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CHANGING COMPARATIVE ADVANTAGE IN AGRICULTURE: THEORY AND PACIFIC BASIN EXPERIENCE

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Abstract

While agriculture's contribution to national output and employment tends to decline with economic growth, its contribution to exports may not. Rather, a country's comparative advantage in agriculture is shown to depend positively on its endowment of agricultural land relative to its mineral resources and nonfarm capital and negatively on its income per hectare of agricultural land, compared with other countries. Over time, its agricultural comparative advantage will decline faster, the slower its rate of agricultural relative to nonagricultural technological change and the faster its rate of industrial growth, compared with these rates in other countries. The implications of this empricially-supported theory for Australia and other Pacific rim countries are then discussed along with some policy implications, particularly for the densely-populated, rapidly-industrializing economies of South Korea and Taiwan.

I. Introduction

Part of the conventional wisdom of development economics is that the agricultural sector's contributions to employment and putput decline as economic growth occurs (Clark 1957; Johnston and Mellor 1961; Kuznets 1966). The usual reasons given for this are the low and declining income elasticities of demand for foods compared with those for nonagricultural goods and services on the one hand (Engel's Law), and on the other hand the considerable capacity for labour-saving technological change in agriculture coupled with low price elasticities of demand for foods (Johnson 1973, Ch. 5). Either of these conditions may be sufficient

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for a decline in (at least the food part of) the agricultural sector of a closed economy. Even together, however, these conditions are insufficient for ensuring a decline in agricultural output and exports in an open economy. Indeed, the high income countries of Australasia and North America are major agricultural exporters, supplying more than one-quarter of the world's food and agricultural exports. The developed countries of Western Europe contribute another one-third to this total. Thus while agriculture may employ a declining share of the workforce and even a declining absolute number of workers as economic growth proceeds in a country, that is not to say that a growing economy's comparative advantage in agriculture necessarily declines over time.

The purposes of the present paper are first, to attempt to develop a theory of changing agricultural comparative advantage in a long-term growth context (ignoring largely the intra-sectoral differences in the competitiveness of various agricultural industries); second, to examine the changing patterns of agricultural production and trade in (non-Latin American) Pacific rim market economies to see how closely they conform with this theory; and third, to discuss briefly the likely future developments in agricultural trade in the Pacific basin and the policy responses necessary to facilitate those developments.

There are a number of reasons for concentrating in this paper on the Pacific basin. Firstly, this region contains among the most rapidly growing countries in the world today, most notably the densely-populated, food-deficit, newly-industrialising economies of Singapore, Hong Kong, Taiwan and Korea as well as the other four ASEAN countries which are also developing rapidly.[1] Thus the pattern of agricultural comparative advantage within the region is changing rapidly. Secondly, the region has on the one hand seven of the world's dozen largest net exporters of agricultural goods, in the United States, Canada, Australia, New Zealand, Thailand, Malaysia and the Philippines. On the other hand it has the world's largest net agricultural importer, Japan, and the increasingly important importing countries of Singapore, Hong Kong, Taiwan and Korea. Both the United States and Japan are surpassed only by West Germany in the value of their gross agricultural imports. Thirdly, and perhaps most importantly, there is a growing interest in developing a closer economic integration of the Western Pacific market economies and North America in the form of a Pacific Community (Drysdale and Patrick 1979). Such a move is all the more likely with the possible further expansion of the highly-protectionist European Economic Community to include Greece, Portugal and Spain. Because agriculture is so politically sensitive, especially in food-deficit Northeast Asia, any discussions

[1] Throughout the paper, the Republic of Korea (South Korea) and Taiwan Province (Republic of China) will for brevity be referred to as Korea and Taiwan.

on closer economic ties between Pacific rim countries requires knowledge of the likely effects on agriculture of closer ties. This paper is a partial step towards meeting that need.

II. Changing Comparative Advantage in a Growth Context: the Theory[2]

2.1 *A Three-factor General Equilibrium Model*

The standard textbook treatment of neoclassical two-sector Heckscher-Ohlin trade theory is unsatisfactory for the purposes of this paper, for at least two reasons. First, it assumes only two factors of production (usually labour and capital), both of which are assumed to be perfectly mobile between sectors, whereas in agriculture land is a crucial third factor which is immobile and specific to the farm sector. And second, the assumption of similar production functions across countries is clearly inappropriate for agriculture, because not only do differing climates, soil, topography and water availability affect production functions but so too do differing technologies developed specifically to suit each country's physical and economic conditions(Naya 1967; Hayami and Ruttan 1971).

A more satisfactory model for present purposes can be developed from one formalised by Jones (1971) which involves three factors of production: agricultural land, which is specific to the agricultural sector; capital, which is specific to the manufacturing sector; and labour, which is used in both sectors, is intersectorally mobile and exhibits diminishing marginal product in each sector. In this model, at a given set of international product prices, the wage rate is determined by the *overall* per worker endowment of land and capital (broadly defined to include human skills and social, technological and organisational capital, following Johnson (1968), while the pattern of comparative as between agriculture and manufacturing is determined by the *relative* endowments of land and capital.

An underdeveloped country with little capital will have a wage rate determined predominantly by its per worker agricultural land endowment, and will export agricultural products in exchange for manufactures. As incomes grow and capital is accumulated, labour will be attracted to the manufacturing sector which will expand relative to the agricultural sector. For any given rate of capital accumulation per worker, the speed of the reallocation of labour towards manufacturing will be greater the lower is the initial wage rate, that is, the smaller is the agricultural land endowment per worker. This is because the low wage will give a densely-populated country an international comparative advantage in (initially labour-intensive, standard-technology) manufactures. Hence it will switch

[2] This section draws on Kreuger (1977), Garnaut and Anderson (1980), and Anderson and Smith (1980).

from being predominantly an agricultural exporter to being an exporter of manufactured goods at a low level of capital per worker. Over time, as the per worker endowment of capital increases, the comparative advantage within the manufacturing sector will shift towards more capital-intensive activities. A lightly-populated country with a relatively high initial wage rate, by contrast, will switch much more slowly towards specialisation in manufacturing, absorbing its accumulation of capital in the development of a more limited range of relatively capital-intensive manaufactures.

2.2. *Extensions to the Three-Factor Model*

While this simple specific factor model provides a better explanation of the pattern of trade in agricultural products than the standard two-factor model, a fuller explanation requires allowance to be made for the fact that other primary production may be important; for the use of capital in primary production; for the fact that many nontradable goods and services are also produced; and for the influence of demand and comparative growth factors.

A Second Primary Sector. The inclusion in the above model of a second primary sector, mining, which uses labour to extract mineral resources will alter the above production picture only very slightly, since even a large mining sector typically employs a very small share of the workforce. Thus at given international prices, the workforce employed in agriculture and/or manufacturing would simply be slightly smaller than otherwise suggested, the extent of which would be greater, the larger the endowment of mineral resources per unit of agricultural land and capital.[3]

Capital in Primary Production. In reality, capital is of course required in addition to natural resources and labour to produce primary products. Including this in the model strengthens the conclusion that natural resource-rich countries will begin manufacturing at a later stage of capital accumulation per worker and will specialise in it less than will natural resource-poor countries. It also means that resource-rich developed countries may retain a comparative advantage in primary production, *vis-a-vis* resource-rich developing countries, for longer than would otherwise be the case. The reasons for this in the case of agriculture are as follows.[4] There is a high degree of substitutability between capital and both labour and land in agricultural production (Binswanger, Ruttan and Others 1978; Naya 1967). Hence the productivity of labour and land in agriculture can be raised by combining them with more and more capital. The greater the per worker agricultural land endowment of country, the more likely it is that capital can be employed more profitably in agriculture

[3] Similarly, one might extend the model to also include a forest sector.

[4] See Anderson and Smith (1980) for a discussion of the mining case.

than elsewhere at a given level of capital per worker. In addition, it is possible for a country's agricultural sector to offset its factor scarcity by investing in the production of new technologies which save most its scarcest factor. The development of farm technological changes that are land-saving in Japan and Europe and labour-saving in North America and Australia are cases in point (Binswanger, Ruttan and Others 1978; Lawrence and McKay 1980). It is then possible for these new technologies to be transferred to and adapted by poorer but similarly land-scarce or land-abundant countries as these countries accumulate sufficient capital to make such technologies profitable for farmers to adopt. This has in fact happened in North Africa and the Near East (from Australia) and in Korea and Taiwan (from Japan—see Hayami and Ruttan 1971, Part IV). It is conceivable that land-scarce developing countries could have a sufficiently greater rate of farm technological advance than land-abundant (especially developed) countries to enable them to not lose comparative advantage in agriculture, but it is rather unlikely, for a number of reasons. First, the rates of return to agricultural research are going to be greater, the larger the domestic industry to which the results will be most relevant, especially because there are economies of large scale in agricultural research (Evenson 1971). Hence countries with large areas of agricultural land are likely to have the fastest rates of farm technological advance. This will be reinforced by the fact that since land-saving (biological and chemical) technologies needed in densely-populated countries have more public goods characteristics than labour-saving (mechanical) technologies appropriate for land-abundant developed countries, the former tend not to be produced by the private sector; and for politico-economic reasons discussed eleswhere (Anderson, forthcoming), governments tend to underinvest grossly in public agricultural research. And second, the usually more favourable prices facing farmers in developed as compared with developing countries are likely to induce relatively more research (as well as production) in the former (Peterson 1979). This, together with the fact that agricultural research is (especially human) capital intensive, will help to further ensure that land-abundant developed countries retain a global comparative advantage in those agricultural products producible in their physical environments.

A Nontradable Sector. Many goods and services are of course nontradable internationally because of prohibitively high transport costs. While the addition of a nontradable sector to the model does not change its conclusions about comparative advantage as between different tradable industries, it certainly modifies the conclusions about the structure of an economy. This has particular significance for resource-rich developed economies, because the simple model without nontradables implies that

most labour and capital resources will be employed in the primary sector. In practive, of course, the majority of non-natural resources, particularly labour, are employed in nontradable service industries in developed countries.[5]

Demand and Comparative Growth Factors. Trade specialisation depends not only on supply factors but also on factors affecting demand. The demand for foodstuffs increases with population and per capital income while the demand for industrial raw materials increases with manufacturing production. Thus a country's export specialisation in food products will tend to be related negatively to its GNP per agricultural hectare, while its export specialisation in minerals will tend to be related positively to its mineral resources per dollar of manufacturing output, *ceteris paribus.*

While domestic economic growth, captital accoumulation and industrialisation in a developing country will tend to weaken specialisation in primary products, with the qualifications outlined above, economic growth and industrialisation abroad may initially have the opposite effect if it results in increased foreign demand for food and industrial raw materials and a consequent terms of trade improvement. However, rapid economic growth in the developed world as a whole will not only result in an improvement in the terms of trade for primary products, the extent of which will in any case be modified by supply responses from resource-rich developed countries and innovations in their production and use (Magee and Robins 1978); it will also generate an improvement in the terms of trade for labour-intensive manufactures due to the increasing relative scarcity of (particularly unskilled) labour in developed countries. Thus, although developed country growth may strengthen export specialisation in primary products for resource-rich developing countries, it may have the opposite effect for resource-poor developing countries, at least after some lagged adjustments have taken place.[6]

So far as the impact of growth in resource-poor developing countries on the pattern of their import demands is concerned, we should expect the share of food in total imports to drop over time, due to the low and declining income elasticity of food demand, with the pattern of food imports shifting towards the relative luxuries of red meat and dairy pro-

[5] The lack of understanding of this point often leads to fears that without manufacturing, protection, resource-rich developed countries would be made up of capital-intensive farms, mines and quarries with not enough jobs for the workforce.

[6] The adjustment lags may be considerable, given both the nature of the transformation required and the likely resistance to industrial restructuring in developed countries until pressures become irresistable. It is possible to interpret the present rapid growth of the newly-industrialising countries as a response to past growth rates in the developed world, with adjustments occurring after developed country growth has slowed down. See also section 2.3 below.

ducts. Also, agricultural raw materials for labour-intensive processing industries (cotton, wool, hides) would first increase their share of imports as industrialisation begins, and then fall as the derived demand for imports of mineral raw materials or metals for more capital-intensive manufacturing expands.

If resource-poor developing countries were the only countries expanding, this would mean a relatively greater growth in demand for minerals and metals as compared with agricultural exports of resource-rich developed countries. Such a tendency would be strengthened by the desire of those resource-poor countries to restrict imports of food in order to protect domestic agriculture (see below). If at the same time, there is resistance in the resource-rich developed countries to adjust to the weakened competitive position of domestic labour-intensive manufacturing, mineral/metals export growth will generate exchange rate/inflationary pressures which will weaken the terms of trade for agriculture, in domestic currency terms, despite growth in overseas import demand for agricultural goods. The resource-rich developed countries' higher incomes and relatively lower nontradable prices as a result of the improved therms of trade would ensure an expanded demand for nonagricultural goods and services relative to food, given the relatively low income elasticity of demand for food relative to nontradables and other tradables, so further encouraging resources to move out of agriculture and into nontradables in particular.[7]

2.3 *The Causes and Effects of Trade and Adjustment Resistances*

The theory outlined is incomplete in its ability to explain changing trade patterns in that it does not explain the magnitude of changes in relative resource endowments, nor does it explain the pattern of political, geographic and informational resistances and resistances to structural adjustment all of which influence trade and investment flows. No explanation of comparative growth rates is attempted here,[8] but some comments on the various types of barriers affecting trade specialisation are perhaps worth making.

Political Barriers. Governments raise trade barriers presumably because it is in the interstes of a country's politicians to raise them, given the factors, including non-economic community preferences, that affect and demand for and supply of such barriers. An important community preference often seems to be for a more 'balanced,' less specialised economy

[7] In Europe this phenomenon has become known as the Dutch disease while in Australia it is known as the Gregory effect, after Gregory (1976). For refinements of Gregory's thesis, see Snape (1977), Smith (1978a), Stoeckel (1979) and Vincent, *et al.* (1979).

[8] For an interesting politico-economic theory of comparative growth rates, see Olson (1978).

(Johnson 1965). Thus countries at an early stage of development often tax both food (and other primary) exports and manufacturing imports so as to not only raise government revenue but also stimulate industrial production and processing activities. As a country's per capita income rises, it can more readily afford to assist industries facing employment declines. In densely-populated advanced developing countries, agriculture will be under pressure to decline rapidly whereas in resource-rich developed countries it is the labour-intensive sections of manufacturing which are losing comparative advantage fastest. This, together with the desire (perhaps partly for risk-aversion reasons) for a more 'balanced', less specialised economy (Jabara and Thompson 1980), may lead one to expect policies protecting the import-competing primary sectors of resource-poor industrialising countries (most notably agriculture) and the import-competing, labour-intensive manufacturing sectors of resource-rich developed countries.[9] Hence the agricultural exports of countries at an early stage of development, particularly land-abundant ones, are likely to be less than they would be in the absence of price distortions, the share of foodstuffs in total imports of densely-populated developing countries is likely to drop faster over time than would be the case in the absence of distortions, and these countries' exports of labour-intensive manufactures to developed countries are likely to grow more slowly than without such barriers. The agricultural exports of resource-rich developed countries, particularly foodgrains as well as fibres and hides for labour-intensive export manufacturing, would be lowered by these protectionist policies both because of the reduced import demand overseas and because of the earlier-mentioned reduced intersectoral competitiveness of agriculture domestically as a result of improving terms of trade for mining and protection for manufacturing.

Geographic Barriers. Resistances to international trade in the form to transport costs are certainly not insignificant (Finger and Yeats 1976;

[9] For other explanations of these protectionist policies, drawn from the neoclassical economic theory of politics, see Anderson (1977, 1980 and forthcoming) and Garnaut and Anderson (forthcoming). There is strong empirical support for the casual observation that food-deficit countries tend to assist their agricultural sector more than food-surplus countries, especially as their per capita incomes rise. This evidence, presented in Anderson (1979, p.6), makes use of an index of real domestic farm prices during 1968–70 for each of 49 noncommunist countries, as compiled by Peterson (1979). When this price index (P) is regressed on per capita GNP in 1969 (Y) and the average share of domestic grain production exported during 1967–71(E), one obtains

$$P = 19.7 + 9.07Y - 187E \quad , \quad R^2 = .482$$
$$(6.52) \quad (2.25)$$

The signs of the coefficients and their significance (indicated by the t-values in parentheses) suggest that a country's domestic farm prices tend to be lower, the smaller its GNP per capita and the larger its grain export surplus. Also, P is positively associated with the share of domestic grain consumption imported.

Sampson and Yeats 1978), and they may be becoming more important with rising fuel prices. Hence, greater distances between trading partners' ports affect adversely their bilateral trade. Factor endowments of nearby economies tend therefore to be more important in determining a country's comparative advantage than the factor endowments of more distant economies. It follows that a country's export specialisation will tend to strengthen in commodities in which import specialisation is strong in rapidly-expanding economies nearby. Strong growth in nearby economies with complenentary resource endowments will tend to raise a country's terms of trade more than strong growth in more distant economies with similarly complementary resource endowments (Drysdale 1969). In addition, relatively high costs of shipping perishable and low value to volume goods mean that such goods enjoy natural effective protection from foreign competition. Fresh fruits and vegetables in particular, which in addition to being perishable are also intensive rather than extensive in their use of land, are likely to become increasingly more profitable relative to grain crops and livestock production in the agricultural sectors of land-scarce open economies. This profitability will be only partly offset by competition from foreign processed substitute products such as canned, dried and frozen fruits and vegetables.

Information Cost Barriers. Costs of acquiring information on trading and investment opportunities in a foreign country are clearly less, the greater one's familiarity with that country's language, culturd, governmental procedures and business practices. The degree of familiarity is often greater, the closer that country and/or the more colonial, political or aid ties there have been between the two countries (Drysdale 1969; Garnaut 1972).

Adjustment Resistances. The rates of intra- and inter-sectoral adjustment in a country as economic growth proceeds will depend not only on changing relative product prices but also on real factor rewards. If, for example, the salvage value of a farmers' physical assets is extremely low, it may pay him to continue producing long after the return on the acquisition value of his assets has dropped below the going interest rate (Johnson 1960). Agriculture is likely to structurally adjust to changing comparative advantage quicker, the less the gap between asset acquisition and salvage values and the lower the volume of such assets. Also, the greater are urban relative to rural real lifetime household income opportunities—due, for example to government distortions—the more rapidly farm families may be prepared to move to the city in response to a decline in agricultural comparative advantage. While such adjustment resistances or lack of them are unlikely to determine the direction of change in trade specialization, they may well affect the speed with which such changes are made and in turn the rate of a country's overall economic growth(Schultz 1975).

2.4 *Implications for Agriculture*

To sum up, the above theory suggests that, at a point in time, a country's comparative advantage in agriculture will be less, the lower its endowment of agricultural land relative to mineral resources and nonfarm capital, compared with that in other (especially nearby) countries. When domestic demand factors are also considered, its agricultural exports are likely to be less, the greater the country's income per hectare of agricultural land. Over time in the course of its and other countries' economic development, a country's comparative advantage in agriculture will decline faster, the slower its rate of agricultural relative to nonagricultural technological change[10] and the faster its rate of industrial growth, compared with those rates in other countries.

Resource-poor, newly-industrialising countries will have a faster rate of growth of food imports and imports of agricultural (and other) raw materials for labour-intensive manufacturing the faster their industrial growth, although over time the share of these items in their total imports will decline as imports of manufactured consumer goods and raw materials for capital-intensive industries expand. (For city-states, further economic growth will tend to be accompanied subsequently with a production and export switch more towards human capital-intensive industries including services than towards heavy, pollution-intensive industries. Hence their imports of primary products will be predominantly foodstuffs rather than minerals and metals.)

On the other hand, resource-rich countries, including those with high per capita incomes, will strengthen their comparative advantage in primary products through periods when their industrial activity and incomes are growing less rapidly than in other, especially resource-poor and nearby countries. Within the primary sector, the comparative advantage of agriculture will be greater, the smaller the country's mineral reserves per agricultural hectare. And for demand reasons, agricultural exports will dominate minerals exports more, the greater the country's manufacturing output per unit of mineral resources.

The extent to which these tendencies are reflected in trade flows depends of course on the nature of trade resistances. Protection of declining industries, most notably agriculture in food-deficit, rapidly-developing countries and labour-intensive manufacturing in developed countries, reduces trade specialisation in these products, as do resistances due to geographic location and information costs. The latter tend to be smaller, the closer are the trade partners and the greater their political, cultural or aid ties.

[10] This contrasts with the conclusion from a closed economy model that the *faster* the rate of farm (relative to nonfarm) technological advance, the more agriculture will decline, *ceteris paribus*.

III. Changing Comparative Advantage: Empirical Evidence from Pacific Rim Countries

To see how well this theory is supported empirically, this section looks at the changing production and trade patterns of the major (non-latin American) market economies in the Pacific basin. It presents data on relative factor endowments and economic growth rates of these countries which, together with the above theory, provide expectations concerning changing agricultural comparative advantage. Production and trade statistics relating to the 1960s and 1970s are then examined. They are seen to provide strong empirical support for the theory, from which it is possible to suggest likely future patterns of development.

Table 1 provides a number of indicators of relative factor endowments and ecnomic growth rates for the Pacific basin countries of interest. It is clear from columns (6) to (10) that Japan and the four advanced developing countries (ADCs) of Asia (Singapore, Hong Kong, Taiwan and Korea) have extremely small per capita endowments of various types of land. On the other hand, the developed countries of North America and Australiasia are extremely well endowed with agricultural land per capital, while the developing countries of Southeast Asia excluding Singapore are moderately so endowed. The distribution of mineral reserves between the countries of the region is roughly similar to that of total land per capita, although the endowment for the United States is greater and that for New Zealand and Thailand is less than indicated by this crude index.[11] To the extent that these per capita endowments are useful proxies for the ratios of agricultural forest and mineral resources to labour, one would expect Japan and the four ADCs to have s trong comparative disadvantage in the production of goods based on these resources, while the other developed countries of the region and the other Southeast Asian countries would be expected to have a stong comparative advantage in primary production.[12] The supply reasons for this set of expectations are reinforced by demand factors because Japan and the four ADCs also have

[11] For detailed data on per capita mineral reserves in each of the Pacific Basin countries, see Anderson and Smith (1980, Table 2).

[12] Since fishing in international waters has not been constrained greatly to date, it is an activity not heavily dependent on national fishing resource endowments. Comparative advantage in fish products, as with manufactures, would depend mainly on value added per worker in that industry, although strong domestic demand for fish (as in Northeast Asia) may enable comparative advantage in its production to strengthen through the effects of this assured demand on large-scale investments to capture possible economies of scale. As with agriculture, though, there is a wide range of capital intensity of production technologies available in the fishing industry, so that comparative advantage may not even depend too much on a country's capital endowment per worker. How the new 200 mile limits will affect fishing comparative advantage still remains to be seen.

TABLE 1 RELATIVE FACOTR ENDOWMENTS AND ECONOMIC GROWTH RATES, PACIFIC RIM MARKET ECONOMIES

	Population (millions)	Area (million hectares)	GNP ($US billions)	GNP per capita ($US)	GNP per thousand agricultural ($US)	Land endowment per capita (hectares)				Real GDP growth rate (% p.a.)		Real industrial growth (% p.a.)	Share of GDP exported (%)		Net agricultural exports (US $ millions)
						Total	Arable	Permanent pasture	Forest or woods	1960–70	1970–77	1970–77	1960	1977	1976
	1977 (1)	1977 (2)	1977 (3)	1977 (4)	1977 (5)	1977 (6)	1977 (7)	1977 (8)	1977 (9)	(10)	(11)	(12)	(13)	(14)	(15)
Net Agricultural Importers															
Japan	113.2	37	641.8	5,670	116	.33	.04	.00	.22	10.5	5.3	5.7	11	14	—10,757
Singapore	2.3	.1	6.6	2,880	825	.04	.00	.00	.00	8.8	8.6	8.6	163	160	—429
Hong Kong	4.5	.1	11.7	2,590	1,300	.02	.00	.00	.00	10.0	.2	6.8	79	98	—1,495
Taiwan	16.8	3.6	19.7	1,170	10.4	.21	.05	.00	.13	9.2	7.7	12.2	11	54	—192
Korea	36.0	9.8	29.5	820	13.0	.27	.06	.00	.18	8.5	10.4	17.0	3	40	—894
Net Agricultural Exporters, Developed															
United States	220.0	936	1,870	8,520	4.39	4.25	.84	1.09	1.32	4.3	2.8	2.3	5	8	11,897
Canada	23.3	998	197.1	8,460	2.95	42.83	1.87	1.00	14.00	5.6	4.7	3.8	18	24	982
Australia	14.1	769	103.5	7,340	.21	54.54	3.17	31.96	7.59	4.1	3.8	3.9	15	16	4,828
New Zealand	3.1	27	13.6	4,380	.99	8.68	.13	4.42	2.16	3.9	2.0		23	28	1,730
Net Agricultural Exforters, Developing															
Malaysia	13.0	33	12.1	930	1.86	2.54	.24	.00	1.67	6.5	7.8	9.3	54	50	1,265
Philippines	44.5	30	20.0	450	2.21	.67	.12	.02	.29	5.1	6.4	8.7	11	19	1,260
Thailand	43.8	51	18.4	420	1.02	1.16	.36	.01	4.82	8.2	7.1	10.3	17	22	1,637
Indonesia	133.5	190	40.1	300	.73	1.42	.11	.09	.92	3.5	7.7	12.9	13	22	311
Paupa New Guinea	2.9	46	1.4	490	3.03	13.86	.01	.03	12.56	6.5	5.0		17	45	30

Sources: World Bank, *World Development Indicators*, Washington, 1979.
Food and Agricultural Organisation, *Production Yearbook 1978*, Rome, 1979· *Trade Yearbook 1976*, Rome, 1979.

much higher incomes per hectare than the other countries (column 5 of Table 1).

Within the primary sector, one would expect the comparative advantage of agriculture to be lower than otherwise in Australia, Canada and the United States (and, to a lesser extent, in Malaysia and Indonesia) because of these countries' abundance of minerals per agricultural hectare, although for the United States this factor is more than offset by the fact that its large manufacturing sector would absorb most of its minerals and metals output and so leave one with the expectation that agriculture is its predominant net primary export (Anderson and Smith 1980). Within agriculture itself, column 7 of Table 1 suggests that Australia, North America and Thailand are likely to be large suppliers of grains; column 8 suggests that Australia, New Zealand and to a much lesser extent North America are likely to have large grazing industries (although the possibility of grain-fed livestock production in North America offsets the effect of its relatively smaller per capita endowment of extensive grazing land); and column 9 suggests that Canada, New Zealand and the Southeast Asian countries are likely to be substantial forest products producers.[13] The much higher ratio of GNP to agricultural land in North America as compared with Australasia (column 5) suggests the former is likely to specialise less in agricultural exports (particularly of relative luxuries such as meat) than the latter.

The comparative economic growth rates reported in Table 1 allow one to develop *a priori* expectations about how this general pattern of comparative advantage in agriculture is likely to be changing over time, and about the consequences of this for the pattern of agricultural trade. It is clear from columns 10 to 12 of Table 1 that the four ADCs, and Japan (though to a lesser extent recently), have been among the fastest growing and most rapidly industrialising economies in the world in the 1960s and 1970s, with growth rates two to four times those for the other four developed countries in the region. The former's relatively rapid growth, together with that of other Southeast Asian countries, would lead one to expect the latter developed countries' comparative advantage in primary products and comparative disadvantage in (especially labour-intensive) manufactures to have strengthened, and conversely for the resource-poor ADCs.

How do these expectations compare with the actual production and trade experiences of Pacific rim countries, particularly the resource-poor ADCs and Australia? Table 2 summarises the changing production situation, from which five points can be noted. First, agriculture's contribution to GDP since 1960 has fallen more rapidly in the rapidly-growing ADCs

[13] The Australian woodlands on the whole have relatively little commercial timber value.

TABLE 2 CHANGING STRUCTURE OF PRODUCTION AND EMPLOYMENT, PACIFIC RIM MARKET ECONOMIES, 1960 to 1977[a]

	Distribution of Gross Domestic Product (per cent)										Distribution of Labour Force (per cent)						Average Annual Growth of Production (per cent)					
	Agriculture		Industry: Mining		Industry: Manufacturing		Industry: Other		Services		Agriculture		Industry		Services		Agriculture		Manufacturing		Services	
	1960	1977	1960	1977	1977	1960	1960	1977	1960	1977	1960	1977	1960	1977	1960	1977	1960–70	1970–77	1960–70	1970–77	1960–70	1970–77
Net Agricultural Importers																						
Japan	13	5	2	1	33	30	7	10	45	54	33	14	30	37	37	49	4.0	3.0	11.0	5.7	11.7	5.3
Singapore	4	2	0	0	12	25	8	10	76	63	8	2	23	32	69	66	5.0	1.6	13.0	9.0	7.7	9.5
Hong Kong	4	2	0	0	25	26	9	5	62	67	8	2	52	57	40	41		1.2		6.3		9.6
Taiwan	28	12	2	2	22	37	5	7	43	42	56	34	11	27	33	39	3.4	1.5	17.3	12.2	7.8	4.5
Korea	40	27	2	2	12	25	5	8	41	38	66	45	9	33	25	22	4.5	5.0	17.2	19.3	8.4	8.5
Net Agricultural Exporters, Developed																						
United States	4	3	2	3	29	24	7	7	58	63	7	3	36	33	57	64	.3	.7	5.3	2.4	4.2	3.3
Canada	6	4	4	4	23	18	7	9	60	65	13	6	35	30	52	64	2.5	1.3	6.7	3.7	5.	5.3
Australia	12	5	2	4	26	19	9	9	51	63	11	6	40	35	49	59	2.7	1.7	5.6	3.9	4.0	3.9
New Zealand		12		0		22		9		57	15	10	37	35	48	55						
Net Agricultural Exporters, Developing																						
Malaysia	37	26	6	7	9	18	3	4	45	45	63	44	12	20	25	36		5.4		12.3		8.6
Philippines	26	29	1	2	20	25	7	8	46	36	61	51	15	15	24	34	4.3	4.8	6.7	6.8	5.2	5.6
Thailand	41	27	2	2	11	20	5	7	41	44	84	77	4	8	12	15	5.5	4.4	11.0	8.5	8.5	6.8
Indonesia	54	31	3	19	8	9	3	6	32	35	75	60	8	12	17	28	2.5	4.2	3.3	11.3	8.0	4.5
Papua New Guinea	49	33	0	14	3	9	10	3	38	41	89	84	4	8	7	8						

[a] The 'Agriculture' category includes forestry, fishing and hunting, while the 'Industry' category refers to mining, manufacturing, construction, and electricity, water and gas.

Source: World Bank, *World Development Indicators,* Washington, 1979.

and Japan than it has in the other developed countries of the region. Second, the mining sector's share of GDP has increased for Australia and the United States and been maintained in Canada, while it has remained small or declined in the ADCs and Japan. Third, the manufacturing sector's GDP share has grown in all developing countries but especially in the four ADCs while it has declined in the developed countries, especially in mineral-rich Australia and Canada. Fourth, a comparison across countries of the rate of decline of agriculture's share of GDP relative to the rate of decline of agriculture's share of the labour force suggests that there has been a greater capital intensification of agricultural production in labour-scarce developed countries as compared with labour-abundant developing countries. That is, countries have tended to choose available techniques or develop new techniques that enable them to save their relatively scarcest factor most, as hypothesized by Hayami and Ruttan (1971). And fifth, while Japan and Korea have enjoyed agricultural production growth rates exceeding those for the other developed countries of the region, they and the other ADCs have enjoyed a much greater margin of growth in the production of manufactures, suggesting a relatively greater shifting of their comparative advantage out of agriculture.

To what extent is the latter shift reflected in the trade statistics of the region? The theory and data presented to data suggest that the share of natural resource-based (NRB, or primary) exports in total exports of the four ADCs and Japan should be lower and declining much more rapidly than the corresponding share for the other countries of the region; and the share of labour-intensive manufactures in the total exports of the ADCs should be high and rising to a peak before starting to fall, while the share for the developed countries should be low and falling and that for the poorer more resource-rich developing countries should be low but starting to rise.[14]

These expectations are indeed borne out in the trade statistics, summarised in Table 3. The shares of agricultural and other NRB goods in total exports of Japan and the four ADCs have declined dramatically since the early 1960s to very low levlels.[15] By contrast, these shares for the other, resource-rich developed countries have declined much more slowly and are still at relatively high levels for developed countries,

[14] The trade discussion concentrates more on exports than imports or exports net of imports, because imports are typically distorted much more severely by trade policies than are exports.

[15] The declining shares for Singapore are more obvious if petroleum refining is considered a manufacturing activity, as the numbers in parentheses in Table 3 indicate. The sawing of timber and the processing of crude rubber (the raw materials for which are imported from nearby Malaysia and Indonesia) make up the bulk of the remaining share of Singapore's NRB exports.

TABLE 3 SHARES OF NRB AND CERTAIN LABOUR-INTENSIVE MANUFACTURED GOODS[a] IN TOTAL EXPORTS, PACIFIC RIM MARKET ECONOMIES, 1964 to 1977

(per cent)

		1964–66	1969–71	1974–76	1977
Net Agricultural Importers					
Japan	—Agricultural Goods	5	2	1	0
	—Other NRB Goods	5	6	5	4
	—Textiles, Clothing, Footwear	14	9	5	4
Singapore[b]	—Agricultural Goods	42	39	9	10
	—Other NRB Goods	28 (8)	32 (8)	48 (17)	46 (16)
	—Textiles, Clothing, Footwear	6	6	5	5
Hong Kong	—Agricultural Goods	7	4	4	3
	—Other NRB Goods	0	0	0	0
	—Textiles, Clothing, Footwear	12	10	10	7
Taiwan	—Agricultural Goods	52	20	14	13
	—Other NRB Goods	9	5	6	3
	—Textiles, Clothing, Footwear	14	30	34	31
Korea	—Agricultural Goods	28	9	5	4
	—Other NRB Goods	13	12	11	11
	—Textiles, Clothing, Footwear	33	33	40	36
Net Agricultural Exporters, Developed					
United States	Agricultural Goods	24	17	22	21
	—Other NRB Goods	9	11	9	9
	—Textiles, Clothing, Footwear	3	2	2	2
Canada	—Agricultural Goods	23	11	12	10
	—Other NRB Goods	39	36	41	39
	—Textiles, Clothing, Footwear	1	1	1	0
Australia	—Agricultural Goods	77	34	45	45
	—Other NRB Goods	8	46	38	39
	—Textiles, Clothing, Footwear	1	1	0	0
New Zealand	—Agricultural Goods	95	77	75	67
	—Other NRB Goods	0	13	8	14
	—Textiles, Clothing, Footwear	0	1	2	3
Net Agricultural Exporters, Developing					
Malaysia	—Agricultural Goods	50	46	44	42
	—Other NRB Goods	44	47	41	38
	—Textiles, Clothing, Footwear	1	1	2	2
Philippines	—Agricultural Goods	60	44	59	52
	—Other NRB Goods	34	49	26	23
	—Textiles, Clothing, Footwear	3	1	3	5
Thailand	—Agricultural Goods	82	69	65	63
	—Other NRB Goods	16	25	16	17
	—Textiles, Clothing, Footwear	1	2	7	8
Indonesia	—Agricultural Goods		40	13	17
	—Other NRB Goods	[98]	59	86	81
	—Textiles, Clothing, Footwear	0	0	0	0
PNG	—Agricultural Goods	95	69	28	57
	—Other NRB Goods	0	17	63	43
	—Textiles, Clothing, Footwear	0	0	0	0

[a] Natural resource-based (NRB) goods are defined as SITC sections 0 to 4 plus item 51365 (alumina) and division 68 (nonferrous metals); the agricultural goods component is food and agricultural products as categorized by FAO. Textiles, clothing and pootwear include SITC items 65, 841 and 851.

[b] Figures in parentheses for Singapore are the shares when refined petroleum is included in manufacturing rather than resource-based commodities.

Sources: United Nations, *Yearbook of International Trade Statistics,* (various issues); Statistical Department, Inspectorate General of Customs, *Trade of China (Taiwan District),* (various issues); Food and Agricultural Organization, *Trade Yearbook* (various issues).

TABLE 4 SHARES OF NRB GOODS IN AUSTRALIAN TOTAL EXPORTS AND EXPORTS TO ASIAN COUNTRIES, 1966/7 to 1978/9

(percent)

	1966/67 to 1968/69	1974/75	1975/76	1976/77	1977/78	1978/79
Total Exports						
Foodstuffs, Oils, Fats (SITC 0,1,4)	34	35	33	31	31	30
Wool, Hides, Skins (SITC 21, 26)	27	10	10	15	12	13
Nonfuel Minerals (SITC 27, 28)	8	14	15	14	14	18
Coal (SITC 32)	3	8	11	11	12	11
Nonferrous Metals (SITC 68)	5	6	5	5	5	6
Total NRB Goods (SITC 0–4, 68)	79	75	76	79	77	81
(Value of Exports, A$m)	(3,148)	(8,726)	(9,640)	(11,646)	(12,245)	(14,247)
(Value of Agric. Exports, A$m)	(1,920)	(3,927)	(4,145)	(5,357)	(5,265)	(6,126)
Exports to Korea						
Foodstuffs, Oils, Fats	5	58	37	27	35	34
Wool, Hides, Skins	84	14	27	29	23	21
Nonfuel Minerals	2	9	10	15	14	14
Coal	—	12	18	21	19	16
Nonferrous Metals	3	.2	.5	2	1	4
Total NRB Goods	94	93	93	94	91	90
(Value of Exports, A$m)	(10)	(123)	(120)	(189)	(266)	(449)
(% of Aust. Exports)	(.3)	(1.4)	(1.2)	(1.6)	(2.2)	(3.2)
(Value of Agric. Exports, A$m)	(9)	(89)	(77)	(106)	(154)	(247)
Exports to Taiwan						
Foodstuffs, Oils, Fats	25	59	56	39	31	29
Wool, Hides, Skins	36	13	19	23	16	19
Nonfuel Minerals	2	3	4	6	14	12
Coal	4	5	2	5	18	17
Nonferrous Metals	7	7	9	15	14	9
Total NRB Goods	74	87	90	88	90	86
(Value of Exports, A$m)	(22)	(81)	(114)	(134)	(182)	(299)
(% of Aust. Exports)	(.7)	(.9)	(1.2)	(1.2)	(1.5)	(2.1)
(Value of Agric. Exports, A$m)	. (13)	(58)	(86)	(83)	(86)	(144)
Exports to Hong Kong						
Foodstuffs, Oils, Fats	22	25	27	29	29	25
Wool, Hides, Skins	13	7	8	8	7	4
Nonfuel Minerals	.2	.6	.4	.5	.2	.3
Coal	.1	—	—	—	—	—
Nonferrous Metals	5	6	5	5	5	5

TABLE 4: (continued)

	1966/67 to 1968/69	1974/75	1975/76	1976/77	1977/78	1978/79
Total NRB Goods	41	39	41	46	41	35
(Value of Exports, A$m)	(65)	(105)	(147)	(189)	(215)	(321)
(% of Aust. Exports)	(2.1)	(1.2)	(1.5)	(1.6)	(1.8)	(2.3)
(Value of Agric. A$m)	(23)	(34)	(51)	(70)	(77)	(93)
Exports to Singapore						
Foodstuffs, Oils, Fats	49	34	35	42	33	33
Wool, Hides, Skins	.8	.2	.7	.5	1	—
Nonfuel Minerals	.3	1	1	1	.4	2
Coal	—	—	—	—	—	—
Nonferrous Metals	1	3	3	4	3	6
Totals NRB Goods	61	43	48	54	48	47
(Value of Exports, A$m)	(59)	(206)	(185)	(184)	(238)	(264)
(% of Aust. Exports)	(1.9)	(2.4)	(1.9)	(1.6)	(1.9)	(1.9)
(Value of Agric. Exports, A$m)	(30)	(70)	(67)	(78)	(79)	(87)
Exports to Japan						
Foodstuffs, Oils, Fats	17	23	24	24	22	24
Wool, Hides, Skins	38	10	12	12	10	12
Nonfuel Minerals	21	32	27	26	27	26
Coal	13	23	28	27	28	26
Nonferrous Metals	3	3	2	2	2	2
Total NRB Goods	92	91	92	91	89	97
(Value of Exports, A$m)	(704)	(2,456)	(3,192)	(3,956)	(3,877)	(4,111)
(% of Aust. Exports)	(22.4)	(28.1)	(33.1)	(34.0)	(31.7)	(28.9)
(Value of Agric. Exports, A$m)	(387)	(810)	(1,149)	(1,424)	(1,241)	(1,480)

Source: Australian Bureau of Statistics, *Australian Exports, Country by Commodity,* (various issues).

particulary in Australia and New Zealand.[16] Among the other Southeast Asian countries, it is the most densely populated countries of the Philippines and Thailand whose primary exports shares are declining fastest. Table 3 also shows that the share of labour-intensive manufactures such as textiles, clothing and footwear is growing most rapidly for the Philippines and Thailand (albeit from a low base). It shows that this share is very high in the low-wage, newly-industrialising countries of Korea and

[16] Note, though, that while the Australasian NRB export shares in total have remained high, the shares due to agriculture have fallen off considerably as minerals exports have grown. Even so, their agricultural shares (and that of the United States) have not dropped as dramatically over the twenty years since 1955 as has the world ratio of agricultural to total exports. The latter was 35 per cent in 1955, and it fell steadily from that to 30, 27, 21 and 17 per cent in successive five year intervals to 1975 (Ojala, 1979, Table 5).

Taiwan, is lower and declining in the higher wage countries of Hong Kong and Singapore (and Japan), but is extremely low and declining in Australia and North America. The only reason New Zealand's share of exports of these goods is rising is that it has been given highly favourable access to the Australian market via import quotas.

Finally, Table 4 shows, firstly, that NRB goods account for a greater share of Australia's exports to Korea, Taiwan and Japan than to the world as a whole: more than 90 per cent compared with less than 80 per cent. And, as expected, industrial raw materials account for a much smaller proportion of Australia's exports to the city-states of Hong Kong and Singapore.[17] Also as expected, the shares of foodstuffs in exports to these countries (except Hong Kong) are declining faster over time than the share of these goods in Australia's total exports. So too are the shares due to wool, hides and skins, both absolutely and relative to the shares in Australia's exports to all countries. In value terms, however, Australia's agricultural exports to these countries are still expanding rapidly, as is clear from the bottom line of each section of Table 4. In the mid to late 1960s, the four ADCs accounted for less than 4 per cent of Australia's agricultural exports; but by the mid 1970s they accounted for more than 6 per cent and now account for close to 10 per cent (compared with Japan's 24 per cent, up from 20 per cent a decade earlier).

Overall, the empirical evidence from Pacific market economies provides strong support for the theory developed earlier in the paper. This is so depite the fact that numerous price and trade policies in various countries tend to distort the pattern of production and trade from that which would emerge if free market policies operated. The next section makes use of the theory to suggest briefly the likely future changes in agricultural comparative advantage in the Pacific basin and the policy responses necessary to facilitate adjustment to those changes.

IV. Likely Future Changes in Agricultural Comparative Advantage

It is likely that the share of exports contributed by agriculture will decline gradually for most middle and high income countries as economic development takes place, particulary if richer countries continue to protect their declining agricultural sectors and if rising energy prices continue to boost the mining sectors of resource-rich countries. The rate of decline in this share, however, is likely to continue to differ widely across coun-

[17] The relatively large shares of Australia's trade with Singapore and Hong Kong compared with Taiwan and Korea in the 1960s was due to the relatively lower trade resistances with the former, presumably because of a common British heritage. The resistances to trade between Australia and Korea especially have since been lowered substantially (c.f. Anderson and Smith 1980, Table 10).

tries. In particular, the four rapidly-industrialising, resource-poor ADCs of Asia are likely to experience an especially rapid decline in agricultura comparative advantage, just as Japan has done and continues to do. The slower-growing, resource-rich developed countries of the Pacific basin, on the other hand, are likely to have a much slower decline in their share of exports from agriculture, although the rate in Australia especially will depend heavily on the extent of expansion in energy and energy-intensive exports. The latter's exports to the Asian ADCs, particularly to Korea and Taiwan, may be less dominated by agricultural goods in the future as these industrialising countries' demands for minerals and metals grow. This will be especially so if these food-deficit countries follow the Japanese 'example' and continue to increase their agricultural protectionism.

The obvious policy implication of these likely developments is that Korea and Taiwan need to recognize that, just as resource-rich developed countries' comparative advantage in labour-intensive manufacturing is declining rapidly, so is their comparative advantage in agricultural production. Protection policies will be incapable of preventing the need for adjustment unless *ever-increasing* rates of protection are applied, at ever-greater cost to the protecting country's consumers-cum-taxpayers. Within agriculture, their most efficient adjustment twould be towards producing more naturally-protected products such as fruit and vegetables and perhaps chicken, eggs and pork, rather than beef, dairy products and feedgrains. It is particularly important for Korea and Taiwan to recognize this need for adjustment now, before they become too entrenched in supporting a high-cost agricultural sector as has happened in Japan (Bale and Greenshields 1978).

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