CHAPTER 2

LITERATURE REVIEW

2.1 Trade, Technology and Economic Growth

Output is a function of technology as defined by Solow (1956). By a now familiar process of reworking the Solow equation, productivity and growth become a function of capital and technology. Technology can be defined broadly as "human capital", not just fixed capital goods. Socio-economic studies focus on how technology is in part a product of learning.

Trade and output, and therefore trade and productivity, are inter-related. There has been much study and discussion of just how this relationship works (causality, direction, etc.). One link between trade and productivity is in the way that trade can influence learning. Learning when embodied in technology has an effect on productivity. This paper attempts to draw out the link that exists between trade, learning, and productivity in Thailand's agricultural sector.

When Solow developed his model of economic growth, it was demonstrated that capital and labor were not the only two factors that contributed to growth. There was also a third factor defined as technology, often referred to by the variable "A". At that time, technology was measured as the residual of economic growth that could not be accounted for by changes in the inputs capital and labor. Research has continued since then to develop an improved definition of technology, to more specifically define A, since an understanding of economic growth is considered critical to modern economics.

Sheshinski (1967) investigated the link between learning-by-doing, technical progress and investment. This work moves to improve upon the model proposed by Arrow (1962) where technical progress is measured by the integral of past investment, by disembodying technical progress and not restricting the production function to fixed coefficients. Sheshinski notes that capital formation could be measured as the source of the learning process, and thus the study proceeds. Capital formation

has played a major role in Thailand's economic development, but its contribution to the agricultural sector specifically is less certain. However, learning and therefore technology growth occurs through other means than just capital formulation. These additional areas need to be addressed.

As examined by Krugman (1979) and others, technology, particularly the flow from developed to less developed countries, determines patterns of world trade and influences changes in those patters. But is the relationship between trade and technology just a one-way relationship? It probably is not. Therefore, it would be of interest to also study how trade might influence technology. One way trade could affect technology is by being a factor in learning. In Thailand's agricultural sector, exports experience competition on the world market, from which a producer must learn in order to be successful. Imports such as machinery can embody new technology.

Further economic studies of technology began to define the idea of human capital in the form of education level, experience and health (see Lucas, 1988; Rebelo, 1991; and others). It has also been demonstrated in empirical research that a country's ability to adapt foreign technology is facilitated by large endowments of human capital (Benhabib and Spiegel, 1994). The agricultural sector in Thailand has traditionally benefited from a large portion of the domestic labor pool, and while it is not the main focus of this research, the importance of technology and investment in preserving this human capital resource should be kept in mind.

How exactly does human capital learn in the world of international trade? There are several areas of study by both social scientists and economists. It appears that the more common area to study from an economics point of view has been learning and growth through specialized technology transfer in the forms of licensing, expatriate management, etc. This is actually only one route by which a country can gain knowledge that contributes to its technology growth. Of growing interest to researchers is the learning and productivity growth that occurs as a result of the processes of trade in goods and services.

Young (1991) developed a model of bounded learning by doing and the effects of international trade. In his research he notes that free trade can enhance the welfare of developing countries though the acquisition of knowledge, as well as the more traditional benefits of trade. The good thing about Young's model is that he makes the bounded learning model dynamic by incorporating spillover technology, which accommodates an evolving trading structure that is supported by empirical evidence.

However, Young finds that in a two country model under free trade, the country of lesser technology experiences technical progress and GDP growth less than or equal to that of the country with higher technology, and thus, the developing country never closes the technology gap with the developed country. This would seem at odds with empirical evidence from the case of developing economies such as Singapore and South Korea. Certainly these countries have reduced the technology gap they have with developed countries significantly in a short period of time. Young makes one assumption that there is no international diffusion of knowledge, the effect of trade on technical progress and growth depends solely on static comparative advantage. While it may be necessary for his model, it is a rather large assumption, and likely misses a major source of trade-induced learning and thus productivity growth in the increasingly global economy.

Hobday (1994) made a study of Singapore's electronics industry, which indicated that technology was accumulated through gradual learning, rather than by leapfrogging. Indeed it would seem from casual observation in the research world that improvements move forward generally one step at a time. The occasional case of "Eureka!" in which knowledge is jumped forward in a groundbreaking move is rare indeed. This emphasizes the importance of continuous minor advances in technology, as opposed to major technical breakthroughs. If the high-tech field is not making the dramatic strides often credited to it in the popular media, this is just one more argument against ignoring the importance of the reportedly "slow moving" agricultural sector.

Finally, Chuang (1998) has extended trade and growth theories by focusing specifically on defining the idea of trade-induced learning. He developed a

theoretical method for examining the effects of international trade on the ability of a country to learn, and thereby improve its technology level and through this its economic growth rate. Chuang notes that both imports and exports are "important sources and are mutually reinforced in intensifying the learning process". He proposes that the characteristics of the traded goods affect the learning process, that the level of the trading partner determines the level of technology that will spillover in the trading process and thus stimulate learning, and therefore productivity growht. He also notes that market openness is necessary but not sufficient for trade-induced learning to occur.

Chuang further argues that volume of trade is a significant factor in learning. Though one single sample of a product may be sufficient for reverse engineering, there is no feedback or market data in a single product. It is only through the dynamic action of the market that one discovers the real stimulus behind demand for products, and begins to see future trends and direction, which can then motivate various forms of imitation, innovation, or learning.

Lawrence and Weinstein (1999) separate imports into competitive and non-competitive imports, and find that only the competitive ones have a significant effect on productivity. It seems possible that Lawrence and Weinstein's definition of non-competing imports would have a direct effect on their ability to capture the effect of imports on technology, and it goes against the positive possibility of imports embodying technology. However, Chuang's research argues that the export-driven import of technically sophisticated capital goods should have a positive effect on productivity.

Lawrence and Weinstein consider only Japan and Korea in their studies, both with economies developed beyond Thailand. It also seems that in the analysis of their data from Japan, the country may present a special case, one that is not an ideal model for other developing nations.

Much consideration and analysis of trade related issues has occurred, focusing for the most part on whether or not an export-oriented or import-substitution oriented (i.e. protected) economy was better for economic growth. Chen and Tang (1987) show that firms producing in an economy with an export-orientation are more

efficient than those in an import-substitution oriented market. This is relevant to Thailand, as the agricultural sector is typically characterized as being export-oriented. While the work of Chen and Tang studies the benefit of facing competition in the export market, it overlooks the possibility that competition from imports could also have a positive benefit.

Sachs and Warner (1995) determined that a large proportion of differences in country to country growth rates over the long run (over a 30-year period) could be correlated to openness to trade. Liberalization of trade, or "openness" is generally seen as having a positive effect on growth, however, it has been tested mainly with aggregate cross-country data, not cross-industry data which could be more informative, considering globalization, and that in many economies different industries receive different levels of protection.

Bernard and Jensen (1999) point out that surveying a large number of earlier studies leaves the mechanism by which openness affects growth unrevealed. It would be interesting to see if research on Thailand's agricultural sector can shed some light on this issue.

From this evolution of ideas regarding the link between trade, learning and economic growth and productivity comes the basis for the studies proposed in this research. Where most authors have considered either technology or trade, this paper attempts to trace a link between the two. There is a need to determine how trade fosters growth in technology through the secondary effect of causing learning processes to occur. There is also a need for industry specific surveys, in particular for study on the agricultural sector, which is so important to many developing economies including Thailand.

2.2 Agriculture, Growth and the Thai Economy

In their survey (for the period 1978 to 1990) of productivity growth in Thailand's agricultural, industry, and services sectors, Tinakorn and Sussangkarn (1994) found that the total factor productivity (TFP) rates in the non-agricultural sectors were very small negative values. These negative values were attributed to the rates of growth

of factor inputs accounting for more than the total growth of output. In agriculture, all factor inputs and their qualities could account for about 68 percent of the growth rate of output, and the remaining 32 percent was accounted for by the TFP. In the same study, during the period 1981 to 1990 the average TFP rates for the non-agricultural sector were very small, positive values, emphasizing the role of factor inputs as the main agent of growth. In agriculture, TFP accounts for 26 percent of output growth.

The overall implication of such findings is that Thailand's rapid growth in the past several decades has been achieved by adding more labor, capital and land to increase production. Some productivity improvements have been achieved, but these may have been through importing more efficient and modern machinery and through the employment of better-educated, skilled or more productive workers.

The results of the sectoral TFP calculation by Tinakorn and Sussangkarn come as a surprise to many. They indicate that the agricultural sector has been more successful than expected in using new technology to increase output, particularly as the ability to increase the land factor in order to increase production has become more and more limited.

The contribution of technology to the growth of output in the agricultural sector between 1981 and 1990 averaged about one-quarter compared to the average figures of less than one-tenth in the non-agricultural sectors. A possible explanation for this phenomenon is that the high growth rate in the non-agricultural sector in the past has been sustained through imported technology, in the form of new machinery and equipment (i.e. technology embodied in capital). This situation is unlike those of other newly industrialized countries where some local industries have attained independence from imported technology through indigenous research and development, something that appears to have historically attracted little attention in Thailand.

Increases in agricultural output have been attributed to an increased application of factor inputs (land, capital, and labor) by many studies. According to Siamwalla, et al. (1990) schooling is by far the most important factor in raising long-term agricultural productivity, and irrigation and agricultural research also have a measurable

impact. Schooling or education is a means of learning, therefore, it can be assumed that learning in general has a positive impact on agricultural production. Thus it would be interesting to investigate other means, in addition to education, by which learning may occur.

The Siamwalla, et al. (1990) research also estimates different sources of growth in Thailand's crop sector during the study period (1961-1985). Their findings indicate the importance of technological progress or total factor productivity (TFP). Here they measure technology in terms of human capital, irrigation, and the agricultural research budget, and show that its effect was substantial, contributing about 50 percent to output growth.

Although land was confirmed an important input, its contribution to the growth of output was only about one-third (much less than commonly expected). While land played an important role in the period prior to 1977, the decrease in per capita available land since 1980 has diminished its importance.

Secondly, although the industrial sector generated high income for the economy, this did not translate into employment opportunities for the Thai labor force. Although the agricultural sector generates substantially less income, it employs a much larger proportion of the labor force. In 1996, agriculture contributed only 12.8 percent to GDP yet this sector absorbed as much as 53 percent of the country's total labor force. In 1999 those values were 7 percent and 43 percent, respectively.

Siamwalla furthers understanding of the Thai agricultural sector in other research. He points out specifically that one theory for the decline in the agricultural sector that cannot be supported is that the sector was both technologically backward and static. According to his estimation, while the sector made up a declining portion of the economy, total factor productivity for agriculture was growing at about the same rate as that in industry and services, and by some calculations is even in excess of that in industry (Siamwalla 1996).

As Thailand still remains an agricultural exporter and retains its dominant share in many commodities despite the lack of trade protection, this indicates not only the importance of the sector, but that Thailand probably has some comparative advantage. Further study of what drives productivity in this sector would allow the government to set policy to maintain if not promote the existing competitive advantage.

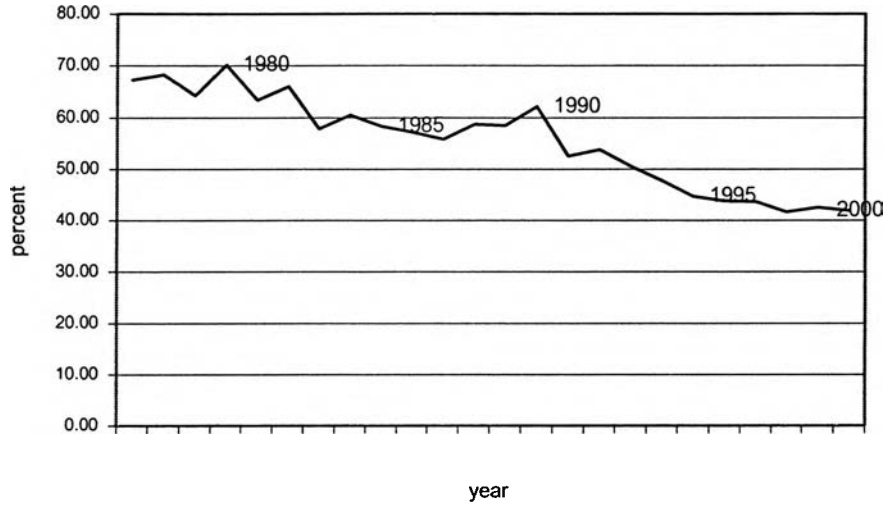
2.3 Factors of Agricultural Production in Thailand

2.3.1 Labor

The agricultural sector continues to be a major source of employment for the labor force in Thailand. In 1993, farm population comprised approximately 57 percent of the total labor force. However, these statistics do not immediately reveal some important changes and sources of economic stress in the recent decades.

Thailand's rapid economic expansion since the 1980s increased aggregate demand for labor in the Thai economy considerably. However, the overall labor supply did not keep up with the demand, largely because of continuously declining population growth rates. The five-year average annual population growth rate fell from 2.02 percent during 1980-85, to 1.6 percent during 1985-90, and fell further to 1.1 percent during 1990-95. The percentage of the population making up the total labor force has also been decreasing due to people staying in school longer, etc. As a result there has been increasing competition for labor among sectors. Particularly the labor market in agriculture has come under pressure (due to wage differentials, etc.). Thus, while its relative share in total employment has always been decreasing, since 1989 agricultural employment has also decreased in absolute terms. The number of employed persons in agriculture dropped from 20.5 million in 1989 to 16.9 million in 1995.

Figure 2. Percent of total labor force employed in agriculture, 1977-2000



(source: NSO)

As a result of the increasing competition for labor amongst Thailand's various economic sectors and the corresponding fall in agricultural labor, there is an economic problem. Without an increase in either foreign labor (a politically and economically complex issue) or an increase in productivity to compensate for the decline in labor, agricultural output is expected to fall. The fall could become quite dramatic in line with the fall in labor since the elasticity of output with respect to labor is high, being close to one (Paopongsakorn, et al., 1998).

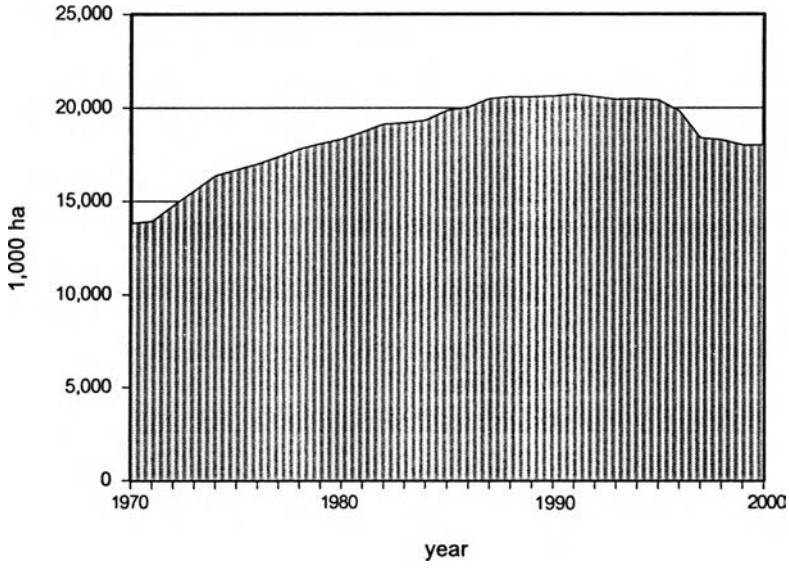
2.3.2 Land

In a production setting where capital does not actually play a major role, such as the labor-intensive agricultural sector of Thailand, land is often one of the key factor inputs. Until the mid-1980s, the major source of agricultural growth was the expansion of cultivated land at the expense of forest area. After that, according to the Thailand Development Research Institute (1995), productivity growth can be accounted for by yield improvement, capital investment, and a shift from low value to high value crops.

The fertile, irrigated plains of Thailand have produced an abundance of rice, maize, and other crops, establishing Thailand as the "rice-bowl" of Southeast Asia. The country has approximately 51 million hectares of land, with about 21.8 million hectares are reserved as the national reserved forests. The cultivated area represented about 20 million hectares in 1990, of which 11.9 million hectares are used for growing rice, 6.7 million hectares for upland crops, and 2.2 million hectares for perennial crops.

In the 1980s the previously increasing supply of land ran out. Whereas land under cultivation had been increasing, largely due to deforestation promoted by sociopolitical policies, this was no longer an option. Thereby putting an end to a major factor input in Thailand's agricultural output.

Figure 3. Area of Arable and Permanent Cropland 1970-2000



(source: FAO)

With the decline in factor inputs from land and labor, increases to productivity become essential to maintain the agricultural sector's economic significance.