between the two sectors must be accompanied by a corresponding transfer of the cash value of assets determined by the going market prices.

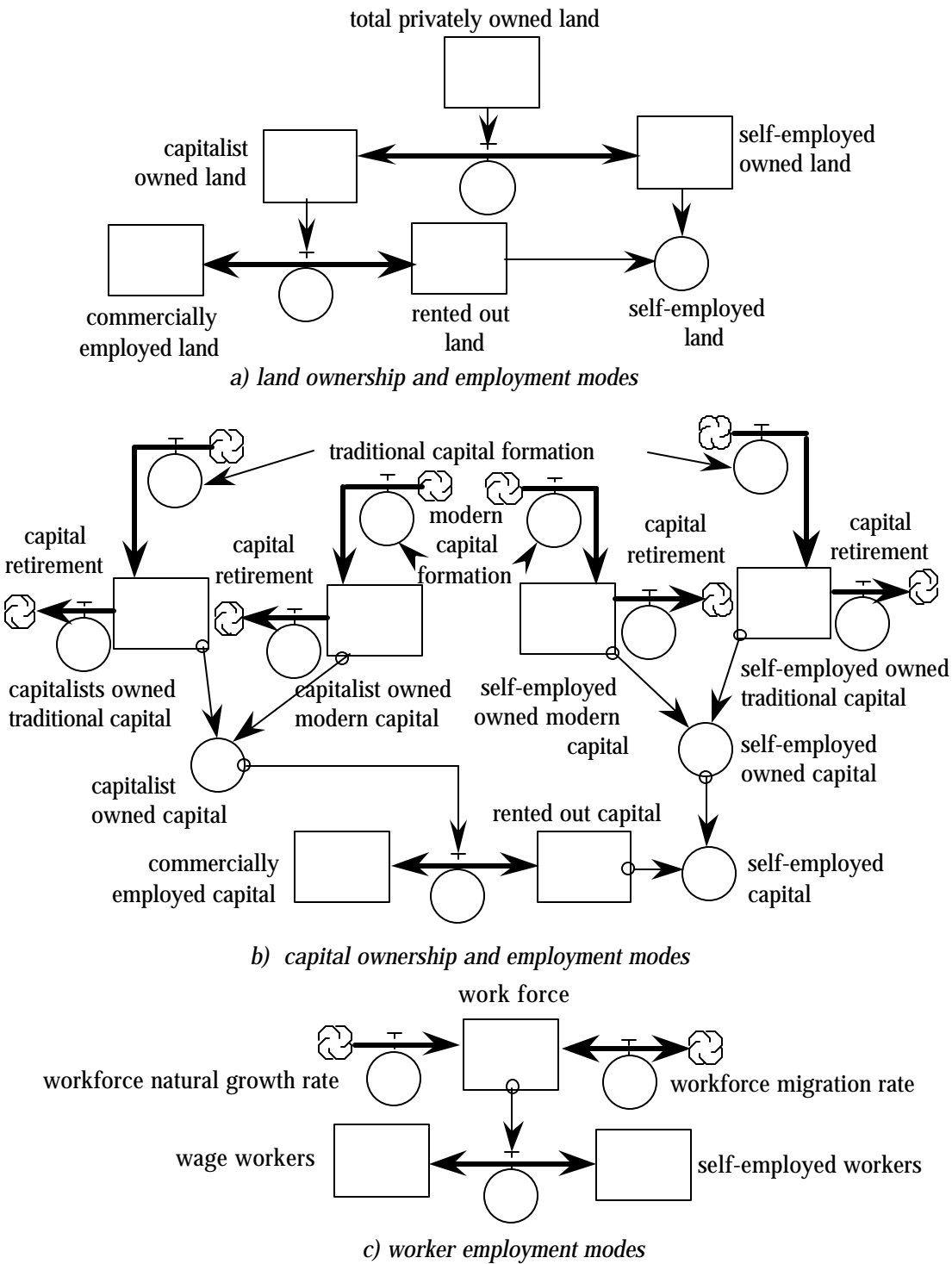


Figure 9 Allocation of production factors in Saeed's dual economy model

Source: Saeed (1994)

The financial markets are assumed to be segmented by sectors and the investment decisions of a sector are not independent of its liquidity position given by the unspent balance of its savings. The saving propensity of the two sectors is also not uniform. Since capitalist households receive incomes which are much above subsistence, the saving propensity of the formal sector is stable. On the other hand, the saving propensity of the informal sector depends on its need to save to maintain investment for supporting unemployed labor and also on the absolute level of consumption available to its members. The model also permits the appearance of technological differences between the formal and the informal sectors when more than one type of capital (traditional and modern) is made available since the two sectors cannot employ the preferred type with equal ease.

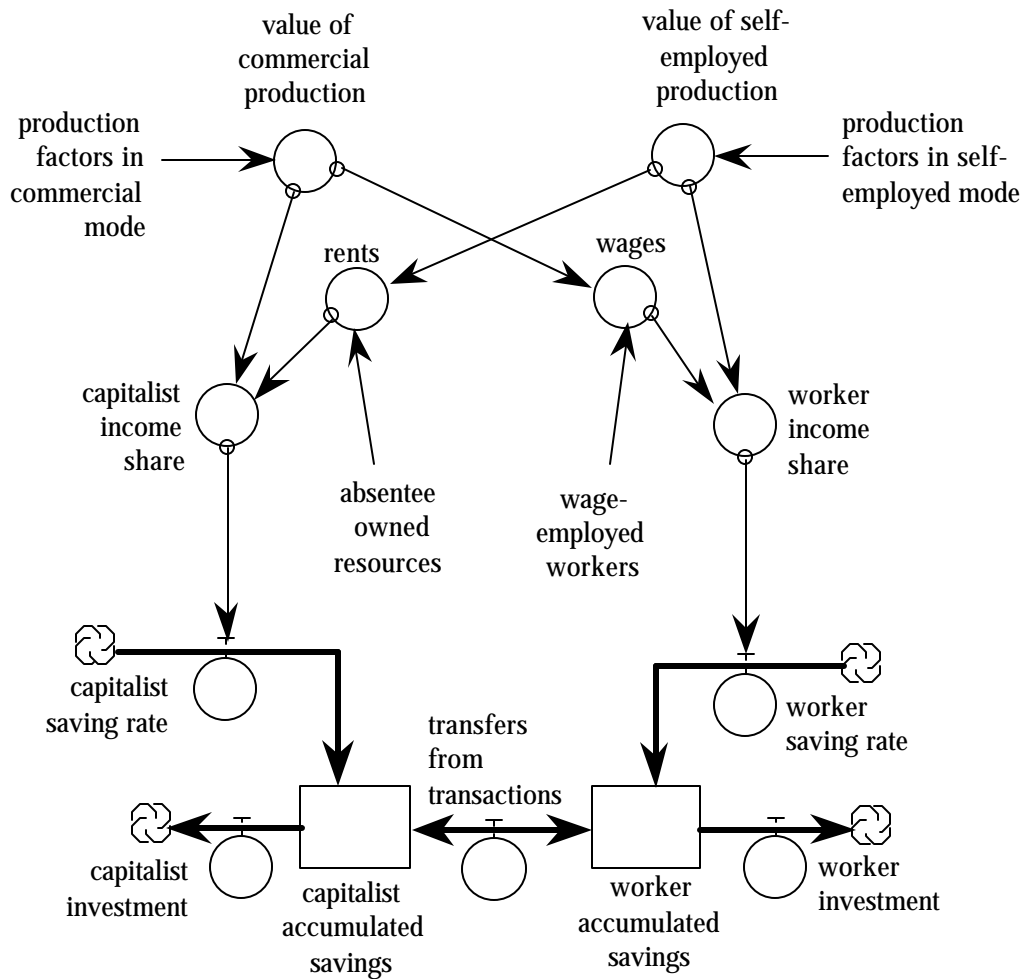


Figure 10 Disbursement of income in Saeed's dual economy model

Source: Saeed (1994)

The model I developed could endogenously create a whole spectrum of growth patterns — medieval, classical, neo-classical, revisionist, dualist — that the various growth theories have viewed as given. A perennial debate in economics concerns the theory of value, how the real prices of commodities are affected by the costs of the factors used in their production, which has been seen differently by the different theorists. However, as pointed out by Saraffa, a circularity exists between commodity prices and factor costs. While commodity prices will depend to some degree on factor costs, these costs cannot be independent of the claims to income their suppliers are able to make, which depend on the commodity prices they have to pay to maintain the factors [Saraffa 1960] as well as on the opportunity cost of the inputs they supply [Saeed 1988, 1994]. Since these claims may be different from true factor contributions to the production process, it is not surprising that a variety of value patterns will be experienced, depending on the bargaining power enjoyed by the various cross-sections of the households providing inputs to the production process. In fact, the bargaining position of the various cross-sections of the households and the degree of polarization in the control of factor inputs will really determine who can file a larger claim to the value created in production, the owners of capital and resources or the suppliers of labor.

Experimentation with my model showed that when, economic efficiency determines who should carry out production, and financial efficiency determines who should control resources, while technology is homogeneous, the ownership of resources becomes concentrated in the formal sector which also receives a large part of the income. At the same time, the informal sector carries out all production while it controls a small part of the resources and receives a small share of the income. This outcome is illustrated in the simulation of Figure 11 reproduced from Saeed(1994), which is borne out in reality by the experience of the post colonial agricultural economies in the developing countries.

Figure 11 Model behavior showing internal trends for resource ownership and income distribution with undifferentiated technology

When a technological differentiation is also created between the formal and informal sectors, the former sector is able to employ a part of its resources in production because of the possibility of higher productivity, but at the same time, the informal sector bids rents up, hence, the formal sector does not transfer all its resources into production. Thus, both formal and informal sectors exist side by side, with the formal sector characterized by capital intensive technology, financial muscle and pursuit of profit both through production and renting activities and the informal sector by labor intensive technology, low level of savings and consumption considerations. This case is illustrated in the simulation of Figure 12 also reproduced again from Saeed(1994), which is also borne out by the experience of the developing countries when they attempted to modernize their economies through technology imports and industrialization.

The fundamental mechanism which creates the patterns of Figures 11 and 12 appears to be renting, which allows the accrual of unearned income that is claimed by the formal sector whether or not it engages in production. The financial muscle so created for the formal sector allows it to expand further its ownership of land and capital assets, while the concentration of the control of the resources in this sector creates a valuation process that under-rates the contribution of the households. The financial fragmentation of households and the differences in their saving patterns further facilitate the expansion of renting practice.

Technological differences between the formal and self-employed sectors not only make possible the side by side existence of the two modes of production, but also exacerbate the dichotomy between ownership of resources and workership by enhancing profit opportunities for the formal sector. Exploratory experimentation with the model led to two kinds of instruments for changing dysfunctional valuation patterns — those creating fundamental forces of change and those facilitating change. To influence income distribution, wage rate and asset ownership, the fundamental instrument of change was to tax the various forms of unearned income, which would price out the renting option in due course of time. The related facilitators included the well-known technological and financial development policies and community assistance programs which have been the main fare of the past development effort in the developing countries. The facilitators were found also be ineffective without the fundamental instrument.

Figure 12 Model behavior showing trends of resource ownership and employment in the presence of technological differentiation

Extending the model to the global context

Above model can be extended to the global context with some restrictions.

The ability of the formal and the self-employed sectors of the model to represent, respectively, the industrialized and the developing country blocks is first of all amply justified. Like the formal sector, the industrialized country production systems comprise profit maximizing firms using capital intensive technology and operating in an environment with well-established financial markets and with the freedom to adjust workers on the basis of profit considerations, the immigrant workers from the developing countries often taking the slack. On the other hand the developing countries, with surplus labor, the need to support growing populations in the face of limited resources, the use of labor intensive technologies and the paucity of financial institutions that may support entrepreneurial ventures, fit well into the informal sector profile.

The model is limited in two ways in its ability to represent the present day global economy. First, while it keeps track of the transactions occurring between the two sectors on the production side and allows valuation of the factor inputs, it aggregates all consumption and does not explicitly keep track of the commodities traded between the two sectors and their valuation. In default, it implicitly assumes uninhibited commodity trade at undifferentiated prices. Second, the total resource endowments remain fixed irrespective of their use, implying that there are no environmental costs whether the resources are employed in the industrialized countries or in the developing countries. These limitations make the model a bit more optimistic than the reality where price differentiation and environmental cost externalization discriminate against the developing countries and also the aggregate resource base is decaying.

Figures 13 (a), (b) and (c) show the allocation of production factors in the reinterpreted model. Note that the information relationships are exactly the same as in the original model shown in Figures 9 and 10 and only variable names have been changed to represent the global context.

Total global resource endowments can be freely transferred between categories under industrial country and developing country control. Those under the industrial country control can be transferred between employment in production at home or placement under renting and colonial orders in the form of investment abroad. The resources employed by the developing countries include both those directly controlled by them and those employed under colonial and renting orders. The capital, traditional as well as modern can be transferred between similar categories. When the industrialized countries control immigration, they will be able to attract all the workers they need and the remaining workers would be forced to live in the developing countries.

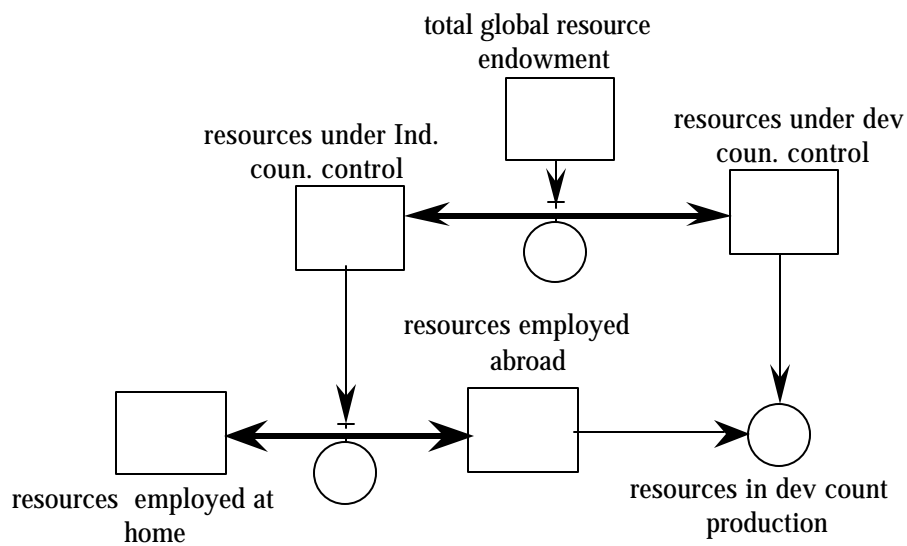


Figure 13(a) Resource endowment and its control

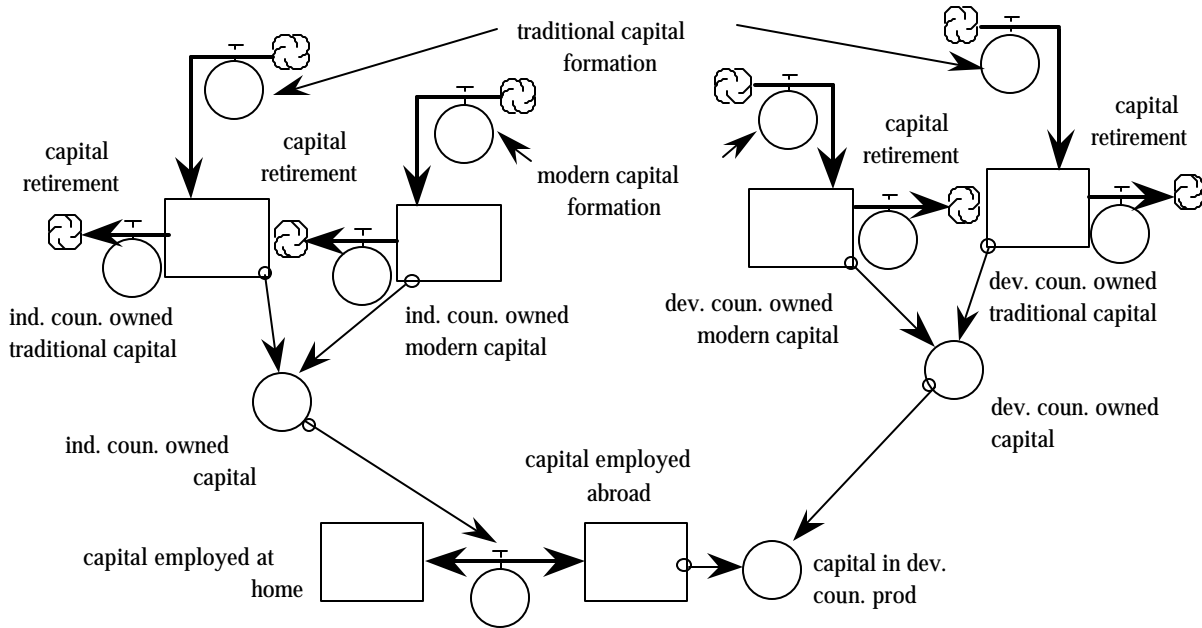


Figure 13(b) Capital ownership and its allocation

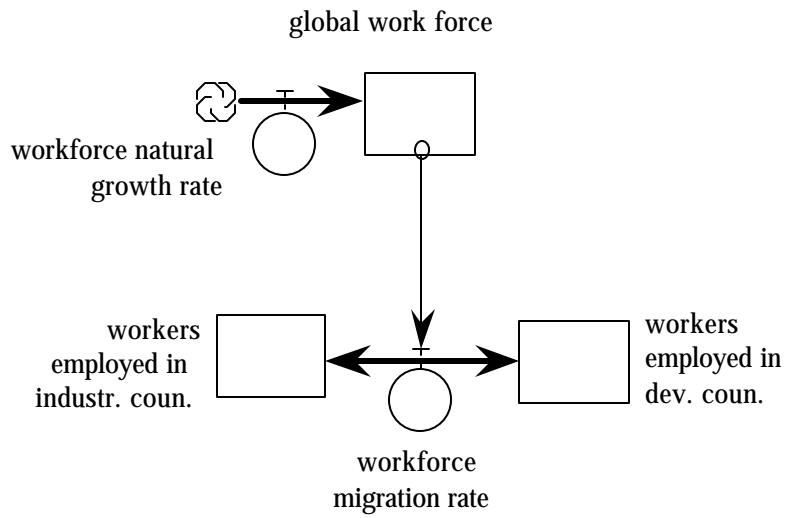


Figure 13(c) Distribution of workforce

The global income will be disbursed as shown in Figure 14 when production side accounts are considered. The industrialized countries will receive the value of what they produce plus fees/rents/levies transferred as factor income from abroad less any remittances as factor payments to abroad. The developing countries will receive the value of what they produce, plus the remittances received as factor payments from the industrialized countries less rents/fees levies paid on factors owned by the industrialized countries but employed in the developing countries.

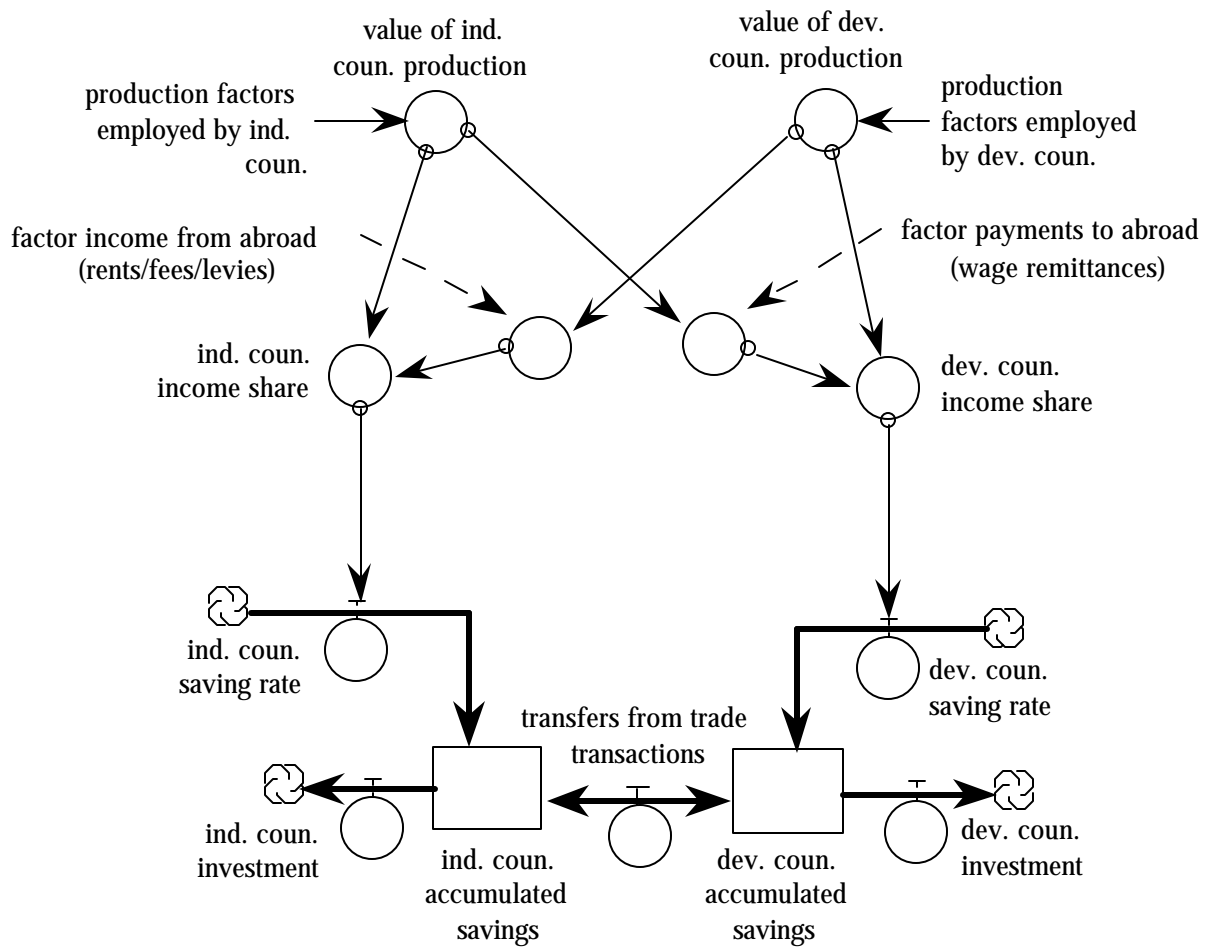


Figure 14 Income disbursement in a global dualist economy

The current model does not distinguish between the developing and the industrialized countries as far as the valuation of production is concerned, although the remittances to the former and the rents/fees/levies charged by the later depend on what the two blocks can bargain for. In default, an unlimited free trade at undifferentiated prices is implicitly assumed. Even so, a reinterpretation of the scenarios of Figures 11 and 12 is far from comforting. In equilibrium, most resources are controlled by the industrialized countries who also receive most of the income in the form of rents/fees/levies or factor payments from abroad, irrespective of whether or not a technological differentiation exists between the two categories of countries. The presence of such a technological differentiation would change the pattern of production in that a part of it would also be carried out in the industrialized countries. It would not change the control of the resources and the valuation of the factor inputs made on the basis of this control.

When the bargaining position of the economic blocks also affects the valuation of the commodities exchanged between them, the disparity between the value they accrue for their contribution to production would be further exacerbated. The value transfer resulting from their transactions would progressively shift the control of more and more resources to the industrialized block along with the option to select production and renting portfolios at will. The developing block, on the other hand, will end up with little control over resources and a heavy rent burden; with no other option but to crowd the market for the residual production. In such a world, conflict would easily arise on who should bear the environmental cost, the industrialized block controlling the resources and accruing large benefits from the valuation of its production and rent appropriations, or the developing block accruing low valuation for its contribution and also bearing a heavy rent burden. This conflict would be further exacerbated when the question of bearing the environmental cost is appended to the problem. Such a conflict may impose yet another threat to the sustenance of the global economy.

Sustainable trade relations in a dualist global system

Arthur Lewis likened the global economic system to an escalator, the ascending rates of riders were intimately linked together due to the interdependence created by the trade flows and the terms of trade, although their respective elevations could vary widely. In this system, it would be impossible to close the gap between the rich and the poor countries unless the former were willing to allow the later a greater share of their markets and also to change the terms of trade in favor of the later. Professor Lewis also observed that what has actually happened is the opposite of this. While the developed countries have attempted to dismantle trade barriers among themselves, their barriers to a fair trade with the low income countries have progressively increased [Lewis 1984]. There are yet repeated calls from the industrialized countries reiterating the benefits of a free global market, while the terms of trade for the developing countries have continued to become worse, as illustrated in Figure 15 showing the trend of the commodity terms of trade between the industrialized and the developed countries [Todaro 1994].

Figure 15 Commodity terms of trade between the industrialized and the developed countries

Source: Todaro (1994)

A re-interpretation in the global context of the policies posited for changing the resource ownership pattern in my dualist economy model would imply creating trade relations between the industrialized and the developing countries that tax factor payments from abroad accrued through rent/colonial orders as well as exports by the former and protecting factor income from abroad and exports by the later, which appears to be against the grain of the current free trade doctrine. It is appropriate, however, for creating a sustainable and conflict free future given the structure of the global economy actually in place. The proposed discriminatory taxes would make it uneconomical to invest in capital assets and to acquire control of natural endowments for investment abroad, which would facilitate the transfer of their control to countries who can gainfully employ them. A concomitant attempt to nurture indigenous technological development in the developing countries would assure that technological differentiation does not concentrate production in the industrialized countries [Saeed and Prankprakama 1994]. Perhaps the income from the discriminatory taxation can be channeled by the developing countries to support such technological development endeavors.

Implications for the design of global accords

Herbert Simon (1982) perceives rationality to be an information bounded condition arising from the following limitations:

1. All decision options are not known nor is it possible to identify the best options out of the ones recognized.
2. Decisions must be taken with limited rather than perfect information.
3. The outcome of the decisions cannot be predicted with accuracy due to the complexity of the information relationships in the system.

The drawing of global accords requires dealing with complex information relationships that would create

unforeseen future behavior if one relies only on the often diverse mental models of policy makers to commit concerned parties to their respective roles. Bargaining based on an existing power structure would often deliver terms that would be unfair and that would create unresolvable conflicts in the future. Experimentation with a system dynamics model, on the other hand, allows all parties to share a common perception of the problem and recognize future implications of the decision process created by an impending agreement, which should help to design robust accords with reliable performance.

A system dynamics model based on experiential information regarding the day-by-day process of decision making is created by an expert through brain-storming with the concerned parties, who would be willing to participate in such a process prior to the signing of the agreement. Experimentation with this model will first create scenarios which the concerned parties are able to endorse. This process would create confidence in the model. An attempt can then be made to improve system behavior through experimentation with its parameters and modification of its information relationships.

Such experimentation clarifies ambiguities in the policy makers' mental models allowing them to agree on realistic terms and provide for setting procedures to deal with unforeseen contingencies. The agreement terms so created would be realistic and flexible so that the potential for future disputes would be minimized. Referring back to Simon's definition of bounded rationality given earlier in this paper, such experimental design would appear to relax some of the bounds of the rational decision process, thus improving the chances of a higher rational order than one that is purely conjecture-based [Saeed and Brooke 1996, Morecroft 1985].

Conclusion

While global trade volume has almost doubled over the past decade, not only the terms of trade have worsened for the developing countries, the specializations it has created appear also to place the industrialized countries in niches producing monopolistic services and products with high a value added

content while the developing countries crowd market segments requiring primary production and goods with low value added content.

When the global economy has a dualist structure, the valuation of inputs and outputs as well as the responsibility for environmental damage will accrue according to the bargaining power of the nations. With the industrialized countries grouped as monopolist profit maximizing firms controlling ample resources and the developing countries as competitive establishments striving to maximizing consumption for their members while operating under conditions of resource shortage and labor surplus, this valuation process will consistently work against the later, thus progressively transferring value from the later to the former when no barriers exist on trade between them.

A reinterpretation of a model I addressed originally to the valuation process in a dual national economy for understanding income distribution indicates that penalizing industrialized countries' actions to expand renting and colonial orders through investment abroad and lending together with taxing their exports to the developing countries and protecting the value of the payments received by them might improve the global valuation processes in the long run. This should create also a more even control of the resource endowments accompanied by a broad-based responsibility towards sustaining the environment. The structure of the model re-interpreted in this paper needs, however, to be further desegregated on the demand side to account more explicitly for the valuation of the commodities exchanged. It also needs to be extended to address explicitly the resource use to assess the nature of the environmental costs accrued to the concerned parties. Global trade accords aiming to sustain a shared common environment should benefit from such an extended analysis.

As the world becomes highly integrated in terms of its economic relations and a shared common environment, questions concerning economic value and the claims of the various cross-sections of the population to it must also become global. If a political and intellectual division on these issues is to be avoided, we must learn to resolve them by taking a holistic view of the logic underlying them and creating operational means to implement the solutions so found. For this, the experimental procedure of system dynamics is of considerable value. A role systems created in a given global context can be

constructed by translating known and inferred experiential information into a model and experimenting with it prior to formulating the terms of an agreement. This would allow mental models of the operation of the agreement to be refined and also modify expectations, so surprises are minimized. An agreement drawn on the basis of the experimental experience so created would incorporate more feasible roles than one drawn in the traditional way.

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