



How Did East Asian Countries Overcome the Food Problem? The Experiences of Japan, South Korea, Taiwan, and Indonesia*

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Abstract: This paper develops a semi-open dualistic model of the development process. Within this context rapid structural change and development is likely to be stymied by low productivity in staple food production. This will result in labor being relatively expensive, even when it is physically abundant. Thus solving the food problem is essential for successful economic development. However, different countries have resolved this problem in very different ways. The experiences of Japan, South Korea, Taiwan and Indonesia are used to illustrate the problem and the different ways each country has evolved to solve it. These experiences have implications for today's developing countries.

Keywords: Food problem, Agriculture, Structural change, East Asia, Southeast Asia

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Since World War II, a number of East and Southeast Asian nations have managed to develop rapidly. Structural change has played a critical role in this process of rapid economic transformation, especially in the early stages. Structural change has involved two dimensions. The share of agriculture in GDP has shrunk significantly, while that of manufacturing and services has increased. In addition, employment in agriculture has declined dramatically as employment in manufacturing rapidly expanded.

Economic analysis of this structural change has also been the focus of much recent research as illustrated by the work of McMillan and Rodrik (2011). In this literature, structural change is considered to be critical for several reasons. Productivity in agriculture is generally lower than in manufacturing. Thus the shift of labor which accompanies structural change raises overall productivity since labor is shifted from low to high productivity occupations. Secondly, Rodrik (2013) has shown that unconditional convergence in labor productivity does tend to occur in manufacturing sectors. This means that once manufacturing sectors in less developed countries are established, productivity there tends to converge to that found in developed countries. As such, aggregate convergence is thought to fail to occur in many low income countries due to the small share of manufacturing employment in these countries and the resulting slow pace of industrialization.

However, this analysis ignores the role of agriculture. Johnston and Mellor (1961) long ago delineated a number of roles which agriculture can play in the development process. Specifically, agriculture provides labor, food, foreign exchange, and savings for the expansion of manufacturing. Nevertheless, a number of these roles are contradictory in nature and there is significant disagreement over agriculture's contribution to development (Tiffen & Irz 2006).

Much of this confusion is due to a lack of focus on the fundamental issue that must be solved if successful structural change is to take place—where will the food come from to support a shift in employment from agriculture to manufacturing? In theory, if the economy in question is

open to free trade and small enough that prices are given exogenously, the food necessary to feed workers in manufacturing can be imported. However, as will be pointed out in this paper, the market for food staples has some peculiar characteristics. First, most of the staple food consumed in most developing countries is produced locally or domestically. The proportion of key food grains actually traded internationally is very small. Thus markets in these types of commodities are quite thin, meaning small changes in purchases and sales can significantly influence prices. Therefore, few countries are small in reference to international markets for staple foods and prices cannot be assumed to be fixed.

As such, the food problem persists and poses a significant barrier to rapid structural change. All countries must somehow resolve the food problem if rapid growth in labor intensive manufacturing is to occur. The economically successful nations of East and Southeast Asia have resolved this problem, allowing their rapid structural change to occur. However, the actual solutions have varied dramatically from country to country.

This paper examines the important question of the food problem and its role in development. The first section develops a number of dualistic models within which the food problem can be analyzed for both closed and semi-open economies. Evidence will be presented to show that the assumption of a completely open economy with respect to staple food is inappropriate for most developing economies. Next, the paper will use these theoretical insights to examine how the food problem has been resolved under various differing conditions. More specifically, the experiences of Taiwan, Indonesia, Japan and South Korea will be used to illustrate the various ways successful developing countries have been able to resolve the food problem. The final section of the paper summarizes the experiences of these four countries, enabling policy implications for today's under-developed countries to be drawn.

Understanding the Problem

The best known dualistic model of development is presented in the work of Lewis (1954). He saw a developing country as being made up of two sectors: modern and traditional. The modern sector involves economic activity in which profit maximization is the driving motive. Firms in this sector are assumed to use capital and labor in the production process, save and accumulate capital, and earn profit. Although Lewis thought this sector included more than just manufacturing firms, in this paper it will be assumed that the modern sector is only manufacturing. The traditional sector utilizes labor and land, engages in no saving or investment, and output is shared among family members (i.e. each receives the average product of labor). It is also assumed that labor is surplus in this sector. There is a great deal of confusion as to what this means. But it will be assumed here that initially the marginal product of labor is zero. Lewis argued that this sector includes agricultural and non-agricultural activities. The latter involves service sector activities such as the transportation and marketing of agricultural products. In this paper it is assumed that this sector produces food staples and the services involved with marketing and transporting these food staples. It is further assumed that no technical innovation occurs. Thus all growth initially results from structural change which shifts labor from the low productivity, traditional sector (where labor's marginal product is zero) to the high productivity, modern sector.

In a closed economy setting, growth unfolds as follows. Saving and capital accumulation in the modern sector draws surplus labor out of the traditional sector and structural change occurs. Difficulties can arise as surplus labor in the traditional sector is exhausted. At this point, food will become increasingly scarce and expensive. This forces up the nominal wage in the modern sector (to cover the increased food costs). Profits will decline and the expansion of this sector will slow or stop. In addition, as labor becomes relatively expensive to the modern manufacturing sector, firms will choose to utilize more capital intensive technologies and this

will further slow the process of structural change. The food problem acts as a brake in the structural transformation of the economy.

A number of objections have been made to this model, the most important being the assumption of surplus labor. However, this assumption can be easily dropped from the model. One can assume that traditional producers of food staples maximize profits and drop the assumption of surplus labor. Eswaran and Kotwal (2004) have developed a dualistic model in which families will spend all of their income on staples as long as their income is below some given level. Once income rises above this level an increasing proportion of income is spent on modern manufactured goods and a decreasing proportion on food.

So, where income levels are very low, households devote their entire budget to staples and the manufacturing sector will not exist. In this model, saving and capital accumulation in the modern sector will initially raise per capita income and families will spend an increasing proportion of their income on manufactured goods. However, food production will immediately decline thus raising the relative price of food. This in turn will reduce profits and capital accumulation in the modern sector and cause production in the modern sector to become increasingly capital intensive. Thus, structural change will be slowed or stopped. The implication is that the rate of growth at which labor can be withdrawn from the traditional sector will be dependent on the rate of productivity growth in the traditional, food producing sector. Thus technical change must be introduced into the agricultural sector to allow for successful structural change.

Of course, the most significant limitation of this dualistic model is that it assumes a closed economy. In an open economy setting, things would be quite different. Savings and investment in the modern manufacturing sector would not be limited by the ability to domestically produce food. Structural change could occur without a rise in the price of food since the food could be imported. And if the country under discussion is small in terms of trade, then the price of food is exogenous and will not rise as the modern manufacturing sector expands.

This imported food would be paid for by exports of manufactured goods. If Rodrik (2013) is correct, as discussed above, then manufacturing firms as they are established would begin the process of unconditional convergence to the technological frontier in manufacturing. Thus a developing comparative advantage in manufacturing would pay for the food imports necessary to feed the growing labor force in manufacturing. Most simply, the food problem disappears in an open economy setting.

It will, however, be argued here that most developing nations are semi-open economies. This is a concept that was developed in the work of Myint (1975). By this he meant that a significant part of the domestic economy remains insulated from the impact of foreign trade and comparative costs. For example, in this paper, it will be assumed that the production of food staples in developing nations is insulated from the international market. More clearly, food staple production is a closed sector implying that food prices are endogenously determined via domestic production and demand, and policy choices made by the state. The manufacturing sector is presumed to be open to trade and thus the price of this sector's output is exogenous.

Thus it is argued here that food production represents a non-tradable sector. For example, in most developing countries the proportion of the population of labor employed in agriculture greatly exceeds the proportion of output produced in agriculture. Much of this labor is focused on the production of staple foods. The Food and Agriculture Organization of the United Nations (FAO) (in Gollin, Parente, & Rogerson 2007) reports that in 2000, almost 70 percent of the arable land in 159 developing countries was devoted to food staples (grains, pulses, roots, and tubers). Of this production, almost all was devoted to domestic consumption. As an example, only a few developing countries are net exporters of grain, and only one, Argentina, exported more than a quarter of its grain production. The situation with respect to the production of roots and tubers is similar. FAO data shows that most poor countries meet their food demands for these goods via domestic

production. In summary, in developing countries most of the resources are used to produce food, the labor requirements of such activities are large, and “it is reasonable to view most economies as closed from the perspective of trade in food” (Gollin, Parente, & Rogerson 2007).

Further evidence in support of the limited tradability of food staples for Sub-Saharan Africa is provided by the work of Minot (2011). Utilizing time series data on international and domestic prices of major food grains (rice, maize, and wheat) for nine Sub-Saharan countries, econometric methods are used to analyze the relationship between the domestic and international price series. The analysis covered a period of between five and ten years (depending on the country) prior to 2007 and 2008. More specifically, for each domestic price series a vector error correction model (VECM) is estimated that combines a food price series from Sub-Saharan Africa and the international price series of the same commodity. Based on the Johansen test, only 13 of the 62 price series showed a long-run relationship in which the domestic price was influenced by the international price for the same commodity. Of the 13 price series that showed a long-run relationship with international prices, only 6 had a long-term elasticity of transmission that was statistically significant and the values of the latter had a median value of only .54 (that is, 54 percent of any change in international prices would be transmitted to the domestic price of the same commodity). Thus staple food prices in Sub-Saharan Africa seem to be, to a great extent, endogenously determined.

Moreover, even when international markets for food staples function, they are often quite thin. That is, of the total worldwide production of a food staple, the percent that is traded is actually quite small. As a result, changes in purchases on the international market by any fairly large economy will have dramatic effects on the price of a particular food staple. Thus when countries participate in the market, it is not a small country case with the price of food staples being exogenously determined, but instead a large country case where the price of food staples is endogenous.

The above discussion would seem to be particularly relevant in the case of rice which serves as the main wage good for most of the countries discussed in the next section of the paper. According to the research conducted by Clarete, Lourdes & Esteban (2013), the ratio of world rice exports to the world output of rice has increased slightly from the 1960s. For example, in the 1960s and 1970s this ratio was on average 4.22 percent. In the 1980s and 1990s, this ratio rose to 5.49 percent, while in the 2000s the ratio rose to 6.79 percent. This indicates that overall the international market for rice remains quite thin. For example, in the 1990s maize exports as a share of total production was over 20 percent.

The thinness of the world rice market has also been correlated with price volatility. The latter is usually measured as the standard deviation of the natural logarithm of monthly changes in prices multiplied by the square root of the total number of observations. For the period 1960 to 2012, rice had the largest price volatility of all the major food grains. The extent of international trading in rice “has been persistently low for nearly half a century, especially when compared with two equally important cereals, maize and wheat, despite the advent of trade liberalization” (Clarete, Lourdes, & Esteban 2013: 14).

Rice-based developing economies can therefore be considered semi-open economies in which the price of the key food staple is endogenous. As a result, the extent to which economic development characterized by dramatic structural change occurs will be dependent on how fast productivity in rice production grows. So if savings and capital accumulation in the modern sector occur at a faster rate than productivity growth in staple food production, then food prices will rise, driving up wages in the modern sector (manufacturing). This reduces the profitability of manufacturing and causes firms in this sector to switch to more capital intensive techniques of production and this will slow or stop structural change in both production and employment. Thus labor movement to the modern sector is slowed. Labor intensive manufacturing will run into increasing difficulty in terms of competing with producers elsewhere. Alternatively, if agricultural productivity in

food staples keeps up with saving and capital accumulation in modern, labor intensive manufacturing, then rapid growth of labor intensive manufacturing can occur.

The essential mechanism in this process is the relationship between staple food prices and wages. Several recent empirical studies support the proposition that rising food prices lead to rising wage rates. Jacoby (2013) utilized data drawn from India for the time period 2004 to 2010 and finds that nominal wages for manual labor across rural industry respond elastically to higher agricultural prices. These results are further supported by the work of Heady (2014). He finds that rising food prices tend to reduce poverty in rural areas and argues that this is most likely due to the positive effect of rising food prices on wages.

Before closing this section, it should be pointed out that one could add a second tradable sector to the model. Specifically one could assume that the agriculture sector be divided into two parts, a staple food production sector which is non-tradable and a commercial, export-oriented agricultural sector that possesses comparative advantage in an agricultural commodity. Based on comparative advantage, the economy would export an agricultural good and import manufactured goods. A strategy aimed at promoting structural change would involve state provision of subsidies aimed at promoting foreign investment in labor intensive manufacturing. As domestic manufacturing displaces imports, labor is transferred from both the food staple sector and the commercial export sector. Relative food prices would rise, leading to wage increases, which in turn would cause production in both the export and import competing sector to become increasingly capital intensive. If the country is relatively physically abundant in labor, then it is likely that both the agricultural export sector will have increasing difficulty in maintaining comparative advantage and the manufacturing import competing sector in terms of attaining comparative advantage. Structural change will fail to occur.

East Asian Approaches to the Food Problem

The implication of the above analysis is that successful economic development and structural change in semi-open economies involves solving the food problem. This section will illustrate how a variety of East and Southeast Asian nations have managed to solve this problem. As will be shown, both Japan and South Korea have used unconventional methods in terms of the provision of food staples. Alternatively, Taiwan and Indonesia have followed more traditional strategies.

Japan

Japan was the first non-Western country to successfully achieve structural change and rapid economic development. Most research on the Japanese experience has focused on the high growth period following World War II. However, the process of industrial growth and structural change was well underway before that. Japan's economic transformation really begins at least as far back as the start of the Meiji Restoration in 1868. It was at this time that feudalism was overturned and significant efforts were made to modernize and promote rapid economic growth.

That the prewar experience of Japan represented relatively rapid modern economic growth is reflected in Table 1, which shows the share of world GDP accounted for by various countries and regions. As can be seen, Japan's share of world GDP rose from 2.43 percent to 4.38 percent, while that for the rest of Asia as well as the United Kingdom declined.

Table 1.

Percentage Composition of World GDP for Japan, Selected Countries and Asia

Year	UK	US	Asia	China	Japan
1870	9.13	9.39	38.74	17.87	2.43
1900	9.55	16.92	29.76	14.09	2.71
1913	8.40	20.28	25.75	11.78	2.70
1938	7.34	20.69	24.79	10.33	4.30

Note. Adapted from Teranishi (2005).

Growth rates of real GDP by sector for Japan are presented in Table 2. As can be seen, overall GDP growth was generally between 2.5 percent to well over 4 percent. Since population growth was around 1 percent during this time period, significant growth in real GDP per capita occurred. Although these growth rates are low relative to those achieved in the postwar period, they are relatively high in comparison with other countries in the prewar period. Also note that the most rapid growth was in industry, construction, and infrastructure.

Table 2.

Historical Growth Rates by Sector: Japan

Year	Primary	Industry	Service	Construction	Infrastructure	Total
1889-1900	1.37	5.91	3.16	5.35	9.06	2.92
1901-1910	1.66	5.82	1.55	4.17	10.30	2.62
1911-1920	1.62	6.40	4.26	2.30	8.74	4.13
1921-1930	0.75	4.82	0.44	6.33	6.79	2.41
1931-1938	1.30	8.88	3.64	9.47	2.85	4.86

Note. Adapted from Teranishi (2005).

The structure of the economy also changed dramatically. As one can see from Table 3, the share of industry in GDP grew significantly while that of primary production shrunk rapidly. By 1930–1938, industry was accounting for more than half of all economic growth. Also, employment in industry and manufacturing rose to approximately 26 percent of all employment (Broadberry et al. 2014).

Table 3.

Sectoral Composition of Real GDP: Japan

Year	Primary	Industry	Services	Construction	Infrastructure
1888	41.5	8.1	46.3	2.6	1.5
1900	34.6	11.3	47.5	3.5	3.1
1910	31.5	15.4	42.8	4.0	6.3
1920	24.7	19.0	43.2	3.4	9.7
1930	20.7	24.0	35.6	4.9	14.6
1938	15.9	32.4	32.3	6.9	12.5

Note. Adapted from Teranishi (2005).

In order to provide the food necessary for this structural transformation, agricultural growth had to occur. The new political elite which came to power in the late 19th century recognized the importance of the agricultural sector to the process of economic transformation, and the key role of rice in particular. Before World War II, rice provided for more than 60 percent of the caloric intake of the Japanese and thus served as the major wage good (Hayami 1972). The new state therefore emphasized policies aimed at raising rice yields. This involved importing biochemical knowledge from Germany, the center of such research prior to World War II. An experiment and research system was also set up to adapt new seed varieties and spread their use throughout Japan. Initially, these new technologies were quite successful and rice productivity increased relatively rapidly. In fact the real price of rice, the nominal price divided by the general price index, remained relatively unchanged throughout the prewar period (Hayami 1972). Hence the main wage cost component during the prewar period was unchanged, in turn keeping labor costs stable. This was particularly important since much of the prewar growth in manufacturing was in labor intensive textiles.

However, the story is a little more complicated. The impact of new technology on agricultural productivity began to slow in the mid-1910s as technological potential was exhausted. While previous growth had relied on utilizing indigenous potential, what was now required was additional investment in the development of new yield increasing technologies. Thus the growth of rice supply slowed relative to demand resulting in dramatic increases in the real price of rice. This in turn led to rice riots in 1918 which swept throughout the major cities of Japan (Hayami 1972). This threatened the prewar process of economic development as the basis for cheap labor growth in manufacturing.

In response to this crisis, Japan organized an imperial self-sufficiency program. Under this program “the Japanese government invested in irrigation and water control and in research and extension to develop and diffuse high-yielding Japanese rice varieties adaptable to the ecologies of Korea and Taiwan” (Hayami 1972: 24). The former had

become a colony of Japan in 1910 and the latter in 1895. These two colonies had been significant producers of rice in the region and, with the introduction of Japanese based agricultural technology, saw rapid increases in agricultural growth. Taiwan was more favorably endowed with climate and soils similar to Japan while Korea was less favorably endowed. Nevertheless, the program of imperial self sufficiency was a major success: “Within 20 years, from 1915 to 1935, net imports of rice from Korea to Japan rose from 170 to 1,212 thousand metric tons per year, and net imports from Taiwan rose from 113 to 705 thousand metric tons” (Hayami 1972: 24). This net inflow of rice rose to 20 percent of domestic production in Japan.

As a result of the imperial self-sufficiency policy, Japan was able to solve its food problem and continue its labor intensive process of economic development and structural change in the prewar period. This was achieved by stabilizing rice prices within the context of the imperial regime. Bassino and van der Eng (2002) have shown that real wages for male unskilled workers remained relatively stable during this period. Japan in effect used its political power to invest in rice production in its colonies and then extract rice for the home market, thus stabilizing the price of the main wages good. Analysis of the Taiwan experience by Ho (1978) indicates that the standard of living in Taiwan rose slowly during this time. However, it is not clear whether that was true in Korea. It must be emphasized here that Japan did not depend on the international market to solve its food problem. The fear was that significant imports would drive up the cost of food and thus wages. Instead, the process of rice production was tightly controlled within the empire with the aim being to feed the homeland. Colonialism and the application of Japanese technology provided the basis for prewar industrialization.

Korea

Following Japan's defeat in World War II, its Korean colony was divided between a Soviet-backed government in the north and an American-supported government in the south. A period of turmoil, political unrest, and economic instability culminated in the Korean War, and the long lasting division of the Korean peninsula into North and South. The former had a larger industrial base and the latter was more agriculturally oriented. This was the result of colonial policies carried out by the Japanese.

Kang and Ramachandran (1999) have argued that although the Japanese exploited Korea in the prewar period, the significant investments made to raise agricultural productivity provided the foundation for postwar industrialization in South Korea. They use input and output data for the colonial period to estimate the economic returns to investment by Japan in the agricultural sector in Korea. As mentioned above, the Japanese invested in a series of programs in an effort to expand rice production. Agricultural output and productivity were significantly higher after these programs were implemented. This occurred via the expansion of irrigation, expansion in the use of external fertilizer, and the utilization of new seed varieties.

Rapid industrial growth and structural change in South Korea did not begin until the early 1960s. The late-1950s was a period in which recovery and stabilization after the Korean War was the main focus of economic policy under the Syngman Rhee government. During this time, American foreign aid played a critical role, and much of this aid paid for imports as well as the provision of food via the PL480 program. The rapid transformation of the economy would only really begin after Park Chung Hee took power in 1961. Policy became oriented towards using subsidies in many forms to promote the rapid growth of labor intensive manufacturing.

The economic transformation which subsequently took place is illustrated in Table 4. As one can see, South Korea underwent a period of

rapid structural change. This structural change was accompanied by rapid rates of growth as well. From 1962 to 1980, agriculture grew at an average annual rate of 2.7 percent, industry (mining and manufacturing) at 16 percent, and services (construction, utilities, transportation, storage, and communications) at 9.2 percent. Real GDP from 1962 to 1984 grew at an average annual rate of 8.4 percent (Looney 2012). Thus, South Korea underwent dramatic economic transformation which was initially led by rapid growth in labor intensive manufacturing. Providing food for this rapidly transforming economy was critical.

The food problem was made all the more pressing by the fact that government policy neglected agriculture until the early 1970s. Initially the Park regime made some efforts aimed at promoting agriculture. The Agricultural Bank was restructured and some debt in the countryside was liquidated. Efforts were also made to expand irrigation. However, most of the government efforts were focused on subsidizing and promoting export-oriented industrialization. Agriculture was, for the most part, neglected. Budget allocations for agricultural investment progressively declined throughout the 1960s (Kihl & Bark 1981). Government price policy with respect to agriculture was to keep food grain prices below international market levels (Lie 1991). Thus the effective rate of

Table 4.
Structural Change: South Korea

	1962	1970	1980
<u>Agriculture</u>			
% of GDP	39.8	29.7	17.8
% of Employment	63.1	50.4	34.0
% of Export	45.0	11.2	6.9
<u>Industry</u>			
% of GDP	14.6	19.7	25.3
% of Employment	8.7	14.3	22.6
% of Exports	65.0	88.8	93.1
<u>Services</u>			
% of GDP	45.6	50.6	56.8
% of Employment	28.2	35.2	43.4

Source: Looney (2012).

protection for agriculture was negative, implying a net outflow of resources from agriculture to non-agriculture (Moon & Kang 1989).

During this period agriculture continued to grow. From 1960 to 1984, the growth rate in agriculture averaged about 3.5 percent per year (Moon & Kang 1989). The investments of the past had created a productive agricultural sector. But the neglect of agriculture during the 1960s created a significant problem. In this case industrial growth “seems to have proceeded independently of agriculture” (Mellor 1995: 2). Thus agriculture was somewhat of a drag on overall growth. The growth that did occur was not sufficient to keep up with the growth of demand as South Korea experienced rapid growth in labor intensive manufacturing, “Between 1965 and 1975, for example, total non-farm demand for food doubled” (Lie 1991: 38). Thus a significant potential food problem posed a threat to the rapid expansion of labor intensive manufacturing and rapid structural change.

Initially this potential food problem was evaded due to significant food aid provided, for the most part, by the United States’ PL480 program. This program allowed food surpluses to be distributed to countries that were important to US foreign policy. US food aid increased steadily from 669,000 metric tons in 1965 to 3.6 million tons in 1972, making up about one-fourth of total grain consumption in South Korea (Hsiao 1981).

A more detailed view of the extent of food aid is presented in Table 5. As can be seen, food aid as a percent of the total aid provided to South Korea rose until it was terminated in the early 1970s. One can also see that food aid made up a significant share of imports, especially in the 1960s. Finally, food aid made up a significant share of GDP for much of the time period.

This aid stabilized food prices and allowed for wage stability. This stability allowed wages in manufacturing to also be stabilized. Table 6 presents data on real wages in manufacturing. As can be seen, real wages were relatively stable until the late-1960s, experienced a rise, and then stabilized again in the early-1970s.

American food aid ended in the early 1970s and this posed a significant problem for continued economic expansion. However, at this time policy in South Korea and in several other large developing countries (Djurfeldt & Jirström 2005) was reoriented. Significant investments were made in the agricultural sector, particularly in rice production and development of new seed varieties. In addition, pricing policies with respect to important food grains were altered. Prior to the early 1970s, the objective of policy was to keep the prices of critical food grains low (i.e. below international prices). The objective was to keep labor in the manufacturing cheap by keeping food prices low. The switch in pricing policy involved allowing the prices paid to farmers to rise above international levels, while keeping the price paid by urban

Table 5.

Foreign Aid to South Korea

Year	Total Aid (millions of \$)	Food Aid (% of total aid)	Food Aid (% of imports)	Food Aid (% of GDP)
1953	201.2	--	--	
1954	179.9	19.0	14.0	1.0
1955	236.7	20.3	14.0	1.3
1956	329.4	22.1	18.8	2.4
1957	382.9	32.1	27.7	3.3
1958	321.3	32.6	27.6	2.9
1959	249.5	14.6	16.0	1.6
1960	268.8	22.3	16.4	1.9
1961	215.2	36.1	23.5	2.3
1962	223.5	33.5	16.6	2.1
1963	255.8	38.9	17.1	2.6
1964	159.2	50.7	18.9	2.0
1965	176.8	43.2	16.2	1.7
1966	173.2	30.1	6.9	1.0
1967	229.7	37.3	8.2	1.6
1968	197.5	31.5	4.1	1.1
1969	239.6	76.7	9.5	2.7
1970	181.8	64.6	5.6	1.5
1971	185.9	87.5	6.5	2.0
1972	241.4	74.0	7.5	2.0
1973	92.0	90.1	5.3	1.6

Note. Adapted from Cathie (1989).

consumers low. The higher price paid to producers dramatically enhanced farmers' incentives to expand production. As a result, by 1975 South Korea was again self-sufficient in rice and barley. The low price to urban consumers helped keep wages down (Moon & Ryu 1977).

The above policy worked in the sense that the objective was to promote rapid expansion in food production while keeping prices low. However, this put an immense burden on the government budget. The response was to rapidly expand the money supply which in turn created inflation (Moon & Ryu 1977). This was an immense gamble by the state. The policy could not persist indefinitely.

Table 6.

Real Wages in Manufacturing: South Korea Monthly Earnings

Year	Employee (won)	CPI	Real Wage
1960	2,390	13.4	45.3
1961	3,610	15.0	45.3
1962	2,780	16.3	43.2
1963	3,180	21.6	38.4
1964	3,880	29.4	34.4
1965	4,600	31.9	37.6
1966	5,420	34.9	40.5
1967	6,640	36.8	47.0
1968	8,400	39.0	56.1
1969	11,270	40.7	72.2
1970	14,150	44.0	83.8
1971	17,349	46.5	97.2
1972	10,104	51.7	101.3
1973	22,330	56.2	103.5
1974	30,209	82.1	95.9
1975	38,378	100.0	100.0

Note. Adapted from Cathie (1989).

However, by this time critical food grains and food in general was becoming less important for consumers. In rural areas the expenditure on

food grains fell from 47 percent to 35 percent of family disposable income. For urban areas it fell from 40 percent to 20 percent. The estimated income elasticity of demand for all food grains for urban consumers was 0.246 in 1965 and 0.035 in 1975. Thus food grains had rapidly declined in importance by the late-1970s (Moon & Ryu 1977). Although prices paid to farmers remained relatively high, the price paid by urban consumers rose such that the financial burden on the state was significantly reduced. The gamble paid off as rapid development via cheap labor had achieved rapid structural change.

Taiwan

Like Korea, Taiwan had been a colony of Japan prior to World War II. As discussed earlier, the Japanese had sought to utilize its colonies to produce rice and thus had significantly invested in rural infrastructure as well as research and development to adapt rice seed grown in Japan to the conditions in Taiwan. These efforts were quite successful in raising agricultural productivity in Taiwan. Although much of this rice was transferred to Japan, productivity growth was rapid enough to also allow the standard of living to rise in the rural areas of Taiwan (Ho 1978). As a result, a foundation for rapid agricultural growth had been created in Taiwan as it had in Korea.

With the end of World War II, control of Taiwan was transferred to the Republic of China (ROC). However, with the defeat of the Chinese Nationalist army by the Communists, the former retreated to Taiwan and the ROC central government was transferred to the island. The new government on Taiwan was immediately faced with the problem of survival in the short-run and economic development in the long-run. Taiwan was certainly labor abundant relative to land, but the lack of food meant that this labor was not necessarily cheap. Thus Taiwan was immediately faced with the food problem.

The ROC government recommenced efforts aimed at raising agricultural productivity. This involved efforts on several fronts.

Significant investments in irrigation were carried out so that multiple cropping increased significantly. An extensive agricultural research and extension system was also developed and expanded. The research was aimed at developing more productive seed varieties while the extension system sought to spread these new agricultural techniques among farmers. As a result, agricultural growth was quite rapid. From 1951 to 1960, output grew at an annual rate of 4.7 percent. From 1960 to 1970, output grew at an annual rate of 4.2 percent (Lee & Chen 1979). The main focus of this paper is food production and Table 7 provides data on food production per capita. As one can see, there is a fairly consistent long-term rise in food production per capita.

Strenuous efforts were made to stabilize the prices of food staples, in particular rice. Table 8 presents data on the real price of rice. As one can see, other than the mid-1970s, the entire period is characterized by stability in the real retail price which meant that food remained cheap throughout the period of rapid labor intensive growth.

Table 7.

Food Production Per Capita: Taiwan

Year	Food Production Index	Year	Food Production Index
1973	95.84	1985	110.39
1976	96.44	1986	106.87
1975	90.61	1987	111.40
1976	100.50	1988	111.37
1977	106.43	1989	112.47
1978	104.96	1990	111.15
1979	111.69	1991	115.34
1980	107.36	1992	114.31
1981	103.64	1993	119.31
1982	103.62	1994	119.11
1983	106.05	1995	121.94
1984	106.85	1996	124.39

Note. Source is FAOSTAT. Base Year = 2004-2006 = 100.

At this point it should be noted that Taiwan, similar to South Korea, received a significant amount of foreign aid from the United States. Specifically, annual deliveries of foreign aid averaged \$80 million from 1951 to 1965. This represented an average of 10 percent of GNP in 1951, but this had fallen to less than 2 percent by 1965. In terms of food aid (PL480), it was most important for the years 1955 to 1965 and averaged about 33 percent of all aid for the period 1951 to 1965 (Jacoby 1966). In comparison with South Korea, Taiwan received less direct food aid and for a shorter period of time. Thus agricultural growth was more important in fulfilling food needs for Taiwan relative to South Korea.

The implication of the theory discussed in the preceding section is that when food is cheap, labor will be cheap, and economic growth will be labor intensive. Indeed, this seems to have been the case. Bassino and van der Eng (2002) have shown that real wages in Taiwan were relatively stable until the late-1960s.

Ho (1978) ranks the labor intensity of sectors by value added per employee and total assets in operation per employee. He finds that there is a shift in export composition with agriculture and processed agricultural products dominating before the mid-1960s and labor intensive manufacturing dominating after that.

One further point should be made concerning the experience of Taiwan. Keeping food prices from rising was of critical importance, but expenditure linkages (Mellor 1995) between agriculture and industry also played a critical role in the development of industry in Taiwan. Park and Johnston (1995) estimate that in the early stages of development, expansion of domestic demand accounted for more than 60 percent of the growth that occurred. Much of this demand arose as the result of rural income growth. Using national expenditure data for 1966 and 1976 it can be seen that the composition of rural expenditure switched from the purchase of staple goods to increased spending on clothing, housing and so on. Thus there was a demand-side effect of productivity growth in agriculture as well as a supply-side effect.

Table 8.

Real Price of Rice: Taiwan

Year	Retail Price \$/ton	CPI	Real Price
1955	127	0.139	914
1956	136	0.154	883
1957	147	0.166	886
1958	101	0.168	601
1959	109	0.186	586
1960	138	0.220	627
1961	147	0.237	620
1962	146	0.243	601
1963	148	0.248	597
1964	149	0.248	601
1965	151	0.248	609
1966	153	0.252	607
1967	160	0.261	613
1968	171	0.281	609
1969	176	0.295	597
1970	183	0.306	598
1971	190	0.315	603
1972	203	0.324	627
1973	239	0.351	681
1974	448	0.517	867
1975	474	0.545	870
1976	471	0.558	844
1977	426	0.597	714
1978	451	0.632	714
1979	544	0.825	659
1980	656	0.968	678
1981	674	0.988	682
1982	705	1.002	704
1983	636	1.002	635
1984	682	1.002	681
1985	603	1.000	603
1986	659	1.007	654

Source: International Rice Research Institute (1991).

With respect to all of these East Asian countries a critical factor in the success of the agricultural sector was land reform. In all three, significant land reform encouraged by the United States government in cooperation with each state government (Jirström 2005) created an

equitable foundation upon which to base overall economic growth. Thus as agricultural growth occurred the benefits of such growth were widely distributed. This provided political legitimacy to these states, allowing them to pursue strategies of growth which resulted in rapid economic development.

Indonesia

The last example of solving the food problem and engaging in rapid growth and structural change is a Southeast Asian country, Indonesia. The emergence of a new ruling elite led by Suharto set the stage for rapid economic development. Facing drought in 1972, food prices, in particular rice, rose dramatically from \$125 per ton in 1971 to \$630 per ton in 1973. This focused the regime's attention on agriculture since the rise in rice prices set off widespread political unrest. This led to programs aimed at subsidizing fertilizer and credit for the rural sector. Indonesia also benefited from a scientific breakthrough sometimes labeled the Green Revolution. These new technologies were the result of an institutionalized international effort to create high yielding seed varieties.

The impact of this new technology in Indonesia was quite significant. From 1967 to 1981, food producing agriculture grew at an average annual rate of 5 percent. This rapid growth led to dramatic reductions in poverty, with the proportion of the poor in the total population falling from 40 percent to 11.3 percent during this period (Thee 2002). By the first half of the 1980s, Indonesia had achieved food self sufficiency. Data on food production per capita is presented in Table 9. As the result of this growth, rice prices remained relatively stable from 1969 to 1995. Data on the real price of rice is presented in Table 10.

The theoretical analysis presented in the previous section indicates that the cheapness of food would have meant that labor remained cheap in Indonesia and one would expect rapid growth in labor intensive industries. Stuvewold and Timmer (2003) find that throughout the 1980s and 1990s labor cost per unit of output was lower in Indonesia than

that in South Korea

Table 9.

Food Production Per Capita (Index): Indonesia

Year	Food Production Index	Year	Food Production Index
1967	46.16	1984	68.85
1968	51.80	1985	68.97
1969	51.13	1986	77.65
1970	53.26	1987	77.34
1971	53.39	1988	74.00
1972	52.16	1989	76.97
1973	55.33	1990	78.24
1974	56.69	1991	77.45
1975	54.22	1992	83.31
1976	52.37	1993	83.10
1977	53.43	1994	82.22
1978	55.56	1995	89.47
1979	56.63	1996	84.49
1980	60.16	1997	88.90
1981	63.03	1998	83.11
1982	61.39	1999	82.38
1983	64.56	2000	84.16

Source: FAOSTAT.

and Taiwan. In the 1980s, rapid growth in labor intensive manufacturing occurred and the result was that employment growth averaged 7 percent annually after 1985 (Henley 2012). All of this resulted in dramatic structural change in Indonesia in terms of both employment and production.

Table 10.
Real Price of Rice: Indonesia

Year	Retail Price (\$/ton)	CPI Bulk Year = 2005	Real Price
1966	6,000	0.27	22,222
1967	17,000	0.57	29,825
1968	48,000	1.29	37,209
1969	43,000	1.50	28,667
1970	47,000	1.68	27,976
1971	45,000	1.75	25,714
1972	49,000	1.87	26,203
1973	83,000	2.45	33,878
1974	100,000	3.44	29,070
1975	111,000	4.10	27,073
1976	128,000	4.41	29,025
1977	133,000	5.45	24,404
1978	140,000	5.89	23,769
1979	170,000	6.85	24,818
1980	199,000	8.09	24,598
1981	229,000	9.08	25,220
1982	255,000	9.94	25,654
1983	304,000	11.11	27,363
1984	330,000	12.27	26,895
1985	332,000	12.85	25,136
1986	346,000	13.60	25,441
1987	388,000	14.86	26,110
1988	469,000	16.06	29,203
1989	500,000	17.09	29,257
1990	519,000	18.42	28,176
1991	557,000	20.16	27,629
1992	604,000	21.67	27,873

Source: International Rice Research Institute (1991).

Summary

In all four of these countries, government policy was used to exploit the agricultural sector (Anderson & Martin 2009) by using various means to depress the domestic price relative to the international price of food staples. However, what distinguishes this group is that in all four there was also significant investment in agriculture as well. This provided the foundation for rapid economic growth.

The mechanism for solving the food problem, and thus successfully engaging in rapid structural change and development, varied from country to country. For Japan, the solution involved utilizing its colonies as a mechanism for providing cheap food for the homeland. In South Korea, food aid was critical in maintaining cheap food, especially in the initial period of rapid structural change. Taiwan relied less on food aid and more on agricultural growth via technical innovation than did South Korea. Finally, Indonesia relied on rapid technical innovation via imported agricultural technology (Green Revolution) and institutional innovation via policy.

Before closing this section a few comments are in order concerning an East Asian country that was not included in this study: the Philippines. It too experienced rapid agricultural growth (in the 1970s) that was the result of the application and diffusion of new technologies originally developed by the International Rice Research Institute (IRRI). However, in this case the benefits from agricultural productivity growth were not widely shared. The benefits bypassed a large segment of the population that did not have access to the necessary infrastructure. For example, in 1966 only 10 percent of the arable land in the Philippines was irrigated whereas for Indonesia this number was 33 percent. In addition, the Philippines was characterized by a much more unequal distribution of landholdings than that found in Taiwan, South Korea, or Japan. Much of the agricultural income was concentrated in farms engaged in plantation production and large scale processing of export crops (Bautista 1995). The limitations in infrastructure limited the spread of the technology on

the supply side, and the inequality of income limited the consumption linkages on the demand side. The impact of this on Philippine economic development requires further research.

Conclusions

In this paper a dualistic model of a semi-open economy was developed to illustrate the key importance of staple foods in the development process, especially as it relates to structural change. In a semi-open dualistic model the price of staple food is not exogenous, instead it is endogenously determined. As a result, rapid growth in labor intensive manufacturing is dependent on keeping labor cheap via keeping the price of staple food stable.

Several empirical examples of this process are provided by the experiences of Japan, South Korea, Taiwan, and Indonesia. While the problem faced by all, in terms of structural change and development, was the same, each utilized a unique mechanism or path to solve this problem. In all of these cases agriculture has played a critical role in the development process. The policy implications for today's developing countries are important. Somehow the food problem has to be solved. In an international environment in which trade in food staples is limited and in which the institutional structure necessary to support rapid growth in food staples trading does not exist, investment in raising agricultural productivity is crucial for structural transformation. This would seem to be particularly true in Sub-Saharan Africa where domestic prices are somewhat disconnected with international prices.

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