THE PRODUCT CYCLE MODEL OF FOREIGN TRADE AND ASIAN DEMAND FOR POULTRY IMPORTS*

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Abstract of

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The Asian poultry market and its demand for imports is examined and Vernon's product cycle model is found to be appropriate. The model implies and forecasts of future import demand suggest that US poultry exports to the region will decline unless continued innovation in the US poultry industry occurs.

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Vernon's product cycle model of foreign trade argues that new products designed in the US (and other DCs) are initially produced here and foreign demand is supplied by exports. As the production technology becomes standardized and the product widely known, US firms invest and produce abroad and the US might ultimately become an importer. An essential element of this model is the eventual transfer of technology abroad. In order for the US to continue exporting, it must continually develop new products.

The transfer of commercial poultry technology to Asia has had many elements in common with the Vernon model. The high-yielding poultry production technology, based on containment feeding of corn and soybean meal rations, was originally developed in the US. It was quickly transplanted to foreign shores, including the middle and high income countries of Asia, where incomes and demand for meat are growing rapidly. Demand for meat imports in these countries depends on how fast domestic production can grow. As technology is transferred from abroad and domestic production efficiency approaches that in the US (or other countries with advanced technology), the demand for imports is reduced.

The implications of this model are important for the US poultry industry, since exports of US chicken grew rapidly in the late 1970s and in 1987 accounted for 5 percent of US production.[1] Asian demand for poultry imports is especially important because more than one half of US chicken

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1. Chicken meat exports dropped sharply in the early 1980s with the rise in the value of the US dollar, but then recovered to previous levels in 1986 and 1987 as the dollar fell.

meat exports were sold in East and Southeast Asian countries, and one-quarter to Japan alone.

In this paper we examine briefly the adoption of commercial techniques in poultry markets in eight countries in South and Southeast Asia, and project demand for poultry imports to 1995.

Growth in Asian Poultry Supply and Demand

In all countries of the region, poultry supply has grown rapidly due to the adoption of containment chicken technology. Traditional poultry production technology consists of native birds allowed to roam free and scavenge. The reproductive rate and time to maturity are low, and scavenged feed supply limits growth in output. The new technology consists of hybrid chicks, imported, at least initially, from the US or Europe, raised in containment facilities, and fed a compound feed diet whose principal components are soybean meal and corn. The advantages of the new technology include a much more rapid reproductive rate, efficient feed conversion, and essentially unlimited feed supplies at world prices.

All of the countries examined have begun the process of adopting the new technology, but the degree varies from country to country. For example, in Japan, essentially all chickens are produced with the new technology. It also seems likely that almost all of the chicken production in both Hong Kong and Singapore uses the containment technology, because there is no traditional agricultural sector in these city-states. On the other hand, in the Philippines a large number of traditional chickens are still produced.

Comparable statistics on adoption of the new technology are not available, but one of two ratios that provide some indication - inventory of traditional birds to total birds, and number of birds per production unit -

can generally be computed and there appears to be a strong, but not perfect, correlation between per capita income and the degree of adoption. Adoption is most advanced in Japan, where the number of birds per production unit increased from 14 in 1960 to 1,200 in 1983. South Korea, Taiwan, and Thailand all have made major strides in adopting the new technology. In South Korea, the chicken inventory per household has risen from 9.5 birds in 1962 to 127 birds in 1984. In Thailand, there were only 20 birds per production unit in 1978, but the share of traditional birds in total inventory fell from 42 percent in 1970 to only 24 percent in 1980. Schwartz reports that by the early 1980s Thai productivity and feed efficiency in commercial operations was identical to that in the U.S. In Taiwan, the ratio of traditional birds to total birds fell from 58 percent in 1970 to 16 percent in 1985. Only the Philippines has seen a relatively small drop in the importance of traditional flocks. In 1983, traditional birds still accounted for 67.5 per cent of the total.

A strong relationship also appears between the rate of adoption of the new technology and the growth in production between the early 1970s and the early 1980s (Table 1). The highest growth rates - from 8.8 percent to 13.7 percent annually - were in Hong Kong, Thailand, Taiwan, South Korea, and Singapore where the shift from traditional to new technology made rapid progress. The countries with the lowest growth rates are Japan, Malaysia and the Philippines. In the case of Japan, the gains from adoption were probably realized in the 1960s, while in the Philippines adoption of the new technology has not yet made substantial progress.

Government policies have played an important role in some countries in encouraging or hindering the adoption of the new technology. The most

visible policy is taxes on imports (or exports) of poultry products, but these are not very large in most of these countries. In Japan, for example, the tariff rates in 1987 ranged from 10 to 20 percent depending upon the cut. Only in the Philippines was the import tariff very high, with a rate of 50 percent after 1981 (Cabanilla). A diverse set of non-tariff policies including quantitative restrictions on imports, investment subsidies, subsidized loans, pollution control regulations, and "moral suasion", both encourage and discourage production. Most of these policies affect input costs and cannot be easily identified. Furthermore, some of them are offsetting. For example, in the Philippines, the benefits to producers of protection from chicken imports has been offset by difficulties in obtaining foreign exchange to import corn.

The net effect of the policies that affect output price can be measured with the nominal protection coefficient (NPC), the percent by which the domestic price is higher than the import (or export) price.[2] During the period 1981-84, of the countries where domestic prices were available, only two - the Philippines and South Korea - had large positive NPCs (Table 1). In Taiwan, the producer price was equal to the border price. Since the appropriate comparison would be with wholesale prices which are higher than the producer price, Taiwanese chicken producers receive some protection from world markets. Despite import tariffs, the Japanese wholesale price was roughly equal to the border price. Thailand is an exporter of boneless chicken meat, and as expected its domestic price is somewhat below the

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2. We use Singapore import unit values as a representative border price for average quality poultry trade in the region. Both Hong Kong and Singapore allow basically free trade in poultry. However, some of Hong Kong imports come from China, and might therefore not reflect world market conditions.

border price. Hong Kong's import unit value is much below that in Singapore, possibly because substantial numbers of live bird imports from China are included in the data.

Unfortunately, we do not have enough data on input price policies to be able to make conclusive statements about the overall impact of government on domestic supply and therefore imports. Certainly, if imports had been allowed into the Philippines and South Korea at the border price, domestic chicken prices would have been lower. However, domestic producers might have also been able to argue for reduced taxes on inputs or profits and the net effect on domestic production is unclear.

As in the United States, the per capita consumption of poultry grew rapidly in the countries of East Asia between the early 1970s and the early 1980s (Table 1). Per capita consumption of poultry grew at 9 to 10 percent annually in Taiwan, Singapore, and Thailand; and at over 6 percent annually in Japan, South Korea, and Hong Kong. In the Philippines and Malaysia, per capita consumption growth was much slower at 2 to 3 percent. Total consumption of poultry more than doubled in every country except Malaysia and the Philippines.

The rapid growth in poultry consumption reflects two trends - the rapid growth of income and the generally declining real price of chicken due to technical change. Per capita income growth has been greater than 4 percent in all countries of the region except the Philippines (Table 1). Real chicken prices have declined in all countries by at least 15 percent between the early 1970s and the early 1980s (Table 1). Econometric estimates of poultry demand show that consumers in the region have responded to these changes (See the Appendix for a description of the model behind these

results). Income elasticity estimates for poultry are all highly significant and fairly large, with the exception of Thailand. They range from 0.46 in Malaysia and Hong Kong to 1.22 in Singapore. Price elasticity estimates for poultry are significant in most countries and vary from -0.2 to -0.3.

The level of per capita poultry consumption is currently highest in Singapore, Hong Kong and Taiwan, where per capita income is relatively high and prices are low (Table 1). Among the eight countries considered here, Japan and South Korea have low per capita poultry consumption for their income levels. The low South Korea consumption is probably due to the fact that chicken prices are about 45 percent higher than in other countries of the region. In Japan, wholesale chicken prices are comparable to other prices in the region, but the retail price of chicken in Japan is more than double the price in the other countries examined ($US 5.05/kg as compared to $2.10/kg in Singapore). The Japanese retail distribution system is very expensive compared to other industrial nations, and the high retail price discourages consumption.

Net Import Projections

To the extent that a country has successfully adopted the containment chicken technology (ie has a feed conversion ratio equal to that in the US or Europe) and can purchase inputs at world prices it should be able to produce chickens at prices that are competitive with potential imports, and import demand should be limited. Supply will expand to meet domestic demand. In countries with protection of domestic production, imports will be limited, even if the production technology is not as efficient as that in

the US. Only countries with special advantages or disadvantages should have substantial quantities of trade in chicken.

Three of the countries examined have had substantial imports of chicken in the past 15 years (Table 1). Two of these - Hong Kong and Singapore - are city-states where expansion of production facilities is likely to be constrained by geography. Yet Hong Kong has had substantial imports of chicken meat while Singapore had little until the early 1980s. The reasons for the difference in imports is not entirely clear. Singapore developed a thriving containment chicken industry while Hong Kong has relied much more heavily on imports, possibly due to a local taste preference for the imported Chinese chickens.

We expect Hong Kong imports to continue to grow to 90,000 mt by 1995 as production remains constant while demand growth continues (See Appendix for methodology). Hong Kong passed environmental regulations in 1987 which should reduce poultry production. Singapore also recently passed environmental pollution regulations which have constrained the growth of chicken supply, and we expect that demand will grow faster than production, leading to imports of 63,000 mt by 1995.

Japan is the largest importer of chicken of the countries examined, with imports of 95,000 mt in the early 1980s. However, at current real prices, and expected income and population growth, future supply would far outstrip future demand because both income and population growth is slowing. The likely result, however, is not Japanese exports, but a decline in the domestic price of chicken, which will both reduce supply and increase demand somewhat. It seems likely, however, that the Japanese market for imports

will be increasingly limited to specialty products such as boneless chicken which require substantial labor inputs.

In the past, Malaysia, South Korea, the Philippines, and Taiwan have had none or only small amounts of trade in chicken meat. In South Korea, the Philippines and Taiwan, domestic chicken prices have been above world prices, as government or industry regulation has kept imports out. It seems likely that this policy behavior will continue and these countries will continue to be minor actors in world chicken trade. For Malaysia, data on domestic prices were not available, and we have predicted 1995 imports of only 7,000 mt on the basis of past trends.

Of the countries examined here, only Thailand exports chicken meat. The Thai comparative advantage is based on labor costs that are low even relative to many other Asian countries, and cheap corn. Chicken meat exports began in the early 1970s and have grown continuously. We expect these exports to continue and peak at around 52,000 mt in 1990. Exports will decline to 40,000 mt in 1995 as domestic demand takes an increasing share of domestic production.

Conclusions

The transfer of containment broiler production technology has led to rapid growth in chicken supply in most Asian countries, and this has supplied most of the increased demand for poultry with income growth. In the future only Hong Kong and Singapore are likely to be major markets for chicken imports, because geography constrains the growth of domestic poultry production in these city-states. Japanese demand for poultry imports will decline substantially as income and population growth slows and domestic production continues to grow. The possible exception is boneless products

that have substantial labor content, which are likely to be provided by Thailand. Future import demand in other Asian countries is also likely to be small, in part because of price policies that have encouraged the adoption of the containment technology and the growth of domestic production.

The product cycle model suggests and the projection estimates reinforce the likelihood that U.S. poultry exports will not grow as rapidly in the future as they have in the recent past. The transfer of the containment production technology to other countries often allows them to produce at a cost equal to or less than that in the US. Future US poultry exports will depend on continued US innovations in the poultry industry, either to reduce cost or to meet specialty market demand.

In contrast to the Vernon model, Asian production has not been undertaken by US firms. Instead, these firms retained control over the technology by exporting only parent or grandparent stock (in the form of day-old chicks), rather than the breeding lines. However, as Asian countries develop the capability to produce their own breeding lines, U.S. exports of poultry technology may also decline (Arboleda).

Table 1: Poultry Production, Consumption, and Past and Projected Net Imports (1000 mt)[a]

	Japan	Sing-apore	Hong Kong	Taiwan	Malay-sia	South Korea	Thai-land	Phili-ppines
Production								
1970-74	590	21	13	95	90	56	79	111
1980-84	1212	49	47	293	146	139	267	176
Ann. growth (%)	7.5	8.8	13.7	11.9	5.0	9.5	13.0	4.7
Per Cap. Consumption								
1970-74	5.7	12	10.9	6.2	8.1	1.7	2.1	2.8
1980-84	11	31.2	21.2	15.8	10.4	3.5	4.9	3.5
Ann. growth (%)	6.8	10.0	6.9	9.8	2.5	7.5	8.8	2.3
Tot. Consumption								
1970-74	613	26	45	95	91	56	79	111
1980-84	1307	77	111	293	151	139	240	176
Ann. growth (%)	7.9	11.5	9.4	11.9	5.2	9.5	11.8	4.7
GNP per capita								
Ave. 1980-84 (US$)	9,697	6,036	5,478	2,623	1,841	1,806	755	708
Ave. growth (%)[b]	4.7	7.6	8.1	5.5	4.4	6.6	4.0	2.3
Prices								
Ave. 1980-84 (U.S.$/kg)	1.31	1.32	1.07	1.32	NA	1.91	1.24	1.94
Real Price % change[c]	-30	-17	-14	-48	NA	-44	-26	-15
NPCs (1980-84)[d]	-1	0	-24	-1	NA	45	-8	46
Net imports								
Past								
1970-74	23	4	32	0	1	0	0	0
1980-84	95	28	64	0	4	0	-27	0
Projected								
1990	0	46	86	1	7	-4	-52	0
1995	0	63	90	1	7	-2	-40	0

Notes:

a. See the appendix for a description of the model used to forecast production and consumption.

b. 1965-85, from World Bank World Development Report, 1986.

c. 1970/74 - 1980/84.

d. The nominal protection coefficient (NPC) is the percent by which the domestic price is greater or less than the border price. Japan, 1981-83. Source of import unit values - FAO, Trade Yearbook, various issues. Domestic prices are wholesale except Taiwan and Thailand which are producer prices.

APPENDIX

Methodology for the Import Projections

Estimates of demand and supply were made in one of two ways - a projection of past trends into the future and an econometric estimate based on changes in economic variables and technology. Estimates of future imports are the difference between a projection of future demand based on future income and population growth, and a projection of future supply based on continuing technological change in production. The econometric projection of the import gap is based on the assumption that government policies will keep real prices at their current levels. In most cases, the econometric estimate is the better than the trend estimate because it is based on more information. However, the trend estimate is used wherever regression results were poor and produced unreasonable projections.

It was assumed that all prices are exogenous, determined either by world prices or by government fiat, so that supply and demand regressions could be estimated independently. The real price of poultry meat, lagged production, the real price of corn, the interest rate, and in some countries a time trend for technical change were independent variables in the supply regressions.

Demand regressions were estimated using per capita consumption as the dependent variable. The independent variables were the real prices of chicken, beef, and pork; and real per capita income.

Space precludes presentation of the regression results. In general the demand regressions produced significant and reasonable estimates of own-price and income elasticities. The supply regression results were poor, however, because of structural changes in supply.

Projections of future demand were made based on future growth in income and population. Future real per capita income was projected based on a linear trend from the early 1970s to the present. This income projection and recent real prices were substituted into the regression equation to produce predicted values of per capita consumption for 1990 and 1995. Population projections were obtained from United Nations statistics. Projected per capita consumption was multiplied by projected population to obtain estimates of total consumption.

To project future supply, recent real prices, lagged production (the estimated value rather than the actual value), and the increasing value of the trend variable were substituted into the regression equation and predicted values were iterated forward to 1990 and 1995.

Simple trend projections of supply were chosen over the regression projections in Hong Kong, Malaysia, the Philippines, and South Korea. Trend projections of demand were chosen over regression projections in the Philippines and Malaysia. Regression estimates of consumption differed from trend substantially in Japan, but the regression demand estimates were chosen because they reflect the slowing of population and income growth and the regression results were quite robust.

Production and trade data were from the FAO Production Yearbook and the Trade Yearbook, respectively, except for Taiwan where country sources were used. For all other data various country sources were used.