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# TRADE LIBERALIZATION AND PRODUCTIVITY GROWTH IN THAILAND

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## I. INTRODUCTION

PRODUCTIVITY growth is important for economic development. Even if there is no change in the supply of factors of production such as capital and labor, productivity growth will expand the level of production. Also an increase in productivity lowers the cost of production, leading to an improvement in the international competitiveness of the product. An improvement in international competitiveness leads to an expansion of exports which in turn promotes economic development. Thailand's rapid economic development came about as a result of interaction between exports and investment expansion, both of which were achieved through a rise in productivity. According to an estimate by the World Bank [18], Thailand recorded an extremely high total factor productivity (TFP) growth from 1960 to 1989, compared with other developing countries.

Competitive pressure on firms and the ability of firms to increase productivity are important factors determining TFP growth. In this study we will examine empirically the determinants of TFP growth for Thai manufacturing industries in the 1970s and 1980s focusing on the effect of trade policies on TFP growth. An analysis of these two decades is of great interest, as trade policies in Thailand went through a shift from import substitution in the 1970s to export promotion in the 1980s. Elucidating the determinants of TFP growth at the industry level is useful not only to complement an analysis conducted at a macroeconomic level such as the World Bank [17], but it is also useful for policy makers interested in formulating industry-level policy measures.

Section II of this study provides an overview of Thai economic development; Section III looks at the changes in trade policies; and Section IV undertakes a quantitative analysis of the determinants of TFP growth. Finally, Section V presents our conclusions.

## II. THAI ECONOMIC DEVELOPMENT: EXPORT-LED INDUSTRIALIZATION

From the 1960s to the 1990s the Thai economy experienced a number of ups and downs. After a steady growth performance, the economy recorded a decline in growth rate in the mid-1970s following the first oil shock. This shock led to a slowdown in the world economy, which in turn caused Thailand's exports to

stagnate, leading to a fall in the country's economic growth rate. The oil shock also brought a surge in the price of oil, pushing up Thailand's overseas payments. At the same time, however, the price of primary products, Thailand's main exports, rose to mitigate the unfavorable impact on the balance of payments caused by the oil shock. Also in the mid-1970s, the Thai government increased its expenditures and implemented active economic development policies which helped economic growth to recover.

The growth of the Thai economy declined from the latter half of the 1970s, the time of the second oil shock, to the first half of the 1980s. This decline was caused by the surge in oil prices resulting from the second oil shock and also by the increase in the government's fiscal deficit brought on by the expansion in government expenditures. Then at the start of the 1980s the economy ran into a series of further difficulties: the global recession after the second oil shock, the slackening of prices for primary products, the rise in interest rates and the rise in value of the Thai baht (due to the rise in the value of the U.S. dollar to which the baht is linked), all caused exports and investment to stagnate leading inevitably to a slowdown in Thai economic growth. To overcome its strained economic situation, the Thai government cut down its expenditures and adopted a tight monetary policy. Externally it limited overseas borrowing while at the same time it implemented export-promotion policies which took the forms of currency depreciation and trade liberalization.

The year 1985 was an important turning point for the Thai economy. Oil prices and interest rates dropped while prices for primary products rose. Also the economies of the industrialized countries recovered, causing an increase in their demand for imports. As a result, Thailand's exports increased greatly. During the latter half of the 1980s, Japan and the Asian NIEs actively carried out foreign direct investment (FDI) in the Asian region. Having maintained policies of economic liberalization since the start of the 1980s, Thailand was successful in attracting a good portion of this FDI. Since a large part of FDI was export-oriented, exports by foreign-owned enterprises expanded, contributing to the growth of Thai exports. At the start of the 1980s, exports accounted for around 25 per cent of Thailand's GDP. However, as a result of the rapid increase in exports from the mid-1980s onward, that figure rose to nearly 40 per cent during the latter half of the 1980s.

## III. CHANGES IN TRADE POLICY: THE SIMULTANEOUS APPLICATION OF IMPORT-SUBSTITUTION AND EXPORT-PROMOTION POLICIES

Trade has played an important role in Thailand's economic development, as discussed above. This section looks at changes in trade policy affecting the manufacturing sector from the 1960s to the 1990s (see Table I).

During the 1960s, under the first (1962–66) and second (1967–71) national economic and social development plans, Thailand followed an import-substitution policy which put priority on the consumer goods sector and also provided protec-

TABLE I

CHANGES IN THAILAND'S TRADE POLICIES

| Period | Summary |
|---|---|
| 1944–47 | Severe restrictions on trade and foreign exchange transactions |
| 1947–55 | Multiple exchange rate system, relaxation of restrictions on trade and foreign exchange transactions |
| 1955–61 | Multiple exchange rate system abolished, Board of Investment (BOI) established |
| 1961–67 | Import-substitution policy using protective tariffs and preferential treatment for investment, absence of an export-promotion policy |
| 1967–71 | Relaxation of preferential tax system for investment |
| 1971–76 | Cutback of investment promotion measures, strengthened import restrictions, import-substitution policy for consumer durables and intermediate goods, export industry promotion policy centered on labor-intensive industries |
| 1977–86 | Continuation of export promotion policy, import-substitution policy for capital goods industries; pursuit of structural adjustment, efficiency improvement, strengthening competitiveness |
| 1987–91 | Fostering of technology-intensive industries, export promotion, moves toward simplification of trade policy |

Source: Compiled from [5, Note 1.1].

tion mainly through the application of tariffs.[1] During the latter half of the second development plan, the potentials for import substitution were reaching their limits while a balance of payments problem arose due to the stagnation of exports. To cope with these problems, the third development plan (1972–76) called for the fostering of labor-intensive industries through the promotion of exports. However, the government maintained the import-substitution policy in the area of consumer durables and intermediate goods. Among the measures adopted for promoting exports were a drawback system on customs duties and low interest financing for exporters. These export-promotion measures were intended to offset the unfavorable effects of the import-substitution policy on export industries. The industries experiencing a growth in exports included natural resource intensive industries (chiefly foodstuffs) and labor-intensive industries (textiles, electrical appliances). At the start of the 1970s, the nominal tariff rates were lowered, but later to cope with the deterioration in the current account caused by the first oil shock, the tariff rates were again raised. As can be seen in Table II showing both the nominal tariff rates and the effective tariff rates, in 1975 foodstuffs and textiles received high protection when compared with the other manufacturing sectors.

By the second half of the 1970s it became clear that protectionist policies created inefficiency in import-substituting industries while at the same time they had unfavorable effects on export industries. To overcome these problems, the fifth development plan (1982–86) emphasized industrial adjustment, improving effici-

[1] See Wonghanchao and Ikemoto [16] and Chiasakul et al. [4] on the development policy in Thailand.

TABLE II

NOMINAL AND EFFECTIVE RATES OF PROTECTION

| | | 1975 | | 1982 | | 1985 | |
|---|---|---|---|---|---|---|---|
| | | NRP | ERP | NRP | ERP | NRP | ERP |
| 30 | Total manufacturing | 20.4 | 46.4 | 14.8 | 33.8 | 14.1 | 23.0 |
| 31 | Foods | 22.6 | 65.8 | 14.5 | 41.1 | 17.3 | 36.6 |
| 32 | Textiles | 25.7 | 44.1 | 24.4 | 50.9 | 8.6 | 5.2 |
| 33 | Wood/wood products | 11.6 | 22.0 | 12.7 | 24.3 | 25.1 | 44.0 |
| 34 | Pulp/paper products | 13.4 | 20.9 | 9.9 | 13.0 | 11.4 | 13.8 |
| 35 | Chemicals | 22.3 | 50.3 | 14.4 | 33.3 | 12.0 | 14.8 |
| 36 | Ceramics | 15.3 | 28.5 | 15.3 | 40.4 | 15.1 | 30.7 |
| 37 | Steel/nonferrous metals | 7.7 | 17.5 | 7.1 | 20.7 | 8.4 | 13.7 |
| 38 | Machinery/transportation equipment | 16.7 | 13.2 | 11.5 | 13.8 | 17.5 | 24.2 |
| 39 | Other manufacturing | 12.0 | 18.0 | 2.9 | 5.2 | 6.0 | 8.7 |

Source: Computed from the Thai input-output table [6] [7] [9].
Note: NRP=nominal rate of protection, ERP=effective rate of protection.

ency, and strengthening competitiveness in domestic as well as world markets. One of the measures for achieving these objectives was a large reduction in tariff rates which was carried out in October 1982. At the time the revenues from these tariffs accounted for 20 per cent of the government's total revenue, and thus it proved difficult to make up for this reduction through other government revenue sources. Faced with this situation, the government raised import tariff rates on machinery and other products in 1985. As a result of the increase in tariff rates mainly on highly processed products, the difference in the nominal as well as effective rates of protection for different goods widened. At the same time, however, export-promotion measures were also strengthened. These included strengthening the already ongoing drawback system and low-interest financing system for exporters. Also preferential measures were applied to export-related investment projects, and bonded warehouses and export-processing zones were constructed.

The sixth development plan (1987–91) continued the objective of improving competitiveness. Thereafter targets for strengthening marketing ability and improving the quality of products were added. With the steady growth of the economy and the resulting improvement in the government's fiscal account, the tariff rates which had been raised in 1985 were reduced during the latter half of the 1980s, although they were still higher than the 1982 level. Most of the tariffs on imports are now rather low, but high tariff rates have been maintained on final goods. For example, on some types of automobiles, leather goods, and beverages, a tariff rate of more than 100 per cent is levied. Import tariffs on materials and intermediate goods needed in the production of manufactured final goods are set at a low level, therefore the effective rate of protection for the production of final goods is rather high (Table II).

In the area of non-tariff barriers, import licenses, import quotas, local content requirements, and other barriers have been maintained, but even in this area

liberalization has moved forward. For example, the number of imported goods requiring import licenses has dropped. As of 1991 such industrial manufactures as automobiles, motorcycles, chemical manufactures and textiles, and primary products such as rice and sugar were subject to import licensing. Of the total number of goods subject to customs duties, about 8 per cent were products requiring import licenses.[2]

From the 1960s to the end of the 1980s, the overall trend of liberalization continued to move forward. Nevertheless, protection policies have been applied to industries that are regarded as important. Likewise from the 1970s onward when the importance of exporting began to be recognized, preferential measures have been devised for export industries. Over time a numerous variety of trade policy measures along with preferential taxation and low-interest financing have come to be applied to protect and foster important industries. Not a few of these measures have been applied without close coordination, as both import-protection and export-promotion policies have been applied to the same industries. In an effort to overcome this inconsistency, moves have recently begun to simplify policies and measures.

## IV. TRADE POLICIES AND TOTAL FACTOR PRODUCTIVITY (TFP)

Since the 1970s the Thai government has alternately applied and even sometimes simultaneously applied import-substitution and export-promotion policies within an overall context of trade liberalization. Export-promotion measures have been applied in the area of labor-intensive goods, while in the area of heavy chemicals protective measures have been taken in order to promote import substitution, thus resulting in the striking differences in trade policies among industries. In this section we will examine the influence of trade polcies on the TFP of different industries.[3]

### A. *Measuring TFP*

An increase in TFP is generally interpreted as technological progress. In fact, however, a number of problems arise when taking TFP figures to mean solely technological progress.[4] The first problem is that this interpretation holds only in cases where long-run equilibrium is realized in production. Long-run equilibrium in production is the condition where inefficient firms exit and only firms that efficiently utilize resources are left operating. In other words, the supposition is that production always takes place along the production function. However, in

[2] Detailed information on recent trade policy can be found in GATT [5].

[3] Akrasanee-Wiboncutikula [1] examine the relationship between TFP and foreign trade for twenty-five industries using the data at ISIC three-digit classification during the period from 1963 to 1986. Brimble [3] analyzes at the company level (seven industries, 139 firms) the relationship between technological efficiency and Thai industrial policy from 1975 to 1983.

[4] See, for example, Nishimizu-Hulten [11] nad Nishimizu-Page [12] regarding the measurement and interpretations of TFP.

the short run, production does not always take place along the production function due to the presence of adjustment cost. In such cases, the short-run change in capacity utilization exerts an influence on the estimated value of TFP. Also related to the point above, X-inefficiency caused by inefficient management or by an inappropriate incentive system will also make it difficult for a firm to carry on production along the production function. In these cases where inefficiencies exist, a rise in TFP indicates an improvement in inefficiency, not technological progress.

The second problem is the existence of economies of scale. With changes over time, the scale of production expands leading to an improvement in production efficiency. A rise in production efficiency due to economies of scale appears as a rise in TFP. Moreover, and connected with that, a rise in production efficiency due to economies of scope which benefit from diversification also contributes to a rise in TFP. These observations indicate that it is difficult to distinguish between technological progress and a rise in efficiency due to economies of scale or economies of scope as a cause leading to a rise in TFP. Accordingly, we interpret the increase in TFP to indicate an improvement in production efficiency in broad terms, reflecting not only achievement of technological progress, but also reduction in X-inefficiency, and exploitation of economies of scale and scope.

1. *Decomposition of output growth*

Table III shows the performance of manufacturing production between 1976 and 1988 with the period divided into two sub-periods: 1976–82 and 1982–88.[5] Production growth during the latter sub-period (1982–88) was high for most sectors. For manufacturing as a whole, growth during the latter sub-period was 12.9 per cent against 6.5 per cent during the earlier sub-period. Looking at manufacturing as a whole, the contributions of intermediate inputs and TFP to output growth were large during the earlier sub-period, and during the latter sub-period the growth rate for intermediate inputs grew dramatically and their contribution rose sharply. The growth rate of the labor force during the two sub-periods also rose by 0.5 percentage points, and though showing negative growth in some industries during the earlier sub-period, it changed to positive values for all industries during the latter sub-period. Thus along with expansion of the economy came an increase in employment. The contribution of capital-input growth did not change from the earlier to the latter period, but its growth rate increased by 0.8 points, contributing positively to production growth. TFP which had a high growth during the first sub-period fell during the latter sub-period, and the percentage contribution to output growth for manufacturing overall came to only 5.4 per cent.

2. *Disaggregation of labor, capital, and intermediate inputs*

We decomposed the growth rate of output into labor, capital, intermediate inputs, and TFP. However, by analyzing the composition of labor, capital, and intermediate inputs in more detail, it is possible to make an interesting analysis

[5] Hereafter, as indicated in the note below Table III, for labor-input growth rate, capital-input growth rate, and intermediate-input growth rate, the values shown are those obtained by multiplying their respective growth rates by their respective shares in total inputs.

TABLE III

TFP GROWTH BY INDUSTRY

(%)

| | $Q$ | $A$ | $(A)$ | $L$ | $(L)$ | $K$ | $(K)$ | $Z$ | $(Z)$ |
|---|---|---|---|---|---|---|---|---|---|
| A. 1976–82 | | | | | | | | | |
| 30 Total manufacturing | 6.5 | 1.8 | (27.0) | 0.1 | (2.0) | 0.8 | (12.4) | 3.8 | (58.6) |
| 31 Foods | 6.0 | 1.7 | (27.9) | 0.2 | (3.3) | 0.2 | (3.9) | 3.9 | (65.0) |
| 32 Textiles | 13.9 | 3.9 | (28.3) | 1.6 | (11.8) | 2.0 | (14.6) | 6.3 | (45.4) |
| 33 Wood/wood products | −9.6 | −7.2 | (−75.1) | −0.4 | (−3.9) | 1.6 | (17.0) | −3.6 | (−38.0) |
| 34 Pulp/paper products | −10.3 | 0.3 | (2.5) | −1.5 | (−14.3) | −1.8 | (−17.4) | −7.3 | (−70.7) |
| 35 Chemicals | 9.3 | 4.0 | (42.8) | 0.3 | (3.2) | 0.2 | (1.9) | 4.8 | (52.1) |
| 36 Ceramics | 11.9 | 4.8 | (40.2) | −0.1 | (−0.8) | 1.7 | (14.2) | 5.5 | (46.4) |
| 37 Steel/nonferrous metals | 33.1 | −10.3 | (−31.3) | 14.9 | (45.1) | 13.0 | (39.3) | 15.5 | (46.8) |
| 38 Machinery/transportation equipment | 2.3 | −0.5 | (−20.4) | −0.1 | (−3.0) | 1.0 | (44.0) | 1.8 | (79.3) |
| B. 1982–88 | | | | | | | | | |
| 30 Total manufacturing | 12.9 | 0.7 | (5.4) | 0.6 | (4.9) | 1.6 | (12.1) | 10.0 | (77.6) |
| 31 Foods | 18.8 | 0.3 | (1.8) | 0.8 | (4.2) | 2.1 | (11.1) | 15.6 | (82.9) |
| 32 Textiles | 13.9 | 3.7 | (26.9) | 0.8 | (6.1) | 1.0 | (7.4) | 8.3 | (59.6) |
| 33 Wood/wood products | 10.9 | 0.4 | (3.4) | 0.2 | (1.8) | 1.2 | (10.7) | 9.2 | (84.1) |
| 34 Pulp/paper products | 24.2 | −1.6 | (−6.5) | 1.1 | (4.5) | 6.5 | (27.0) | 18.2 | (75.0) |
| 35 Chemicals | 7.0 | −1.0 | (−14.0) | 0.1 | (1.4) | 1.6 | (22.4) | 6.3 | (90.2) |
| 36 Ceramics | −5.6 | −1.5 | (−27.0) | 0.2 | (4.3) | 0.2 | (2.7) | −4.5 | (−80.0) |
| 37 Steel/nonferrous metals | 25.7 | 5.0 | (19.6) | 0.3 | (1.2) | 3.3 | (12.9) | 17.0 | (66.3) |
| 38 Machinery/transportation equipment | 15.6 | 1.4 | (9.0) | 0.7 | (4.2) | 2.2 | (14.2) | 11.3 | (72.6) |

Source: Computed by the authors from [14].

Notes: 1. $Q$=output, $A$=TFP, $L$=labor inputs, $K$=capital inputs, $Z$=intermediate inputs.

2. Growth rates of labor inputs, capital inputs, and intermediate inputs are those obtained from multiplying their growth rates by the respective value shares in total inputs.

3. The figures in the parentheses are percentage contribution to output growth.

of manufacturing performance.[6] Labor can be divided into workers who are directly engaged in production (unskilled workers, *UL*) and workers concerned mainly with management (skilled workers, *SL*).[7] Capital goods and intermediate inputs can be divided into those that are produced domestically and those that are imported (domestically produced capital goods, *DK*; imported capital goods, *MK*; domestically produced intermediate goods, *DZ*; imported intermediate goods, *MZ*).[8]

According to Table IV, during the latter half (1982–88) of the period under examination, labor, capital, and intermediate inputs all showed dramatic increases. It can be seen in particular that the growth rate of unskilled workers within labor as a whole, of imported capital goods within capital goods as a whole, and of domestically produced goods within intermediate inputs as a whole increased rapidly when compared with their growth rates during the earlier period (1976–82). Looking at capital goods inputs, in chemicals and machinery/transportation equipment, inputs of domestically produced capital goods declined during the latter half while inputs of imported capital goods expanded. Imports of intermediate inputs during the earlier half showed an average growth rate of 3.8 per cent for manufacturing overall with negative growth in two industries, but during the latter half the average growth rate increased to 10.0 per cent with the pulp and paper industry exhibiting the highest growth rate of 18.2 per cent. The growth rate of imported intermediate inputs in the wood/wood products industry and in the pulp/paper industry was extremely high.

The increase in imports of capital and intermediate goods indicates that during the latter half of the 1980s not only was Thailand able to obtain the foreign exchange required for these imports, but it also shows that import liberalization had made it easier to obtain these imports. This fact signifies that in each of the industries the range of choices for inputs had broadened. In other words, inputs (raw materials, intermediate inputs, and capital equipment) required for

[6] The decomposition formula can be expressed as follows:

$$\frac{\dot{A}}{A}=\frac{\dot{Q}}{Q}-\left[\frac{wL}{pQ}\left(\frac{UL}{L}\frac{\dot{UL}}{UL}+\frac{SL}{L}\frac{\dot{SL}}{SL}\right)+\frac{rK}{pQ}\left(\frac{DK}{K}\frac{\dot{DK}}{DK}+\frac{MK}{K}\frac{\dot{MK}}{MK}\right)\right.$$
$$\left.+\frac{qZ}{pQ}\left(\frac{DZ}{Z}\frac{\dot{DZ}}{DZ}+\frac{MZ}{Z}\frac{\dot{MZ}}{MZ}\right)\right],$$

where $Q$, $L$, $K$, and $Z$ are respectively output, labor-input, capital-input, and intermediate-input; $UL$ and $SL$ are unskilled and skilled labor; $DK$ and $MK$ are domestic and imported capital goods; $DZ$ and $MZ$ are domestic and imported intermediate goods; and $p$, $w$, $r$, and $q$ are respectively the price of output, wage rate, rental price, and the price of intermediate goods.

[7] The term "skilled workers" means the executive management, technicians, managers, managerial supervisors, researchers, office workers, sales personnel and the like; "unskilled workers" means laborers who are engaged in wage labor directly at the site of production.

[8] The amount of domestic and imported capital goods, and the amount of domestic and imported intermediate goods are estimated using the Thai input-output tables. Specifically, the following tables are used: the 1975 table for the 1976 figures, the 1982 table for the 1982 figures, and the 1985 table for the 1988 figures. A detailed description of the derivation is available on request from the authors.

TABLE IV
DECOMPOSITION OF INPUT GROWTH

(%)

| | | L | | K | | Z | |
|---|---|---|---|---|---|---|---|
| | | UL | SL | DK | MK | DZ | MZ |
| A. | 1976–82 | | | | | | |
| 30 | Total manufacturing | 0.1 | 0.1 | 1.1 | −0.3 | 3.0 | 0.8 |
| 31 | Foods | 0.2 | 0.0 | 0.3 | 0.0 | 3.4 | 0.5 |
| 32 | Textiles | 1.5 | 0.1 | 2.9 | −0.9 | 5.8 | 0.5 |
| 33 | Wood/wood products | −0.4 | 0.0 | 0.5 | 1.1 | −4.0 | 0.4 |
| 34 | Pulp/paper products | −1.3 | −0.2 | −1.4 | −0.4 | −5.6 | −1.8 |
| 35 | Chemicals | 0.2 | 0.1 | 1.6 | −1.4 | 3.5 | 1.3 |
| 36 | Ceramics | −0.3 | 0.2 | 1.2 | 0.5 | 5.2 | 0.3 |
| 37 | Steel/nonferrous metals | 13.5 | 1.4 | 12.9 | 0.1 | 14.2 | 1.2 |
| 38 | Machinery/transportation equipment | −0.1 | 0.0 | 0.9 | 0.1 | 2.0 | −0.1 |
| B. | 1982–88 | | | | | | |
| 30 | Total manufacturing | 0.5 | 0.1 | −0.5 | 2.1 | 7.8 | 2.2 |
| 31 | Foods | 0.5 | 0.3 | 1.3 | 0.8 | 14.9 | 0.7 |
| 32 | Textiles | 0.8 | 0.0 | −0.1 | 1.1 | 5.6 | 2.7 |
| 33 | Wood/wood products | 0.2 | 0.0 | 3.6 | −2.5 | 2.3 | 6.8 |
| 34 | Pulp/paper products | 1.0 | 0.1 | 7.9 | −1.4 | 8.3 | 9.9 |
| 35 | Chemicals | 0.1 | 0.0 | −1.0 | 2.6 | 4.4 | 1.9 |
| 36 | Ceramics | 0.3 | 0.0 | 0.0 | 0.2 | −4.0 | −0.4 |
| 37 | Steel/nonferrous metals | 0.2 | 0.1 | 3.5 | −0.2 | 11.8 | 5.3 |
| 38 | Machinery/transportation equipment | 0.6 | 0.1 | −0.3 | 2.5 | 5.9 | 5.5 |

Source: Computed by the authors from [14].
Notes: *UL*=unskilled worker, *SL*=skilled worker, *DK*=domestic capital inputs, *MK*=imported capital inputs, *DZ*=domestic intermediate inputs, *MZ*=imported intermediate inputs. The figures are the growth rates multiplied by the respective shares in the total value of inputs.

production could now be selected not only from domestically produced goods but also from imported goods. Moreover, during the latter half of the 1980s (more precisely, from 1987 onward), foreign direct investment, mainly from Japan, flowed rapidly into Thailand. As a result, imports of intermediate and capital goods needed for production increased. Imports of intermediate goods are also very much related to the changes in the effective rate of protection (ERP). In the three industries of wood/wood products, pulp/paper, and machinery/transportation equipment, the ERP rose between 1982 and 1988, suggesting that the tariff rates on intermediate goods declined. As is clear from Table IV-B, the growth rate for imported intermediate goods in these three industries was higher than in any of the other industries.

### B. *Determinants of TFP: Trade Policy and Production Efficiency*

In this section we will analyze the factors determining TFP, or production efficiency, with a particular focus on the effect of trade policy using cross-section data of the Thailand Standard Industry Classification (TSIC) at the four-digit level.

1. *Factors determining TFP*

Factors determining TFP can be divided into two categories. One includes those factors related to the industry environment in which a firm carries on production. These factors can be regarded as external to the firm. The other category of factors includes those related to the capabilities of the firm itself, and are internal to the firm, or firm-specific.

Among the factors external to the firm, competitive pressure is the most important one influencing TFP. For a firm to survive in the midst of strong competitive pressure, it needs to develop new production technologies and/or make efficient use of the factors of production. Conversely, when competitive pressure is weak, there is no need to improve production efficiency. When expressing domestic competitive pressure using the market concentration ratio ($CR$), if this ratio is high and the market is oligopolistic, competitive pressure is considered to be low.[9] In this study we will analyze the influence of market concentration on production efficiency regarding a change in domestic competitive pressure between two points of time as a change of market concentration ratio ($\Delta CR = CR_{t-n} - CR_t$). It is expected that there will be a negative relationship between the change in the market concentration ratio defined above and TFP, a measure of production efficiency.[10]

Competitive pressure from foreign competitors is brought in via imports.[11] If the inflow of products from overseas through importing is large, competitive pressure will be strong. In this study, we use the effective rate of protection (ERP), which indicates the degree of protection, as an indicator showing competitive pressure from overseas. If ERP is high, it is expected that the rise in TFP will be low. To analyze the influence of trade liberalization on production efficiency, we use the change in ERP between two points of time ($\Delta ERP = ERP_{t-n} - ERP_t$) as the indicator showing the degree of trade liberalization. It is expected that there will be a positive relationship between $\Delta ERP$ and TFP.

It is possible to use the share of imports in domestic sales (i.e., the import-penetration ratio) as a way to express competitive pressure from overseas. But there is a problem with this method when analyzing the determinants of production efficiency. While import pressure will have an influence on production efficiency,

[9] The relationship between the market concentration and the magnitude of competitive pressure may not be straightforward. For example, even if the market concentration ratio is high, if potential competition exists because market entry and exit is free (i.e., if the market is contestable), then it is conceivable that competitive pressure will be high. Moreover, there are situations where the number of firms in the market is small and the market concentration ratio is high, but these firms may compete fiercely making competitive pressure strong. Thus, the behavior of firms, in addition to the market structure as expressed through market concentration, is also an important factor determining competitive pressure.

[10] Weiss [15] analyzed the influence of the change in the market concentration ratio on prices in the American manufacturing sector and obtained a negative relationship between these.

[11] Foreign direct investment (FDI) can also be regarded as a factor exerting competitive pressure, but because of a lack of data, the impact of FDI is not analyzed in the present study. However Brimble [3] shows that the level of technological efficiency is higher for U.S. and Japanese firms compared with local firms.

production efficiency will at the same time influence the degree of import penetration, something which can be regarded as a reverse causal relationship. For example, products produced by firms with low production efficiency will be weak in competitiveness, and as a result the import-penetration ratio will be high.[12] In fact, it has been found in numerous studies that there is a negative relationship between the import-penetration ratio and production efficiency.[13]

First-specific factors influencing production efficiency which need to be considered are such factors as a firm's ability to develop and improve technology (i.e., a firm's technological ability), and the quality and capability of the workers and equipment used in production. If the technological ability of firms is high, the possibility for technological progress will be high; if technological progress is achieved, the production efficiency of firms will improve. Empirical studies on the TFP determinants of industrial countries have shown that R&D expenditures are an important factor for raising production efficiency. In this study as well, we use the share of R&D expenditures[14] in total output as an explanatory variable. The portion of the total workforce made up of technicians and scientists is another important firm-specific factor indicating a firm's ability to development technology. In this analysis, we use the share of the workforce made up of managerial and technical workers (*SLS*) as a proxy. It is expected that there will be a positive relationship between the share of R&D expenditures in output (*R & D*) along with the share of managerial and technical workers in the workforce (*SLS*) on the one hand and TFP on the other.

Regarding machinery and other capital equipment, new technology is considered to bring about an improvement in production efficiency. It is not easy to evaluate the quality of technology embodied in capital equipment. Therefore, based on the supposition that imported machinery is of a higher quality than domestically produced machinery, we use the portion of fixed capital formation composed of imported capital goods (the imported-capital input ratio, *MKR*) as the proxy showing the quality of capital equipment. Moreover, if importing intermediate

[12] See Nishimizu-Page [12], Nishimizu-Robinson [13]. To avoid the problem of simultaneity, Bonelli [2] analyzed the effect of import-penetration ratio (the contribution of the increase in imports to the increase in production) with a 1-period lag. His analysis on the determinants of TFP for Brazilian industries shows that an increase in imports brings about an increase in productivity.

[13] Shown below is the Spearman rank correlation coefficient between the TFP growth rate for the data used in the analysis and the change in the import-penetration ratio.

| | | | |
|---|---|---|---|
| Earlier period: | 1976–82 | −0.450 (33) | significant at the 1% level |
| Latter period: | 1982–88 | −0.287 (39) | significant at the 8% level |

Notes: 1. Import-penetration ratio = total imports / (gross output + imports − exports).
2. Sample size in parentheses.

In both time periods a significant negative correlation can be observed between TFP and the change in the import-penetration ratio, suggesting that low production efficiency leads to a high import-penetration ratio.

[14] The amount paid to social-science and natural-science research organizations and that paid to educational services, which are obtained from the Thai input-output table, are used as R&D expenditures.

goods broadens the range for choosing intermediate inputs more suitable to the technology of domestic enterprises, it can be considered that a rise in the share of imported intermediate goods making up all intermediate goods (the imported-intermediate input ratio, *MZR*) will likewise cause a rise in production efficiency. Consequently, it is expected that there will be a positive relationship between the imported-capital input ratio (*MKR*) along with the imported-intermediate input ratio (*MZR*) on the one hand and TFP on the other hand.

When economies of scale exist, the increase in TFP does not necessarily indicate technological progress alone; as discussed above it is also a reflection of the improvement in production efficiency due to economies of scale. Moreover, it has been found in a number of empirical studies that an increase in production brings about a rise in productivity, and this relationship is known as "Verdoorn's law."[15] The benefit from economies of scale is realized either when the market size expands or when the firm size increases. The limited size of the market has turned out to be an impediment for many developing countries. In many of these countries import-substitution policies have secured the domestic markets, but because the scale of these markets is limited, it has been difficult to raise productivity and thus to improve competitiveness. In Thailand, as was seen in Section II, emphasis was directed toward export-promotion policies because of problems that emerged with production efficiency under the import-substitution policy. In this study, to analyze the influence of economies of scale on production efficiency, we use the growth rate of gross output (*Q*) as the explanatory variable. It is expected that the relationship with TFP growth rate will be positive.

2. *Determinants of TFP growth: empirical results*

Table V shows the results of regression analysis carried out on the determinants of the change in TFP during the two periods of 1976–82 [estimated equations (1), (2)] and 1982–88 [estimated equations (3), (4)].

According to the estimated results for the period of 1976–82 before trade liberalization, the variables for the degree of trade liberalization, initial ERP, scale effect, domestic competitiveness pressure, and imported-intermediate input ratio all show the expected sign, but the variables for the initial market concentration ratio, R&D ratio, managerial and technical worker ratio, and imported-capital input ratio do not. The fact that the estimates on the degree of trade liberalization and initial ERP estimates have positive and negative signs respectively suggests that in industries where protection was initially high, the rapid progress in trade liberalization caused a rise in production efficiency; but these coefficients are statistically insignificant.[16] In these estimated equations, only the scale effect was statistically significant at the 5 per cent level with the expected sign.

In the estimation for the 1982–88 period when trade liberalization moved ahead, the estimated coefficient on the variable for the imported-capital input ratio is the only one that does not show the expected sign. Trade liberalization, scale

[15] See, for example, Nishimizu-Page [12].

[16] Akrasanee-Wibonchutikula [1] show in their analysis that compared with other industries, the growth of TFP in import-substitution industries is low while in export industries it is high.

TABLE V
DETERMINANTS OF TFP

| | 1976–82 | | 1982–88 | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| *CONST* | 2.17 | 2.24 | −1.81 | −1.35 |
| | (0.86) | (0.79) | (−0.81) | (−0.59) |
| *ΔERP* | 3.7[a] | 3.4[a] | 12.5[a] | 9.7[a] |
| | (1.29) | (1.16) | (3.85)** | (2.22)** |
| $ERP_t$ | −2.1[a] | −2.6[a] | −3.0[a] | −3.0[a] |
| | (−0.82) | (−0.96) | (−1.32) | (−1.31) |
| $(\Delta ERP)^2$ | | 0.1[a] | | −0.1[a] |
| | | (0.56) | | (−0.94) |
| *Q* | 8.8[a] | 9.9[a] | 13.7[a] | 14.2[a] |
| | (2.07)* | (2.10)* | (3.41)** | (3.50)** |
| *ΔCR* | 3.9[a] | 3.7[a] | 6.9[a] | 7.0[a] |
| | (1.28) | (1.17) | (2.98)** | (3.02)** |
| $CR_t$ | 1.4[a] | 0.9[a] | 3.1[a] | 3.5[a] |
| | (0.42) | (0.25) | (1.03) | (1.13) |
| $R\&D_t$ | −0.61 | −0.63 | 4.31 | 4.42 |
| | (−0.12) | (−0.12) | (2.08)* | (2.12)* |
| $SLS_t$ | −3.7[a] | −4.0[a] | 3.5[a] | 3.1[a] |
| | (−0.46) | (−0.49) | (0.47) | (0·41) |
| $MZR_t$ | 2.1[a] | 3.4[a] | 7.4[a] | 6.2[a] |
| | (0.44) | (0.62) | (1.72) | (1.37) |
| $MKR_t$ | −4.0[a] | −4.5[a] | −0.3[a] | 0.01[a] |
| | (−1.50) | (−1.58) | (−0.15) | (0.01) |
| $R^2$ | 0.36 | 0.37 | 0.58 | 0.59 |
| $Adj.R^2$ | 0.16 | 0.14 | 0.47 | 0.47 |
| *F* | 1.78 | 1.60 | 5.24** | 4.78** |
| White test | 37.55 | 38.00 | 43.77 | 35.90 |
| Sample size | 38 | 38 | 44 | 44 |

Source: Estimated by the authors.

Notes:
1. See Appendix Table I for the definitions of the variables.
2. The values with "a" should be multiplied by $10^{-3}$.
3. The *t* value is in parentheses; * and ** indicate that the estimated coefficients are statistically significant at the 5 per cent and 1 per cent level respectively.
4. Heteroskedasticity cannot be detected from the results of the White test.
5. The symbols having the subscript of the independent variables *t* indicate the initial value of the respective time periods (the 1976 value for the 1976–82 period, the 1982 value for the 1982–88 period).

effect, and the strength of domestic competitive pressure (each significant at the 1 per cent level) had the expected effect of improving production efficiency. Moreover, coefficients on the R&D ratio and imported-intermediate input ratio were statistically significant at the 5 per cent level and the 10 per cent level respectively. The observation of the effect on imported-intermediate input ratio seems to indicate that trade liberalization led to an improvement in production efficiency since it expanded the choice of intermediate goods for firms.

The relationship between trade liberalization and production efficiency may not be a simple linear relationship; a number of empirical studies have shown a nonlinear relationship.[17] More specifically, the results of earlier studies show that when protection is reduced at a moderate rate, the rise in productivity is the highest; when protection is reduced at an excessively fast rate or when it is not reduced at all, the rise in productivity is low. Such results have been used to justify the infant industry argument. However, from the results of estimated equation (2) and (4), we do not detect a nonlinear relationship between trade liberalization and production efficiency in Thailand.

## V. CONCLUSION

Raising productivity is important for economic development, and this study analyzed the determinants of total factor productivity (TFP) in Thailand focusing on the Thai manufacturing industry. It is clear from the results of this analysis that during the years from 1982 to 1988 as trade liberalization advanced, the following factors contributed to the growth of TFP: (1) the intensity of competitive pressure domestically and from overseas; (2) the wider choice of intermediate goods; (3) the expansion of output; (4) R&D expenditure.

These results indicate that policies to liberalize trade and foreign direct investment, as well as antitrust laws and other policies to strengthen competition in the domestic market are important for bringing about an increase in productivity which in turn has been important in promoting economic development. Furthermore, promoting R&D activities is shown to be important in improving production efficiency.

Our analysis was performed at the industry level because of the availability of the data. In order to gain a deeper understanding of the effect of policy changes such as the liberalization of foreign trade and foreign direct investment, an examination of individual firms, both local and foreign, could provide insightful findings. This is an area where future study needs to be carried out.

[17] Krueger-Tuncer [10], for example, observed a nonlinear relationship in Turkey.

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APPENDIX TABLE I
DEFINITIONS AND SOURCES OF DATA

| Variable Names | Sample Size | Simple Mean | Standard Deviation | Main Sources |
|---|---|---|---|---|
| A. Competitive pressure | | | | |
| Change in market concentration ratio: $\Delta CR$ $(=CR_t - CR_{t+n})$ | | | | |
| 1976–82 | 38 | −3.2 | 27.00 | [8, 1976, 1982, and 1988 editions] [14, 1976, 1982, and 1988 editions] |
| 1982–88 | 44 | −26.9 | 31.29 | |
| Initial market concentration ratio: $CR_t$ | | | | |
| 1976 | 38 | 26.2 | 25.46 | [8, 1976 and 1982 editions] [14, 1976 and 1982 editions] |
| 1982 | 44 | 28.8 | 25.15 | |
| Degree of trade liberalization: $\Delta ERP$ $(=ERP_t - ERP_{t+n})$ | | | | |
| 1976–82 | 38 | 1.4 | 25.98 | [6] [7] [9] |
| 1982–88 | 44 | −2.6 | 21.07 | |
| Initial effective rate of protection: $ERP_t$ | | | | |
| 1976 | 38 | 38.1 | 33.07 | [6] [7] |
| 1982 | 38 | 36.1 | 32.56 | |
| B. Firm-specific factors | | | | |
| R&D ratio: $R\&D_t$ | | | | |
| 1976 | 38 | 0.0 | 0.14 | [6] [7] |
| 1982 | 44 | 0.1 | 0.36 | |
| Skilled worker ratio: $SLS_t$ | | | | |
| 1976 | 38 | 16.8 | 9.91 | [14, 1976 and 1982 editions] |
| 1982 | 44 | 20.2 | 12.62 | |
| Imported-capital input ratio: $MKR_t$ | | | | |
| 1976 | 38 | 25.3 | 31.99 | [14, 1976 and 1982 editions] [6] [7] |
| 1982 | 44 | 24.0 | 33.43 | |
| Imported-intermediate input ratio: $MZR_t$ | | | | |
| 1976 | 38 | 21.9 | 17.31 | [14, 1976 and 1982 editions] [6] [7] |
| 1982 | 44 | 24.0 | 18.48 | |
| C. Economies of scale: $Q$ | | | | |
| 1976–82 | 38 | 2.4 | 20.24 | [14, 1976, 1982, and 1988 editions] |
| 1982–88 | 44 | 15.3 | 21.92 | |