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Agricultural Machinery Industry:
Impact of Trade Policy Reforms on Performance, Competitiveness and Structure

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PHILIPPINE INSTITUTE FOR DEVELOPMENT STUDIES

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Abbreviations

ACPC	Agricultural Credit Policy and Council
AMDP	Agricultural Mechanization Development Program
AMIC	Agricultural Mechanization Inter-Agency Committee
AMMDA	Agricultural Machinery Manufacturers and Distributors Association
AMTEC	Agricultural Machinery Testing and Evaluation Center
BAAC	Bank of Agriculture and Agricultural Cooperatives
BOI	Board of Investments
BPI	Bureau of Plant Industry
BPS	Bureau of Product Standards
CAM	Committee on Agricultural Mechanization
CB	Central Bank
CBU	Completely built-up
CIF	Cost, Insurance, Freight
CPI	Construction Price Index
CR	Concentration Ratio
DA-IRRI	Department of Agriculture-International Rice Research Institute
DBP	Development Bank of the Philippines
DRC	Domestic Resource Cost
DRCM	Domestic Resource Cost at Market Price
DTI	Department of Trade and Industry
ECN	Establishment Code Numbers
EEC	European Economic Community
E.O.	Executive Order
EPR	Effective Protection Rate
FOB	Free-on-board
GDP	Gross Domestic Product
HI	Herfindahl Index
HYV	High-yielding Varieties

IBRD	International Bank for Reconstruction and Development
ILP	Import Liberalization Program
IPP	Investment Priorities Plan
IPR	Import Penetration Ratio
K/L	Capital-Labor Ratio
LBP	Land Bank of the Philippines
MTI	Machinery and Transport Index
NEDA	National Economic and Development Authority
NEMO	National Emergency Memorandum Order
NIC	Newly Industrialized Country
NSO	National Statistics Office
OER	Official Exchange Rate
PAMP	Philippine Agricultural Mechanization Program
PPF	Production Possibility Frontier
QR	Quantitative Restriction
R&D	Research and Development
S-C-P	Structure-Conduct-Performance
SCR	Seller Concentration Ratio
SEC	Securities and Exchange Commission
SER	Shadow Exchange Rate
TC	Tariff Commission
TEC	Technical Efficiency Coefficient
TFP	Total Factor Productivity
TRP	Tariff Reform Program
VAT	Value-Added Tax
USAID	United States Agency for International Development

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Introduction

OUTWARD-oriented strategies for industrial growth were initiated in the Philippines in the early 1980s. A trade reform package was launched, the major components of which were the Tariff Reform Program (TRP) and the Import Liberalization Program (ILP). The TRP gradually lowered and rationalized the country's protection rates, while the ILP lifted a number of import licensing regulations. The shift in trade policy orientation is aimed at increasing the efficiency and competitiveness of local industries.

Recent literature concerning trade-productivity nexus points out that trade liberalization will result to greater total factor productivity (TFP) growth. Advocates of neoclassical trade theory have strongly argued that more exposure to international market will induce local industries to improve their efficiency performance and adopt new technologies. Although this thesis is widely accepted as the main avenue for rapid industrial growth, doubts about trade liberalization remain strong in many circles (Havrylyshyn 1990). One reason for such doubt is the lack of empirical evidence linking productivity and openness.

In the height of this debate on trade policy-productivity nexus, a new literature has emerged which marries the insights of industrial organization with those of international trade. The "new theory" of international trade has focused its attention on the role played by industrial market structure in the analysis. Thus, the main thesis of this study is that trade liberalization will generate positive effects on the performance and competitiveness of the agricultural machinery industry in the Philippines. However, the outcome of trade policy reforms depends on the industry's market structure and other non-price factors.

This study aims to evaluate the effects of the Trade Reform, particularly the Tariff Reform Program on the structure, performance and competitiveness of the agricultural machinery industry. It also tries to identify non-price factors which may have affected the efficiency and competitiveness of the industry.

For this study, the industry under investigation is the manufacture of power-driven agricultural machinery, specifically hand tractors and power threshers. The industry is said to be import-substitute in nature, which has remained underprotected. The study by Bautista, Power and Associates (1979) estimated the industry's effective rate of protection in 1974 to be at 14 percent, much lower than the 44 percent supply-weighted average for all manufacturers. Notwithstanding, the advent of trade policy reforms in 1981 did not exclude the industry in the rationalization of the country's protection structure. The 1981-1985 TRP reduced the duty rate for hand tractor and increased the duty rate for power thresher. On the other hand, tariff rates for inputs were reduced. In 1991, another major tariff restructuring was implemented. Line-by-line tariff adjustments for both outputs and inputs of the industry are further scheduled until 1995. Determining how and to what extent the Trade Policy Reform has affected the industry is therefore a policy concern.

In this paper, Chapter 2 presents a review of empirical studies on the impact of trade policy orientation on efficiency, competitiveness and structure at the firm and industry levels. Chapter 3 discusses the theoretical framework of the study, while Chapter 4 presents the different sources of data and measures utilized in the study. A factual background of the agricultural machinery industry in the Philippines is presented in Chapter 5. Chapter 6 discusses and analyzes the performance of the industry. The final chapter concludes the paper by pointing out the vital points and offers some policy recommendations.

2

Review of Literature

THE role of trade policy in the process of industrial growth and economic development has long been a major focus in the development literature. However, only a few have explicitly analyzed the effect of trade policy on efficiency gains. A review of some of these empirical findings is presented in this chapter.

TRADE POLICY AND PRODUCTIVITY PERFORMANCE

With regard to the trade-productivity nexus literature, the claim that a more neutral trade policy will generate large efficiency gains is still ambiguous. Pack (1988) observes that "to date there is no clear confirmation of the hypothesis that countries with an external orientation benefit from greater growth in technical efficiency in the components sector in manufacturing." Havrylyshyn (1990) also notes that doubts about trade liberalization stem from the fact that there is little evidence that directly link trade reform with productivity growth.

One of the rare studies that directly investigate the effect of trade policy on efficiency gains is that of Krueger and Tuncer (1982). Rates of growth in total factor productivity (TFP) and absolute levels of single factor-productivity for two-digit manufacturing industries in Turkey over the period 1963 to 1976 were estimated. Their results show that a faster TFP growth was experienced in periods when a more neutral trade policy was adopted.

In a cross-country comparison of sectoral factor productivity growth in Korea, Turkey, Yugoslavia, with Japan as comparator, a positive association between trade openness and productivity performance was examined by Nishimizu and Robinson (1984). Thus, the following hypotheses were confirmed: (a) export expansion leads to higher TFP growth through economies of scale and/or through competitive incentives; (b) increased import substitution (import liberalization) leads to lower (higher) TFP growth, perhaps through reducing (increasing) competitive cost-reduction incentives; and (c) export expansion and import liberalization increases TFP growth by relaxing the foreign exchange constraint and imports of non-substitutable intermediate and capital goods.

At the firm-level, following Farrell's contribution to the analysis of production, Hill and Kalirajan (1991) focused on Indonesia's small-scale garments industry. The explanatory variables closely associated with high levels of firm-specific technical efficiency were export orientation, sources of finance, and gender composition of the workforce (female participation in particular). The authors have suggested that an export promotion policy and a well-defined credit market are needed for a successful industrial development.

However, the study by Tybout, de Melo and Corbo (1991) reveals that comparisons of pre- and post-liberalization manufacturing census data of Chile exhibited little productivity improvement overall. Nonetheless, it was observed that industries undergoing relatively large reductions in protection experienced relatively large improvements in average efficiency levels and relatively large reductions in cross-plant efficiency dispersion. The authors, however, cautioned that the positive effects of trade reforms on the Chilean manufacturing sector may have been masked by major macroeconomic shocks.

Since there remains to be no strong empirical evidence on the link between trade policy reforms and efficiency gains from TFP studies, Havrylyshyn (1990) points out that "the main contributions of an outward-oriented trade policy to efficiency may arise from the larger total market available when exports are not discouraged, allowing for both increased capacity utilization and economies of scale arising from specialization."

Studies using firm-level data from Ghana and India support the importance of capacity utilization in explaining differences in efficiency. Using Ghana as model, Page (1980) attempted to link technical (or managerial) efficiency, the choice of technique, and economic performance. To establish the relationship, the study utilized Farrell's efficiency-frontier methodology and the domestic resource cost (DRC) criterion. The findings reveal that the level of efficiency was most affected by the following: (a) correction of factor prices; (b) move to full capacity utilization; and (c) pure technical efficiency (i.e., shifts from inefficient use of inputs relative to the optimal level of production). For India, Page (1984) applied a frontier transcendental logarithm production function to explore the relationship between firm size and technical efficiency. Firm size was found to be positively correlated with relative productive efficiency in only one of the four selected manufacturing industries. The same industry also exhibited greatest evidence of plant level scale economies. Although the study did not reveal a significant association between firm size and the level of technical efficiency, it was observed that capacity utilization greatly influenced efficiency. Moreover, the study also reveals the influence of scale economies on the level of efficiency, but in a less conclusive manner, due to mixed results for different manufacturing industries. It must also be noted that not all industries were subject to economies of scale.

THE "NEW THEORY" OF INTERNATIONAL TRADE

Research interests of trade and industrial economists for the past several years have moved closer together. Trade theorists for the past years focused their analysis mainly on highly competitive market structures. At present, however, they have started to focus their interest in the trade implications of imperfect market structures and refer to industrial organization literature for guidance. Studies exploring the "new theory" of international trade, however, are limited.

To capture an international trade dimension, foreign trade variables are integrated into the traditional market structure-conduct-performance (S-C-P) paradigm. This was done by Pagoulatos and Sorensen (1976) in their analysis on the structure-profitability relationship in the industrial sector of the European Economic Community (EEC). The foreign trade variables were foreign competition, exporting opportunities, and multinational activity. To assess profitability performance, the price-cost margin was used. It was concluded that the concerned foreign variables were an important addition to domestic structural variables in explaining inter-industry differentials in price-cost margins. Seller concentration, one of the domestic factors used, was only significant in larger EEC economies and in industries where import competition was insignificant. This result supported the hypothesis on the positive relationship between price-cost margin and seller concentration. Moreover, trade openness (i.e., the elimination of import duties) also fostered greater efficiency and competition within the member countries of the EEC via market expansion and increased numbers of competitors within the larger EEC markets. These effects, as observed, had countered increases in industry concentration within certain member countries of the EEC.

The study by de Melo and Urata (1986) indicates that the Chilean liberal trade policy of the mid-1970s reduced profitability performance as a consequence of an increase in industry concentration. The contrasting movement of concentration and profitability was attributed to the following reasons: (a) There was an exploitation of economies of scale, which resulted from foreign trade exposure and the exit of small inefficient firms; and (b) Import penetration increased the elasticity of demand facing domestic firms. The study also found that the sectors with the highest import-penetration ratios also bared the largest decline in price-cost margins, thus lending support to the "import-discipline" hypothesis.

Rodrik (1988), in his attempt to examine the likely linkages between trade policy and technical efficiency, states that the overwhelming effect of economies of scale on productivity improvements appeared to be a strong argument for trade openness. The economies of scale argument, however, relies on the "frictionless entry to and exit from the industry" assumption. The free entry of additional firms would result to the reduction of domestic price and would lead some incumbent firms to exit the industry. The remaining firms would therefore have to produce at a sufficient scale of output for the reduced level of average costs to match the lower domestic price.

Furthermore, the author concluded that the argument calls for more empirical investigation. Tybout, de Melo and Corbo (1991) also found that increased exposure to foreign competition led to industrial rationalization. Their results disclose that the remaining firms produced at output levels closer to minimum efficient scale. These firms also moved closer toward the efficient technology as suggested by the technical efficiency coefficients (TECs). As noted earlier in this chapter, these positive effects of trade reforms on scale and technical efficiency may have been masked by adverse macro conditions.

Also, in the context of imperfectly competitive markets, Harrison (1989) examined the impact of trade liberalization on TFP growth based on a panel of firms in the Ivory Coast. There was a strong linkage between trade liberalization and productivity growth when perfect competition in the product markets was assumed. However, the relationship did not hold when the variations in price-cost margins brought about by the trade reform were allowed for. Thus, there seems to be a need to take into account the role played by the industrial market structure.

3

Theoretical Framework

BEFORE the 1980s, the Philippines had been under a more inward-oriented trade regime. Several studies have pointed out the several biases in resource allocation brought about by tariff and non-tariff barriers. High level of protection is associated with high cost and inefficient use of resources while low level of protection affirms otherwise. This disappointing effect which translates to dismal industrial performance has, in a way, led the country to embark on a more outward-oriented trade policies. The twin objective of the Trade Policy Reform is to rationalize the protection structure of the country through the Tariff Reform Program (TRP) as well as to ease import regulations through the Import Liberalization Program (ILP). Specifically, the TRP is aimed at putting tariff rates on a more uniform level to reduce excessive protection as well as to increase incentives to neglected industries at the lower end of the protection scale. Thus, it is believed that a more neutral trade regime will improve the efficiency performance and competitiveness of domestic industries.

This chapter provides the framework for analyzing the impact of trade liberalization on industrial performance. The first section explains some theoretical considerations of efficiency performance, competitiveness, and market structure dimension; the second section deals with the linkages between trade policy reform, efficiency performance, competitiveness, and industrial market structure; and lastly, the third section deals with other factors influencing the performance of the industry.

Concepts: Efficiency Performance, Competitiveness, and Market Structure Dimension

Efficiency Performance

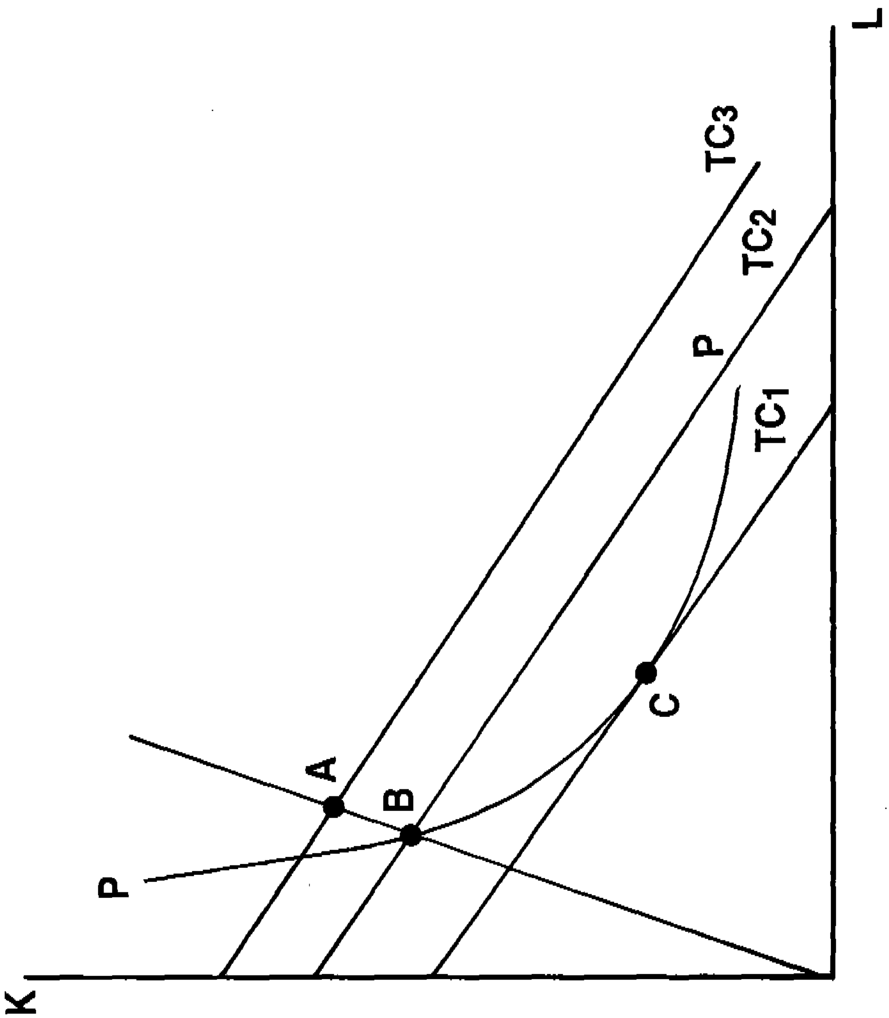
The analytical framework used in measuring *efficiency performance at the level of the firm* is founded on the economic theory of production and cost. According to Kirkpatrick and Maharaj (1992), a distinction can be made between static (allocative and technical) and dynamic (technological progress) productivity measures based on the conventional analysis of the firm's production and cost relations. This is illustrated in Figure 1, where PP is the efficient or "best practice" production frontier, determined by the given state of technology. Three factor lines — TC_1, TC_2 and TC_3 — are also shown.

Improvements in efficiency performance may be due to the changes in (static) efficiency or changes in (dynamic) technological progress or productivity. Static efficiency gains can be defined by comparing points A, B and C in Figure 1. At point A, the firm is said to be inefficient since it incurs higher costs, TC_3, than the firm at point C whose costs are TC_1. This differential may be decomposed into: (1) *the cost of technical inefficiency*, TC_3-TC_2, which is due to low factor productivity relative to firms at point B on the efficient isoquant employing the same capital-labor ratio; and (2) *the cost of allocative inefficiency*, TC_2-TC_1, which is due to the choice of the wrong technique at existing relative factor prices. Thus, improvements in static efficiency are measured by a move from point A to point C.

On the other hand, improvements in dynamic productivity or technological progress are observed when the "best practice" production function (i.e., PP) shifts toward the origin. However, this study only covers the concept of static efficiency (allocative and technical efficiency) gains.

To measure allocative efficiency, this study uses the concept of the Domestic Resource Cost (DRC), which has been widely utilized as an index of economic efficiency in restrictive trade regimes. The DRC is essentially a cost-benefit ratio representing the social oppor-

Figure 1
Efficiency of the Firm



tunity cost of domestic resources used per unit of net foreign exchange earned (saved) by the export (import substitution) of a given product (Bautista, Power and Associates 1979).

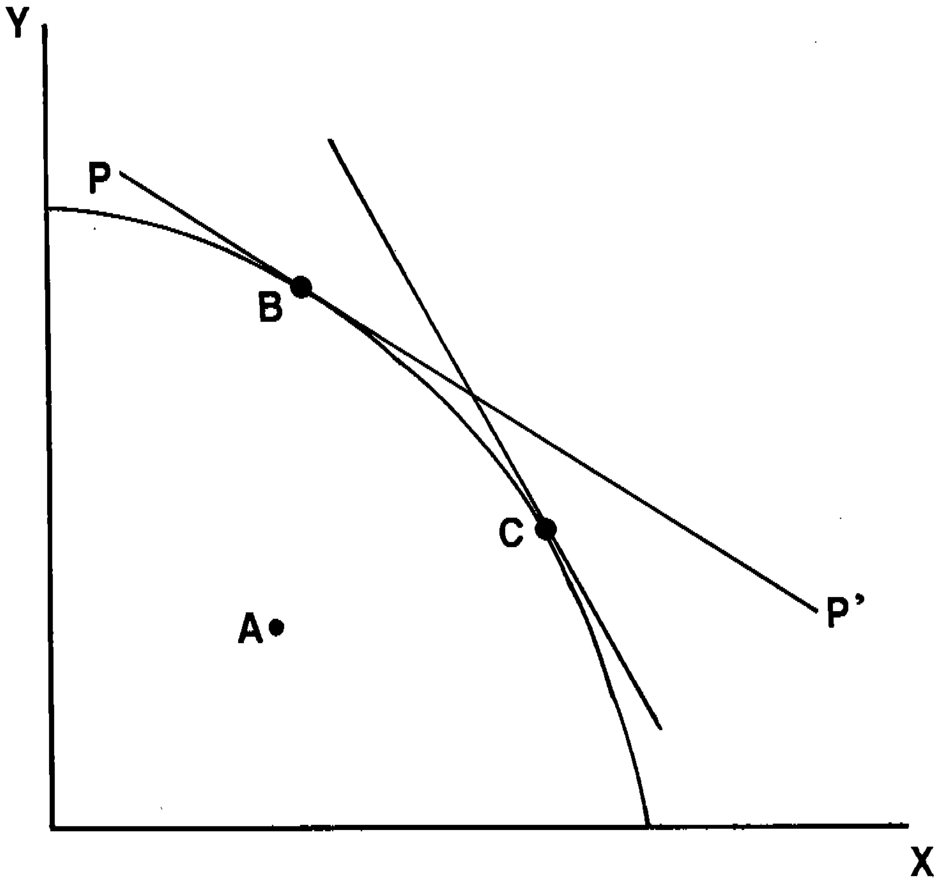
In the *ex post* sense, the DRC criterion can be related to the effective protection rate (EPR), which is the percentage excess of domestic value added at protected prices (made possible by protective measures such as tariffs, taxes and import restrictions in certain cases) over the value added at free trade prices. Thus, the DRC can be used to represent the social cost of promoting exports or of protecting import-substituting industries under an existing trade regime.

The DRC estimates are derived using shadow prices, that is, social accounting prices. The rationale behind the use of shadow prices in place of market prices lies behind the assumption that market prices, in the presence of distortions, do not reflect real costs of inputs and the real benefits of outputs to society. Policy-induced distortions exist in the Philippines as in many developing countries. DRCs using market prices (DRCM) are also estimated to measure international competitiveness but will be discussed later in this chapter.

Technical efficiency, on the other hand, is defined as the ability of the firm to produce the maximum potential output on the production frontier, given a specified mix of inputs and technology (Hill and Kalirajan 1991). The level of technical efficiency of firms can be explained by firm-specific characteristics, such as entrepreneurial experience, technological knowledge, and the age of the firm as a test for the presence of learning-by-doing phenomenon (Page 1980). Due to differences in these firm-specific factors, the level of technical efficiency among firms varies.

The concept of *efficiency performance within the economy* can also be portrayed through Figure 2, which shows the production possibility frontier (PPF). PPF is a curve that shows the maximum possible combinations of two goods, such as X and Y, that an economy can produce by fully utilizing all of its resources with the best technology available. Points on the frontier thus represent technically efficient, attainable combinations of X and Y. Points inside the frontier, such as point A, are possible but are inefficient either

Figure 2
Efficiency within the Economy



because of underutilization and/or inefficient use of existing resources. The movement from point A to point B would therefore represent a gain in technical efficiency as the economy achieves higher output levels with its current available resources. However, at point B, a restrictive trade regime has made relative prices of both goods to differ. That is, protection has made good Y more expensive and likewise more profitable than X. This, in effect, would render point B to be allocatively inefficient. Correcting the distortion in relative output prices, by relaxing trade barriers, would induce a movement from point A to point C on the frontier.

In general, a gain in technical efficiency (from point A to point B) may be attributed only to non-price factors, while a gain in allocative efficiency (from point B to point C) would call for price-related changes.

Competitiveness

International competitiveness refers to the ability of firms and industries to compete in the domestic market with importers and in external markets with other exporters, including the domestic producers in the destination market (Tecson 1992). One indicator of international competitiveness is the DRC at market prices (DRCM).

In showing the relationship between the DRC at shadow prices and at market prices, the DRC (at shadow prices) may be expressed in another form:

$$\frac{DRCM}{OER} = \frac{DRCM}{DRC} * \frac{SER}{OER} * \frac{DRC}{SER}$$

where:

OER	=	official exchange rate;
SER	=	shadow exchange rate;
DRCM/OER	=	competitive advantage;
DRCM/DRC	=	the distortions due to the domestic tax system and wage structure;
SER/OER	=	the distortions due to currency overvaluation, for instance; and
DRC/SER	=	comparative advantage.

Due to market distortions, a firm or an industry may achieve competitive advantage position. Furthermore, a firm or an industry may achieve comparative advantage but may not be competitive at all.

Market Structure Dimension

The traditional view is that certain dimensions of market structure condition the behavior of firms within that market, which in turn determines the outcomes of the competitive process within that market (Lee 1992). Two of the more commonly identified structure variables have been seller concentration and entry barriers.

Traditionally, seller concentration ratio (SCR) refers to the number and size distribution of sellers in the market. Technically, SCR refers to production concentration ratio if imports and exports are ignored.

Another dimension of market structure are the barriers to entry which traditionally refers to the degree of ease or difficulty with which new firms may enter a market. Entry barrier also refers to anything that allows incumbent firms to earn excess profits, that is, keep prices above minimum average costs (Bain 1956). Barriers to entry tend to limit the number of players in a particular sector, thereby limiting competition, which would encourage dominant firms to earn supranormal profits, as in the case of monopolistic or oligopolistic market structures.

Trade Policy Reform, Performance, Competitiveness and Market Structure Linkage

The weak empirical evidence pertaining to the benefits of trade liberalization on economic performance rests on the uncertainty with which firms respond to the new set of incentives established by trade policy changes (Kirkpatrick and Maharaj 1992). It is argued that the behavior of firms is conditioned by the uncompetitive nature of the domestic industrial sector. The "new theory" of international trade which combines the concepts of industrial organization with trade theory, emphasizing on economies of scale and imperfect competition, leads to various possible outcomes depending on the assumptions made.

One of the most appealing arguments for trade liberalization is the rationalization of industrial structure when exposed to the forces of a more neutral trade policy. This possible outcome lies on the premise that protection tends to attract a number of firms producing at low levels of output, that is, way below the minimum efficient scale. The advent of trade liberalization will therefore lead to industry rationalization by forcing inefficient producers out of the market. As protection falls, market prices also fall, driving some players in the industry — the inefficient ones — out of business; those who remain must reduce their production cost, thereby resorting to innovative activities in order to compete. However, Rodrik (1988) points out that these effects, rooted on the industry-rationalization argument, will only be plausible under assumptions of economies of scale and free entry and exit.

In situations where entry and exit are easy, coupled with the assumption that firms can rapidly adjust to the removal of protection, domestic firms can expand their output to meet the increase in demand following the reduction in domestic price (Kirkpatrick and Maharaj 1992). However, in situations where entry and exit are difficult, trade liberalization will now depend on the "import-discipline" hypothesis which claims that increased foreign competition (or the threat of potential entry) will reduce the market power of domestic firms, thereby affecting their pricing and production decisions. Hence, this has a direct bearing on technical efficiency improvements because domestic producers have to move to a lower cost curve so as not to be displaced by imports and be coerced out of the industry. In the context of imperfectly competitive markets, it was observed by Tybout, de Melo and Corbo (1991) that heightened exposure to foreign competition led to industrial rationalization, with surviving firms operating at sub-optimal levels and moving closer toward the "best practice" production frontier.

The theory of contestable markets also argue that in a market where entry barrier is nonexistent (i.e., perfect contestability) and even with the presence of high seller concentration, the incumbent sellers will behave as they would in a competitive market condition due to the threat of potential competition, whether external or internal (Lee 1992). However, if entry barriers are high, the exercise of any monopoly or oligopoly power, which is already prevailing within the market, will be protected and preserved.

Other Factors Affecting Industrial Performance

The level of performance of a firm or industry does not only stem from the impact of trade policies. Distinctive characteristics as well as other non-price factors also define the behavior of a firm or industry. One crucial factor is the demand conditions or constraints which may restrict the attainment of scale economies. Demand constraints may be illustrated by lack of market assurance which can be ascribed to low purchasing power of buyers aggravated by capital market imperfections. A credit system biased against small- and medium-scale firms constrains the growth of these firms since it is difficult for them to procure financial resources or access to credit. As a result, these firms will be compelled to produce an output which is less than the maximum potential level. On the other hand, firms may experience the accumulation of excess capacity, that is, supply would exceed demand in a market that is characterized by a depressed demand.

The industry's linkage with other sectors also affects its level of performance. If the backward linkage of the industry is not well developed, then the supply of sub-standard quality of locally-sourced inputs could be more prevalent. Poor quality of local material inputs leads to chronic capacity underutilization and manufacture of sub-standard quality products, clearly reducing competitiveness in international markets.

4

Data Sources and Research Methodology

THIS chapter consists of two main sections. The first one identifies the different sources of data, both primary and secondary. The second section presents in detail the different measures and indicators used in the study.

DATA SOURCES

This study relies on data from the 1983 and 1988 Census of Manufacturing Establishments (or plants) by the National Statistics Office (NSO). Supplementary data was taken from a survey of agricultural machinery firms in 1986 and 1991. The years 1983 and 1988 are the two reference points considered to represent the pre-trade reform period and the transition towards the post-trade reform period, respectively. The 1986 and 1991 survey data will likewise provide additional information pertaining to trade reform conditions since trade policy adjustments are still being aimed until 1995.

The use of both sources of data is not without limitations. Changes at the establishment level cannot be examined using census statistics because establishment code numbers (ECNs) vary every census year. Thus, the ECNs in 1983 do not match with that in 1988. With the firm-level survey data, the study tries to illustrate firm-level characteristics. However, effective protection rate (EPR), domestic resource cost (DRC), and other important measures to be analyzed at the industry level cannot be obtained due to incomplete information.

Other sources of data are the Department of Agriculture-International Rice Research Institute (DA-IRRI) Industrial Extension Program, Securities and Exchange Commission (SEC), Board of Investments (BOI), Tariff Commission (TC), Agricultural Mechanization Development Program (AMDP), National Economic and Development Authority (NEDA), NSO Foreign Trade Statistics, and Agricultural Machinery Manufacturers and Distributors Association (AMMDA).

Research Methodology

Measures of Protection

Effective protection rate (EPR)

The effective protection rate (EPR) is a measure of the protection given to incumbent firms and industries. It is defined as the percentage excess of domestic value added at protected prices ($V'j$), made possible by protective measures such as tariffs, taxes, and import regulations in certain cases, over the value added at free trade prices (Vj), that is, without protection. The general formula of the EPR is as follows:

$$EPR = \frac{(V'_j - V_j)}{V_j} = \frac{V'_j}{V_j} - 1$$

where

$V'j$ = the value of production minus the total cost of raw materials (both net of sales taxes); and

Vj = the value of production minus the total cost of raw materials (both at border prices).

The above equation may be written as

$$EPR = \frac{\sum_j \frac{VP_j}{1+S_j} - \sum_i \frac{A'_{ij}}{1+S_i}}{\sum_j \frac{VP_j}{1+T_j} - \sum_i \frac{A_{ij}}{1+T_i}} - 1$$

where	VP_j	=	value of production of output j;
	A'_{ij}	=	cost of local raw material i per year;
	A_{ij}	=	cost of imported raw material i per year;
	s_j	=	domestic sales tax on output j;
	s_i	=	domestic sales tax on raw material i;
	T_j	=	implicit tariff rate on output j; and
	T_i	=	implicit tariff rate on imported raw material i.

Implicit tariff

Implicit tariff represents the proportional difference between domestic prices and border prices of homogeneous goods (Bautista, Power and Associates 1979). The difference is due to protective measures such as tariffs, taxes and import restrictions in certain cases. The implicit tariffs for both output and input are computed by using the following general formula:

$$T = [(1 + t) \quad (1 + s)] - 1$$

where	T	=	implicit tariff rate;
	t	=	nominal tariff rate; and
	s	=	sales tax.

Net effective protection rate (NEPR)

The above discussion on EPR indicates the relative incentives given to different subsectors and industries (Tan 1979). It emphasizes on the relative position of subsectors in the EPR scale since protection is a relative concept. However, as a whole, tradable goods can be penalized relative to nontradables by an overvalued currency or can be protected by an undervalued currency. Thus, to account for the extent of currency overvaluation, the EPR is adjusted as follows:

$$NEPR = \frac{OER\ (1 + EPR)}{SER} - 1$$

where NEPR	=	the net effective protection rate;
OER	=	the official exchange rate; and
SER	=	the shadow exchange rate.

Measures of Efficiency

Domestic resource cost (DRC)

The Domestic Resource Cost (DRC) is a commonly used measure to examine allocative efficiency and competitiveness of the domestic industry in the international scene. As defined in Chapter 3, it is a cost-benefit ratio representing the social opportunity cost of domestic resources used per unit of net foreign exchange earned (saved) by the export (import substitution) of a given product. In general, the formula of the DRC for any output j is

$$DRC_j = \frac{\text{Domestic Cost per Unit of } j}{\text{World (Border) Price} - \text{Foreign Cost per Unit of } j}$$

where the numerator is expressed in pesos, while the denominator is in dollars. World (border) price is expressed in free-on-board (f.o.b.) terms for exports and cost, insurance, freight (c.i.f.) terms for imports.

For this study, the DRC estimates are computed using shadow and market prices to assess comparative and competitive advantage position, respectively, of the plant/subsector/industry. Both estimates only differ in the numerator of the DRC equation because DRC at market prices used actual prices. That is, the components of the numerator in the computation of DRC based on market prices are not deflated by sales taxes. Moreover, the cost of unskilled labor is not converted into its shadow cost. The following discussion on the DRC procedure is based on the use of shadow prices.

There are five major cost components of the DRC, and these are: (1) capital cost (depreciation and interest costs); (2) land cost (for the firm-level survey only); (3) labor cost; (4) cost of raw materials and supplies; and (5) other domestic costs.

Capital cost

Capital cost consists of depreciation and interest costs of capital assets, which are classified as: (1) buildings and structures; (2) production machinery and equipment; (3) transport equipment; (4) other fixed assets (e.g., office equipment and fixtures); and (5) inventories. The steps in obtaining depreciation and interest costs of these assets are outlined below.

Replacement cost of capital. Except for inventories, the replacement costs (the present costs of replacing the fixed assets) of capital assets are derived by inflating their acquisition costs by the appropriate price indices. Construction price index (CPI) is applicable for buildings and structures, while machinery and transport index (MTI) is for machinery and transport equipment and other fixed assets. The values obtained are further deflated by a compounded annual productivity growth rate of three percent to get their replacement costs. The price index inflator adjusts for inflation in the capital asset, while the productivity deflator takes into account the offsetting increase in the productivity of the asset. Thus, the replacement cost equation is

$$RC_k = \frac{AC_k * pr}{1.03^t}$$

where

AC	=	the acquisition cost;
pr	=	the ratio of the price indices of the current year and the year the fixed asset was acquired; and
t	=	the age of the fixed asset.

AC is derived by the equation

$$AC_k = n_k * d_k$$

where

n	=	the fixed asset's economic life: (a) 50 years for buildings and structures; (b) 23 years for machinery and equipment (used in the manufacture of agricultural machinery); (c) 15 years for transport equipment; and (d) 20 years for other fixed assets; and
d	=	the asset's annual depreciation cost.

Depreciation cost of fixed assets. Depreciation must reflect the actual life of the fixed asset as well as inflation and productivity increases over time. Thus:

$$DC_{kj} = \frac{RC_k}{n_k * 1.5}$$

where

1.5	=	the factor used to reflect the extended years the capital fixed asset is being utilized.

It is a well-known fact in most developing countries that the actual life of a capital asset extends beyond the useful/standard life and therefore, it is assumed that the actual life is 50 percent longer than the reported standard life.

After estimating the depreciation cost of the fixed asset, it is then allocated into its domestic and foreign components. The allocation ratios are:

Fixed Asset	**Domestic** %	**Foreign** %
(1) Buildings and structures	100	0
(2) Machinery and equipment	0	100
(3) Transport equipment	20	80
(4) Other fixed assets	15	85

The domestic depreciation cost for asset K is

$$DC_{kdj} = \frac{DC_{kj} * Y_{kd}}{1 + s}$$

where

Y_{kd}	=	the domestic share of asset K, and
s	=	the sales tax.

The foreign depreciation cost, therefore, is:

$$DC_{kfj} = \frac{DC_{kj} \quad (1 - Y_{kd})}{OER \quad (1 + T_k)}$$

where

OER	=	the official exchange rate;
T_k	=	the implicit tariff appropriate for asset K; and
$(1+T_k)$	=	the deflator needed to convert foreign depreciation cost of asset K to peso border price.

Interest cost on fixed assets. Interest cost on fixed assets is obtained by multiplying the replacement cost of asset K to the r (rate of return), which is assumed to be the social rate of return in manufacturing for the year (12 percent for 1983 and 10 percent for the rest of the years under study, that is, 1986 onwards). The shadow interest rate in 1983 is higher than in 1986 onwards because it is assumed that capital was more scarce in 1983 than in 1986 onwards, when the Philippine economy started to recover from the balance-of-payment crisis in the latter period of 1983-84. Thus, the equation employed is

$$I_{kj} = r * RC_k$$

The total interest cost above is then allocated into its domestic and foreign components. The ratios used for allocation are:

Fixed Asset	**Domestic** %	**Foreign** %
(1) Buildings and structures	85	15
(2) Machinery and equipment	85	15
(3) Transport equipment	85	15
(4) Other fixed assets	100	0

The domestic interest cost for asset K is

$$I_{kdj} = \frac{Y_{kd} * I_{kj}}{1 + s}$$

where

Y_{kd} = the domestic component.

The foreign interest cost, adjusted to border prices, therefore, is:

$$I_{kfj} = \frac{I_{kj} \cdot (1 - Y_{kd})}{OER \quad (1 + T_k)}$$

where

$(1 - Y_{kd})$ = the foreign component.

Interest cost on inventory or working capital. In the case of inventories, an average inventory level for the period is first computed based on a simple average of beginning and ending inventory of finished goods, work-in-process, and raw materials and supplies and other stocks.

The shadow interest rate, r, is then applied to the total average inventory to obtain the total interest cost on inventory, which is then broken down into its domestic and foreign components.

Land cost or rent

Computation for the interest cost on land is applicable only when using the survey data. The land on which the plant is situated is either owned, leased, or rented. The opportunity cost of land, if owned, is the imputed rent obtained by applying the shadow interest rate, r, to the estimated current value of land. The current value of land may be provided by the firm or may be computed by inflating the original acquisition cost of land from the year it was purchased to the current year desired. The inflator used is CPI since rent/housing is one component in constructing the CPI and is assumed to approximate the price increase of land. Thus, the equation used is the following:

$$L_{dj} = AC_L * r$$

The rental to land is considered entirely domestic.

Labor cost

Labor cost covers basic salaries and wages and overtime pay. Contributions to government or private insurance institutions and other benefits are not included.

The shadow wage rate for skilled workers is assumed to reflect actual earnings or true marginal productivities, while that of the unskilled workers is assumed to be 70 percent of the market wage. Hence, the social cost of labor is

$$SW_{tj} = SW_u + SW_v$$

where

SW_u = the shadow wage rate for unskilled workers
SW_v = the shadow wage rate for skilled workers

Raw materials and supplies

Raw materials include the major and minor inputs used in production. Supplies include office supplies, fuels, lubricants, electricity, and water. The following are the allocation ratios:

Items	Domestic %	Foreign %
(1) Major and minor raw materials	70	30
(2) Office supplies	15	85
(3) Fuels and lubricants	0	100
(4) Electricity and water	100	0

The domestic cost for raw materials and supplies (RM) is divided into two equal components as follows:

$$RM_{Rdj} = \left(\frac{(RM_{Rj} * Y_{Rd})\ 0.5}{1 + T_i}\right)\left(\frac{SER}{OER}\right) + \frac{(RM_{Rj} * Y_{Rd})\ 0.5}{1 + S_i}$$

where

RM_{Rj} stands for the reported cost of raw materials and supplies R.

The foreign cost is adjusted as follows:

$$RM_{fj} = \frac{RM_{Rj}\ (1 - Y_{Rd})}{OER\ (1 + T_i)}$$

Other domestic cost

Based on data from the census, other domestic costs (ODCj) include costs incurred to industrial and non-industrial services done by others. Subsidies received are also considered. Based on the survey data, other domestic costs also include rental payments. The domestic cost takes the following adjustment:

$$ODC_j = \frac{ODC_a}{1 + S}$$

where

ODC_a = the actual cost accrued to other domestic costs.

Border value of production

The border value of production of product j (BVP_j) is simply the deflated value of output of product j (VP_j). Thus:

$$BVP_j = \frac{VP_j}{OER\ (1 + T_j)}$$

After doing all the necessary adjustments, the general form of the DRC used in the study is

$$DRC_j = \frac{DC_{kdj} + I_{kdj} + RM_{dj} + L_{dj} + SW_{tj} + ODC_j}{BVP_j - (D_{kfj} + RM_{fj})}$$

where

Domestic Cost

DC_{kdj}	=	domestic depreciation cost;
I_{kdj}	=	domestic interest cost;
RM_{dj}	=	cost of local raw materials and supplies;
L_{dj}	=	land cost;
SW_{tj}	=	domestic labor cost;
ODC_j	=	other domestic cost;

Foreign Cost

DC_{kfj}	=	foreign depreciation cost;
I_{kfj}	=	foreign interest cost;
RM_{fj}	=	cost of imported raw materials and supplies; and
BVP_j	=	border value of production.

The DRC is then compared with the SER to measure allocative efficiency and comparative advantage or social profitability at the firm, subsector, and industry level. The lower the DRC/SER value, the more efficient is the use of domestic resources in the production of an import-substitute or export good, and vice-versa. The conventional definition of DRC/SER value which indicates allocative efficiency and comparative advantage falls between 0 and 1, however, this study makes an allowance of 0.2 to account for marginal errors. Firms with a DRC/SER ratio greater than 0 but less than or equal to 1.2 are considered efficient or low cost users of foreign exchange. Those with ratios greater than 1.2 but do not exceed the ratio of 1.5 are considered moderately inefficient. Otherwise, they are considered inefficient (i.e., greater than the ratio of 1.5) or high cost users. Lastly, those with negative values are considered dissavers of net foreign exchange since their foreign costs exceed the border value of their output.

In the case of DRC estimates at market prices, the DRCM is compared with the OER to measure competitive advantage or private profitability. The definition for DRCM/OER value follows that of the above.

Technical efficiency

Another indicator of performance is technical efficiency, defined as the firm's ability to maximize potential output from a specified mix of inputs and technology (Hill and Kalirajan 1991). To estimate potential output and thereby obtain the technical efficiency index of the industry, the deterministic programming method applied in this study is derived from Nishimizu and Page (1982) and Page (1984). Both studies specified a translog production frontier, and the estimation procedure adopted was an application of linear programming.

The linear programming technique for estimating technical efficiency represents the deviation from the frontier as an optimization problem. The technique used minimizes the deviation of the actual from the maximum potential production function, subject to a number of constraints. Thus:

$$Min \quad Y_e - Y,$$

where

$$\begin{aligned} Y_e = \; & a_0 + \alpha_L \ln L + \alpha_K \ln K + \alpha_M \ln M \\ & + \alpha_{LK} \ln L \ln K + \alpha_{LM} \ln L \ln M + \alpha_{KM} \ln K \ln M \\ & + \frac{1}{2} \alpha_{LL} (ln \; L)^2 + \frac{1}{2} \alpha_{KK} (ln \; K)^2 + \frac{1}{2} \alpha_{MM} (ln \; M)^2 \end{aligned}$$

subject to the following constraints:

$$
\begin{array}{llllllll}
(i) & \alpha_L & + & \alpha_K & + & \alpha_M & = & 1 \\
(ii) & \alpha_{LK} & + & \alpha_{LM} & + & \alpha_{LL} & = & 0 \\
 & \alpha_{KL} & + & \alpha_{KM} & + & \alpha_{KK} & = & 0 \\
 & \alpha_{ML} & + & \alpha_{MK} & + & \alpha_{MM} & = & 0 \\
(iii) & \alpha_{LL} & \leq & 0 & & & & \\
 & \alpha_{KK} & \leq & 0 & & & & \\
 & \alpha_{MM} & \leq & 0 & & & &
\end{array}
$$

where

Ye	=	estimated maximum potential output;
Y	=	value of actual output;
L	=	total number of man-hours;
K	=	user cost of capital; and
M	=	cost of raw materials.

The results of the minimization problem presented above will describe the frontier production function or "best practice" frontier of the industry.

Technical efficiency can be presented in the following way:

$$\text{Technical Efficiency} = \frac{Y}{Y_e}$$

The above ratio is called the technical efficiency coefficient (TEC). It denotes the extent to which a plant is able to achieve the maximum potential output given its choice of technique. The two subsectors in the subject industry used the same production technology and as such, they are lumped together to obtain the average TEC.

A plant or an industry is said to be technically efficient if its technical efficiency coefficient (TEC) is not less than 75 percent (Hill and Kalirajan 1991).

Import Penetration Ratio

The import penetration ratio (IPR) is employed to examine the extent of the industry's exposure to import competition. It indicates the proportion of imports to total domestic sales, which is the value of output minus exports and plus imports. In equation form

$$IPR = \frac{Imports}{Domestic\ Sales - Exports + Imports}$$

Market Structure and Profitability Indicators

For this study, two measures of concentration are employed: (1) the 4-plant concentration ratio (CR4), which measures the share of revenue in terms of major products and census value added accounted for by the four largest plants in the subsector/industry; and (2) the Herfindahl index (HI), which measures the dispersion in plant sizes within industry i, is the sum of the squared plant market shares in industry i. In equation form:

$$Hi = \sum S_{ij}^2$$

where j = 1 ... n plants in industry i

An industry or subsector is said to be highly concentrated if CR4 is above 60 percent. It is also highly concentrated if HI is much higher than the ratio 1 over the total number of plants (i.e., 1/n) and close to 1.

For profitability assessment, price-cost margin is utilized. The price-cost margin is derived by dividing the difference between census value added and compensation over the value of output. It may be written in the following form:

$$PCM = \frac{Census\ Value\ Added - Compensation}{Value\ of\ Output}$$

The higher the estimated PCM, the higher the market power exercised by a subsector or industry.

Factor Productivity and Intensity

Capital productivity, labor productivity and capital-labor (K/L) ratio or capital intensity are computed by following these formulas:

$$\text{Capital Productivity} = \frac{\text{Census Value Added}}{\text{Capital Stock at Replacement Cost}}$$

$$\text{Labor Productivity} = \frac{\text{Census Value Added}}{\text{Number of Workers}}$$

$$\text{Capital Intensity} = \frac{\text{Capital Stock at Replacement Cost}}{\text{Number of Workers}}$$

Census value added is changed into constant 1972 prices using the gross domestic product (GDP) deflator for the manufacturing sector. Replacement cost of capital, obtained from the DRC calculations, is adjusted using the deflator for capital goods.

5

Industry Background

This chapter provides a factual background of the agricultural machinery industry in the Philippines. It presents the general profile of the industry and examines the government policies affecting it. The changes in the level of protection brought about by the shift in trade policy orientation are also presented in this chapter.

General Profile

Product Description

Agricultural machinery is a general term used to describe tractors, combines, implements, machines, and any other device more sophisticated than a hand tool, which are animal or mechanically powered (Handbook on Agricultural Mechanization in the Philippines 1988).

This paper focuses on the manufacture of power-driven agricultural machinery, particularly hand tractors (or power tillers), and power threshers. Basic versions of the hand tractors are identified as traditional and hydrotiller; while the power threshers are basically known as axial-flow and portable. Based on the data obtained from the Department of Agriculture-International Rice Research Institute (DA-IRRI) Industrial Extension Program, hand tractors constitute 48.26 percent share of the reported production of the industry over the period 1975-1992, followed by power threshers, which covered 39.38 percent of the industry's production (Table 1).

Table 1
Product Share: 1975-1992 (In percent)

Products		% Share
Hand Tractor		48.26
Traditional	41.24	
Hydrotiller	7.02	
Power Thresher		39.38
Axial-Flow	24.72	
Portable	14.66	
Batch Dryer		1.04
Axial Flow Pump		1.39
Transplanter		0.56
Reaper		0.61
Seed/Fertilizer Applicator		0.36
Tapak-Tapak Pump		1.30
Sipa Pump		1.05
Seeder		0.67
Weeder		0.58
Centrifugal Pump		3.76
Puddler		0.03
Corn Sheller		1.01
Total		100.00

Note: Some cooperators of the program did not report their production statistics. The number of active cooperators also varies every year.

Source: Department of Agriculture - International Rice Research Institute (DA-IRRI) Program

Brief History

Domestic production of hand tractors was started in 1967 by the Machinery Industries Company, Incorporated of Naga City in the Bicol area. The company's brand name was popularly called *Magico* which has been one of the main sources of machine designs in the country until now. However, the rapid growth of local manufacture only took shape in the early 1970s when IRRI released its first low-cost designs of hand tractor and power thresher. The popularity of the latter, however, did not gain a foothold until after 1975. Since these machines were also designed to suit local physical conditions and farming practices, they were well accepted by farmers. With IRRI's industrial extension services, the early 1970s marked the shift from large imported machines to small, low-cost and locally produced machines to the use of mechanization technology in farm operations.

Aside from the manufacture of IRRI-designed machines (especially hand tractors), there were other important factors influencing the rapid growth of the industry in the first half of the 1970s, particularly the period from 1972 to 1975 (Handbook on Agricultural Mechanization in the Philippines 1988). These factors were: (a) the implementation of the Land Reform Program which resulted in large income gains to farmer share tenants; (b) the outbreak of hoof and mouth disease which afflicted 14,000 work animals in 1975; (c) the availability of financing programs for locally-built farm machines; and (d) the promulgation of the General Order 47 in 1974.

Size and Plant Distribution

The agricultural machinery industry is composed of a combination of a few large- and medium-scale establishments and numerous small-scale ones. A number of these small-scale manufacturers started as operators of welding shops and were predominantly family-owned and -managed. Almost all establishments in the industry are producing more than one product line.

Table 2 shows the number of establishments in the industry based on the 1978, 1983, and 1988 census data. In 1983, the hand tractor manufacturers dropped to 5 from the 1978 figure of 18, registering a 72.22 percent decrease. One plausible reason for the substantial drop in the number of establishments was the stiff competition with micro-scale or "backyard" operators, who only operate when there is a demand for certain farm machinery and equipment, in a diminishing market. These operators are based in the rural areas where the large local market is, thereby making them very accessible to end-users. Proximity to potential users do not only facilitate physical selling of agricultural machines but also make interaction with farmers regarding machine improvements and modifications possible. The proliferation of these backyard operators was primarily triggered by the launching of the DA-IRRI Program in 1980. Another plausible reason was the unstable political as well as economic climate in 1983 which badly affected the industry. However, one establishment had entered the market between 1983 and 1988.

In the manufacture of power thresher, there were only 14 establishments in 1978 which escalated to 25 in 1983, but slightly declined to 24 in 1988. This can be ascribed to the farmers' increasing awareness of the benefits of post-harvest technologies.

Over the 1978-1988 period, the number of hand tractor establishments decreased by 67 percent, while that of the power thresher establishments increased by 71 percent. At the aggregate level, a decline of six percent was experienced during the period under study.

The census data also revealed that only 27 percent of the manufacturing establishments in 1983 were located in the National Capital Region (NCR), while the bulk of these were strategically dispersed in other parts of the country (Table 3). In 1988, the number of establishments in the NCR increased by a negligible three percent.

Input Structure

The raw material needs of the industry are mainly metallurgical. Steel materials (e.g., B.I. sheets, pipes, steel bars, and plates) account for 70 to 90 percent of the total weight of power-driven machinery

Table 2
Number of Establishments: 1978, 1983 and 1988

	1978	1983	1988
Hand Tractor	18	5	6
Power Thresher	14	25	24
Industry	32	30	30

Source: *Census of Establishments*, 1978, 1983 and 1988, National Statistics Office.

Table 3
Geographical Plant Location: 1983 and 1988 (In percent)

	1983		1988	
	NCR	ONCR	NCR	ONCR
Hand Tractor	40	60	17	83
Power Thresher	24	76	33	67
Industry	27	73	30	70

Notes: NCR - National Capital Region
ONCR - Outside National Capital Region

Source: *Census of Establishments*, 1983 and 1988, National Statistics Office.

(Manaligod 1988). At present, the raw materials being imported include: engines, bearings, chains, gear boxes, sprockets, perforated sheets, and cold roll steel. On one hand, the other raw materials are already being supplied by local mills. Since engines are wholly imported and therefore costly, they constitute approximately 60 percent of the total cost of the machine package. An engine can be suited easily to the user's needs and design because it is not yet installed on the machine. As such, users have a choice as regards the type of engine they prefer which they can also easily attach to other farm machinery.

In 1982, however, Delta Motors Corporation (DMC) ventured into producing a single-cylinder CX-engine of 10 horsepower (AMDP 1990). But two years later, it stopped operation due to heavy indebtedness and worsening economic situation. The company was able to sell a total of 1,009 units at an average cost of P3,423.00 per unit, which was P1,565.00 lower than the imported Briggs and Stratton engine of the same capacity. Performance test report of the Agricultural Machinery Testing and Evaluation Center (AMTEC) revealed that the local engine was of good quality. Table 4 shows the sales volume of engines and selected agricultural machines from 1966 to 1991.

Machine Design and Product Quality

Most agricultural machine designs have been tailored from IRRI's research and development efforts since the early 1970s. Free blueprints are being provided by IRRI to interested individuals for commercial production and marketing. Since the Institute does not issue exclusive fabrication rights to a single manufacturer, majority of the manufacturers in the industry therefore are engaged in innovative and product-improving technological change activities (Mikkelsen 1984).

Quality and performance standards are being formulated by the Technical Committee No. 19 (see Appendix 1 for description) and AMTEC. Test procedures and evaluation of after-sales capabilities of local producers are also conducted to ensure users of quality spare

Table 4

Sales Volume and Growth Rates of Selected Agricultural Machineries: 1966-1991 (In units)

Year	Engines				Hand Tractors				Power Threshers	
	Gasoline	Diesel	Total	Growth Rate (%)	Gasoline	Diesel	Total	Growth Rate (%)		Growth Rate (%)
1966	—	—	—	—	—	—	1,932			
1967	—	—	—	—	—	—	3,058	58.28		
1968	—	—	—	—	—	—	1,873	(38.75)		
1969	—	—	—	—	—	—	910	(51.41)		
1970	—	—	—	—	—	—	425	(53.30)		
1971	—	—	—	—	—	—	680	60.00		
1972	—	—	—	—	—	—	1,408	107.06		
1973	—	—	—	—	—	—	3,120	121.59		
1974	—	—	—	—	—	—	6,721	115.42		
1975	44,284	2,330	46,614	—	—	—	11,077	64.81		
1976	26,962	2,995	29,957	(35.73)	—	—	8,937	(19.32)		
1977	27,124	4,053	31,177	4.07	—	—	9,209	3.04		
1978	34,559	5,967	40,526	29.99	6,200	1,603	7,803	(15.27)	2,220	

Table 4 (continued)

Year	Engines				Hand Tractors				Power Threshers	
	Gasoline	Diesel	Total	Growth Rate (%)	Gasoline	Diesel	Total	Growth Rate (%)		Growth Rate (%)
1979	41,471	5,917	47,388	16.93	4,287	1,092	5,379	(31.06)	3,006	35.41
1980	26,666	6,646	33,312	(29.70)	2,070	923	2,993	(44.36)	2,401	(20.13)
1981	26,203	9,528	35,731	7.26	1,696	1,205	2,901	(3.07)	1,137	(52.64)
1982	20,552	7,695	28,247	(20.95)	1,643	514	2,157	(25.65)	391	(65.61)
1983	18,773	5,927	24,700	(12.56)	1,066	569	1,635	(24.20)	335	(14.32)
1984	4,997	2,370	7,367	(70.17)	947	286	1,233	(24.59)	487	45.37
1985	6,974	2,647	9,621	30.60	99	727	826	(33.01)	653	34.09
1986	7,660	2,570	10,230	6.33	—	—	313	(62.11)	247	(62.17)
1987	14,538	3,269	17,807	74.07	18	167	185	(40.89)	142	(42.51)
1988	16,184	3,531	19,715	10.71	224	715	939	407.57	245	72.54
1989	32,799	6,385	39,184	98.75	199	930	1,129	20.23	275	12.24
1990	50,368	11,555	61,923	58.03	—	—	1,677	48.54	281	2.18
1991	29,851	9,467	39,318	(36.51)	—	—	957	(42.93)	300	6.76

Note: '—' means data not indicated.

Source: Agricultural Machinery Manufacturers and Distributors Association (AMMDA).

parts. Other private and public supporting agencies, with corresponding details, are listed in Appendix 1.

Production Technology

The industry is characterized by a predominantly labor-intensive production technology. The most common production facilities used are the bar cutter, sheet cutter, power saw, drill press, grinder, sheet bender, arc weld, oxy-acetylene, lathe machine, shaper, and air compressor. The manufacturing process basically involves cutting, grinding, drilling, machining, sub-assembling, and finishing. According to industry experts, however, there is need to upgrade quality and introduce low cost and better production techniques.

As a result of financial constraints on both sides — manufacturers and users — large investment on capital assets (i.e., purchase of sophisticated fabrication machinery and equipment) is not viable for the majority of the firms which are small-scale.

Industry Concerns

One of the main concerns facing the industry is the poor quality of the local steel materials which can be traced to the absence of a truly integrated steel mill complex and lack of forging and foundry facilities in the country (AMDP 1990). According to Manaligod (1988), the metallurgical properties of local steel materials do not follow the standard softness and hardness required for the specified metal classification. This problem in effect translates to time-consuming and costly fabrication process. Another problem is the high cost of raw materials, especially those imported materials and components which are subjected to high tariff rates. The need to upgrade the present production technology is also a main concern of the industry. Since its introduction in the early 1970s by IRRI, major changes have not been made in the fabrication technology. Moreover, low demand for agricultural machinery and equipment is another problem which may be due to the following reasons: (a) low economic viability of farmers brought about by high cost of some agriculture inputs; (b) inadequate financing and credit; and (c) unfavorable natural calamities such as droughts, typhoons, floods, and pests (Resurreccion 1991).

Policy Environment

The Issue of Agricultural Mechanization

Agricultural machinery and equipment could increase farm output and income. Timeliness of farm operations allows farmers to take advantage of high-yielding varieties (HYVs) and accommodates higher cropping intensities. As a key input to agricultural production, the industry derives its demand from the agriculture sector. The country's agricultural policies (e.g., agricultural mechanization and irrigation development programs), therefore, influence the performance of the industry.

In the Philippines, agricultural mechanization is generally limited to land preparation and threshing activities (see Appendix 2). The former mainly uses hand tractors for small land holdings and four-wheel tractors for large farm estates, while the latter uses power threshers. On the average, the power input in the country is only 0.53 horsepower per ha.

Until now, the absence of a more rational mechanization policy in the Philippines is largely attributed to the labor displacement issue which is commonly faced by any labor-abundant economy. Nonetheless, the country's National Development Plans for the past several years have encouraged the use of appropriate technology in the farm production process.

In line with the government's thrust for the Philippines to reach the status of a Newly Industrialized Country (NIC) in 1998, Senate Bill 1103 — an act known as the Philippine Agricultural Mechanization Program (PAMP) Act — is currently being deliberated in the Senate. This act calls for the institution of a "more comprehensive and realistic agricultural mechanization program" in the country.

Financial Incentives

To finance the acquisition of agricultural machinery and equipment (both local and imported), the Central Bank (CB) made an agreement with the World Bank's International Bank for Reconstruction and Development (IBRD) on 2 November 1965 to set up a financing program that would be channeled through rural banks. This program was known as the CB-IBRD Credit Program. Four credit lines, amounting to US$76 million (an average of P35.2 million annually), were provided from 1965 to 1980 to interested farmers (see Appendix 3). It was only in the fourth credit line that local manufacturers were given considerable attention. Also, in response to the provision of the fourth credit line and with the proliferation of local manufacturers, the Agricultural Machinery Testing and Evaluation Center (AMTEC) was established. The need to put up a testing center was imperative to protect farmers from "fly-by-night" manufacturers that produced sub-quality products.

Industry sources claimed that the CB-IBRD Credit Program, considered then as the main institutional credit support system for the purchase of agricultural machines, largely contributed to the growth of the industry until it was exhausted in 1980. Although banks were required under P.D. 717 during the Marcos regime to reserve 25 percent of their loan portfolios for agricultural lending, this project did not work at all for the farmers' benefit, as disclosed by an industry source (AgriScope 1987). The reason was that the loan requirements of the banks were often too stringent for the farmers. Moreover, the farmers could not afford to borrow under the lending programs that were offered by the banks.

With the outbreak of the hoof and mouth disease that plagued the working animal condition in 1975, the Power Tiller Rationalization Program was implemented. Aside from CB-IBRD loans, Land Bank of the Philippines (LBP), Development Bank of the Philippines (DBP) and Philippine National Bank (PNB) were mobilized by the government to allocate more funds for the acquisition of agricultural machinery. LBP financed around 2,500 hand tractors, while DBP financed 600 four-wheel tractors.

Until now, LBP has remained an institutional credit support system. Recently, in 1992, DA launched a development tie-up with LBP to finance agricultural mechanization activities in the countryside. This project or financing scheme is known as the Agricultural Mechanization Financing Program for Farmers' Cooperatives, where an amount of P500 million is available for credit. One of the program's areas of concern is the acquisition of agricultural machines. However, loans are addressed only to existing cooperatives. This is in line with the government's thrust to encourage the development of cooperatives in the rural areas.

To date, Senate Bill 1103 currently being deliberated upon in the Senate has included credit assistance as one of its main sections. Banking institutions such as the ACPC (Agricultural Credit Policy Council), LBP, and DBP to mention a few, are mandated to come up with credit assistance packages for those farmers, other beneficiaries and entrepreneurs willing to undertake agricultural mechanization projects. Indeed, pursuing and realizing this program would mean a brighter future for the agricultural machinery industry.

Investment Incentives

In 1967, the Investment Priorities Plan (IPP) was created by the Board of Investments (BOI) to encourage local manufacturing industries. Considered as one of the priority projects then, the industry was given a set of incentives, mostly in the form of tax deductions, as provided for in the Investment Incentives Act (R.A. 5186). Machines that are still under BOI listing are hand tractor, power thresher, corn sheller, and other post-harvest equipment. Some poultry equipment are also included.

Tariff Reform Program

The importation of agricultural machinery and equipment has never been subjected to quantitative restriction (QR) measures as long as compliance is made on the foreign exchange requirements of the Central Bank (CB) of the Philippines. The local industry, however, is protected through tariffs.

In 1974, the Tariff and Customs Code of the Philippines reflected a bias against locally manufactured agricultural machinery and equipment. Imported agricultural machinery was subjected to ad valorem (CIF) duty rates of 10 to 30 percent, while the duty rates for material inputs were very high; for instance, for steel it was 50 percent. Prime movers (i.e., single cylinder engines with 25 horsepower and below) were subjected to a 10 percent duty rate. In addition, an advance sales tax of 10 percent was also imposed.

In 1981, the first Tariff Reform Program (TRP) was launched under Executive Orders (E.O.s) 609 and 632-A. TRP gradually lowered and rationalized the country's protection structure in a period of five years which ended in 1985.

E.O. 632-A in 1 January 1981 increased the level of nominal protection for harvesting and threshing machinery (Table 5). In addition, the tariff rates of some of the industry's major inputs, such as engine and transmission assembly parts, also increased. Such a stance was proposed to protect these particular subsectors especially the pioneer engine manufacturing activity.

E.O. 632-A was then incorporated in the 1982 Tariff and Custom Codes. The duty rate of hand tractor was reduced by some 10 percent. Tariff rates on inputs were also lowered. Note that the average tariff rate on the industry's inputs was 30 percent at the start of the TRP, and was reduced to 26 percent in 1983 until 1988.

In 23 January 1990, the National Emergency Memorandum Order No. 8 (NEMO 8) cut down the duty rates for agricultural machinery. The duty rate was pegged at 10 percent for hand tractor and its parts. In addition, the duty rate for engines with 25 horsepower and below was eliminated, that is, from 20 percent to zero percent. Through E.O. 404, the rates of import duty, as modified by NEMO 8, were extended. An attempt was made to return the concerned tariff rates to their previous rates via E.O. 413, but due to a strong lobbying from the private sector, the drastic policy change was not carried out. NEMO 8 was instead maintained in E.O. 470, another major tariff restructuring scheme launched in 1991 and is to end in 1995. Under

Table 5
Tariff Schedule (In percent)

	1978	1981	1983	1986	1991	1992	1993	1994
A. Output								
1. Hand tractor	30	20	20	20	10	10	10	10
2. Power thresher	10	10	10	30	20	20	20	20
B. Inputs								
1. B.I. sheets	50	40	30	30	25	25	20	15
2. B.I. pipes	50	40	40	30	30	30	30	30
3. Steel bars (angle, flat and round)	30	20	20	20	10	10	10	10
4. M.S. plates	50	40	30	30	25	25	20	15
5. Cast iron	10	5	5	10	3	3	3	3
6. Welding rods	50	40	30	30	30	30	30	30
7. Ball bearings	10	10	10	10	10	10	10	10
8. Roller chains	20	30	30	30	30	30	30	30
9. V-belts	20	50	40	40	30	30	30	30

Table 5 (continued)

	1978	1981	1983	1986	1991	1992	1993	1994
10. Bolts, nuts, screws, cotter-pins, washers	50	40	30	30	30	30	30	30
11. Transmission shafts, cranks, clutches, bearing housings, gear boxes, pulleys	10	10	10	20	10	10	10	10
12. Sprockets	20	20	20	20	20	20	20	20
13. Oil seals	30	30	30	30	30	30	30	30
14. Paints and thinners	100	70	40	40	40	30	30	30
15. Springs	30	30	30	30	30	30	30	30
16. Pneumatic tyres	30	30	30	30	30	30	30	30
17. Internal combustion engine (Rated 25 HP and below)	10	10	20	20	0	0	0	0
Simple average tariff rate	34	30	26	26	23	22	21	21

Source: *Tariff and Customs Code of the Philippines*, various years.

the 1991 Tariff and Customs Code, tariff rates for hand tractors and power threshers were 10 and 20 percent, respectively. These tariff rates for the industry's outputs will remain effective until 1995. For inputs, tariff rates ranged from 0 to 40 percent in 1991, but the range fall between 0 and 30 percent in 1992 will take effect until 1995. Hence, the average tariff rate on the industry's inputs was 23 percent at the start of the 1991 TRP and was slightly reduced to 22 percent in 1992. The average tariff rate slightly decreased again to 21 percent in 1993, which remain effective until 1995.

Effective and Net Effective Protection

A more relevant measure of protection accorded on the firm/sub-sector/industry is the effective protection rate (EPR) which takes into account the protection for both output and inputs.

Looking at Table 6, the hand tractor subsector received an EPR of 19.04 percent in 1983, but its EPR went down to 15.96 percent in 1988. The reduction in the subsector's EPR is attributed to the decrease in its implicit tariffs, T_j and T_i, in 1988 (Table 7). Though the nominal tariff for hand tractor and the average nominal tariff for its inputs have not changed at all, the decrease in implicit tariffs is due to the elimination of the 25 percent mark-ups over CIF import prices after 1986.

Table 6

Effective and Net Effective Protection Rates: 1983 and 1988 (In percent)

	1983		1988	
	EPR	Net EPR	EPR	Net EPR
Hand tractor	19.04	-4.77	15.96	-7.23
Power thresher	5.66	-15.47	40.84	12.68
Industry	7.29	-14.17	37.95	10.36

The power thresher subsector, on the other hand, received an EPR of 5.66 percent in 1983, but its EPR notably rose to 40.84 percent in 1988. The plausible reason for this movement is the increase in the nominal tariff for power thresher (from 10 percent in 1983 to 30 percent in 1988), which in effect, increased its T_j. In addition, the increase in its T_j is combined with the decrease in its T_i.

At the aggregate level, the EPR of both subsectors averaged at 37.95 percent in 1988 from its very low EPR in 1983 which was 7.29 percent.

Net EPRs, which include the adjustment for foreign exchange overvaluation, were also estimated for 1983 and 1988. The results are also presented in Table 6. It can be discerned that the hand tractor subsector remained penalized even in 1988, as revealed by its negative net EPR. This result implies that the particular subsector would actually receive negative protection if the currency overvaluation is considered.

In the case of the power thresher subsector, a different scenario is depicted. From a negative net EPR in 1983, it achieved a positive net EPR in 1988. This shows that the power thresher subsector in 1988 is favored even with an overvalued foreign exchange currency.

Table 7
Implicit Tariff Rates: 1983, 1986, 1988 and 1991 (In pecent)

	1983	1986	1988	1991
On output: Tj				
Hand tractor	35.00	35.00	32.00	21.00
Power thresher	23.75	46.25	43.00	32.00
On inputs: Ti	41.75	41.75	38.60	35.30

In sum, the TRP has considerably rationalized the protection structure of the agricultural machinery industry, but it is still distorted since the the average implicit tariff of the industry's inputs is higher than the implicit tariff of hand tractors between 1983 and 1988. The figure is greater than those of both products in 1991 and even until 1995.

6

Industrial Performance

THIS chapter examines the performance of the agricultural machinery industry during the pre-trade reform period and the transition towards post-trade reform. It presents the growth, changes in the industrial market structure, efficiency performance, and competitiveness of the industry. For the most part, the analysis is based on data from the 1983 and 1988 Census of Manufacturing Establishments. Additional information is taken from a firm-level survey of the industry which covers the years 1986 and 1991. It is important to emphasize at this point that industrial performance is *not solely* influenced by trade policy decisions. Hence, the non-price factors influencing efficiency are considered in the presentation and analysis of results.

GROWTH

The growth indicators which are based on three census years — 1978, 1983, and 1988 — of each subsector and the industry as a whole are the following: value of output, census value added, sales (except for 1978), and employment size (Table 8). Other growth indicators such as production, imports and exports are also presented in this section.

Value of Output

At constant prices, the value of output of the industry amounted to approximately P84 million, P13.3 million, and P15.4 million in 1978, 1983, and 1988, respectively. An 81.7 percent fall in the value

Table 8
Growth Indicators: 1978, 1983 and 1988

	Hand Tractor			Power Thresher			Industry		
	1978	1983	1988	1978	1983	1988	1978	1983	1988
Value of output*	67,256,949	2,613,154	1,890,116	16,818,384	10,713,541	13,471,165	84,075,333	13,326,695	15,361,281
Census value Added*	38,959,601	1,768,698	249,794	7,157,667	5,975,017	5,294,570	46,117,268	7,743,715	5,544,364
Sales*	n.a.	2,929,899	2,367,774	n.a.	6,771,146	13,498,387	n.a.	9,701,045	15,866,161
Employment size	1,350	105	117	571	555	436	1,921	660	553

Notes: * In constant 1972 prices.
n.a. = Information not available.

Source: *Census of Establishments*, 1978, 1983 and 1988. National Statistics Office.

of output was marked during the 1978-1988 period. The hand tractor subsector showed a 97.2 percent decrease, while the power thresher subsector declined by only about 19.9 percent. Between 1983 and 1988, however, the industry's value of output in real terms augmented. This was mainly due to the contribution of the power thresher subsector whose value of output in real terms increased by about 25.74 percent.

According to industry sources, the value of output recorded in the census data does not exactly represent the actual size of the agricultural machinery industry. This is primarily because the production statistics of micro-scale or "backyard" operators are not captured in the census. These operators crowd the industry and when lumped together constitute a large portion of the industry's domestic market.

Census Value Added

At constant prices, the agricultural machinery industry registered a census value added of P46.1 million, P7.7 million and P5.5 million, in 1978, 1983 and 1988, respectively, indicating an 88 percent decrease over the 1978-1988 period. A large reduction in the census value added was contributed by the hand tractor subsector which exhibited a 99.4 percent fall in its performance. On the other hand, the power thresher subsector went down by only 26 percent.

Examining the 1983-1988 performance, the reduction in the census value added of the hand tractor subsector was far greater than the reduction exhibited by the power thresher subsector, that is, 85.88 and 11.39 percent, respectively.

Sales

Sales performance of the industry in real terms was P9.7 million in 1983 and P15.9 million in 1988 indicating an increase of 63.6 percent. A negative sales performance of 19.2 percent was recorded by the hand tractor subsector, while the power thresher subsector marked a significant increase of 99.4 percent in its 1988 sales figure.

Table 9
Production Statistics of Selected Agricultural Machineries: 1978-1992 (In units)

Year	No. of Coope-rators	Hand Tractor			Power Thresher		
		Tradi-tional	Hydro-tiller*	Total	Axial-Flow	Portable	Total
1978	20	795	—	795	689	1,746	2,435
1979	21	1,337	—	1,337	1,850	2,290	4,140
1980	31	979	—	979	1,059	1,218	2,277
1981	33	1,107	—	1,107	1,417	1,275	2,692
1982	55	2,310	—	2,310	1,689	1,113	2,802
1983	75	2,268	—	2,268	1,162	1,129	2,291
1984	79	1,985	—	1,985	1,571	515	2,086
1985	79	3,844	—	3,844	1,314	310	1,624
1986	58	1,214	1,162	2,376	1,458	290	1,748
1987	46	1,386	1,418	2,804	793	186	979
1988	31	1,538	258	1,796	1,639	384	2,023
1989	34	2,809	193	3,002	2,211	253	2,464
1990	45	5,250	324	5,574	1,474	167	1,641,
1991	22	1,438	1,320	2,758	597	473	1,070
1992	52	2,054	1,438	3,492	1,295	598	1,893

Notes: * Hydrotiller was introduced in late 1985; data include existing designs of floating tiller.
'—' means data not available.

Source: Department of Agriculture - International Rice Research Institute (DA-IRRI) Program.

Employment Size

Concerning employment size, a general reduction over the 1978-1988 period was also experienced in the industry. Between 1978 and 1988, employment size at the aggregate level decreased by 71.2 percent. A sharp negative growth rate of 91.3 percent was recorded by the hand tractor subsector, while only 23.6 percent was registered by the power thresher subsector. However, the employment size of the hand tractor subsector between 1983 and 1988 slightly increased, while the other subsector declined.

Table 10
Production Growth Rates: 1978-1992 (In percent)

Year	Hand Tractor			Power Thresher		
	Tradi-tional	Hydro-tiller	Total	Axial-Flow	Portable	Total
1978	—	—	—	—	—	—
1979	68.18	—	68.18	168.51	31.16	70.02
1980	(26.78)	—	(26.78)	(42.76)	(46.81)	(45.00)
1981	13.07	—	13.07	33.81	4.68	18.23
1982	108.67	—	(108.67)	19.20	(12.71)	4.09
1983	(1.82)	—	(1.82)	(31.20)	1.44	(18.24)
1984	(12.48)	—	(12.48)	35.20	(54.38)	(8.95)
1985	93.65	—	93.65	(16.36)	(39.81)	(22.15)
1986	(68.42)	—	(38.19)	10.96	(6.45)	7.64
1987	14.17	22.03	18.01	(45.61)	(35.86)	(43.99)
1988	10.97	(81.81)	(35.95)	106.68	106.45	106.64
1989	82.64	(25.19)	67.15	34.90	(34.11)	21.80
1990	86.90	67.88	85.68	(33.33)	(33.99)	(33.40)
1991	(72.61)	307.41	(50.52)	(59.50)	183.23	(34.80)
1992	42.84	8.94	26.61	116.92	26.43	76.92

Source: Table 9

Production

Table 9 provides historical production statistics of hand tractors and power threshers from 1978 to 1992, while Table 10 shows the production growth rates. The production volume is based on the annual report of the active cooperators of the DA-IRRI Industrial Extension Program. As can be observed, the production growth rates illustrate an erratic trend which is attributable to the irregular number of DA-IRRI cooperators who reported their production volume every year.

Nonetheless, some inferences could be drawn from the production data when there was a regular trend in the number of active cooperators for a particular period. For instance, during the period

1980-1981, an increase in the volume of production was exhibited by the hand tractor and power thresher subsectors. This can be partly attributed to lower tariffs on some of their imported inputs which was made possible by the TRP in 1981. From 1983 to 1984, however, production by both products declined, which was largely due to the political and economic crises the country experienced during that period. By 1985, hand tractor production expanded by 93.65 percent, while the power thresher production expanded only in 1986 despite the fact that there were less active cooperators in that year compared to the previous year. Noteworthy, the same case applied to the hand tractor subsector in 1988 where growth rate posted at 106.64 percent.

The 1990 production data in the hand tractor subsector may be ascribed to the implementation of NEMO 8 (which reduced the tariff rates for the industry's outputs and inputs, particularly putting zero tariff for imported engines with horsepower of 25 and below). AMMDA claimed that they immediately felt the effect of NEMO 8 when it was implemented in February 1990 (Greenfields 1990). Due to the absence of locally-made engines, all engines used for farm machinery and equipment are wholly imported, thus, making them more expensive to acquire. As noted in the previous Chapter, the cost of engine constitutes about 60 percent of the total cost of the machine package.

According to AMMDA, from February to April of 1990, gasoline engine sales jumped by 84 percent compared to sales in the same period in the previous year (see Table 4 for AMMDA's Report on Sales). Sales on diesel engines also escalated by as much as 129 percent.

Accompanying the increase in engine sales, AMMDA further claimed that the sales of local and imported agricultural machines also increased. Major machinery manufacturers in the country, especially those in Bulacan, Iloilo and Cotabato, were not even able to supply that year's market demand for hand tractors and power threshers.

Imports

The degree of trade openness, particularly import competition, exhibited in a certain industry can be measured by the import penetration ratio (IPR). It indicates the proportion of imports to total domestic demand, that is, total domestic sales. In the case of the agricultural machinery industry in the country, an IPR of 0.52 was registered in 1983, but it went down to 0.49 in 1988.

Import statistics of hand tractors and power threshers are presented in Table 11. The high volume of imports from 1978 to 1981 was largely attributed to the availability of credit through the CB-IBRD Credit Program. This program offered a lower interest rate as well as low transaction costs compared with other financing institutions. In addition, farmers with as much as five *has* of land could avail of the program. Demand for farm machinery in this period was mainly triggered by the introduction of new high yielding rice varieties (HYVs), new farming techniques or technologies, and improvement of irrigation facilities.

Imports for power threshers after 1978 as well as for hand tractors after 1981 seemed negligible. The major contributing factor which put imports almost to a halt was the local machine's adaptability to the country's farming environment. That is, local machines are developed to suit domestic agricultural system and socio-economic conditions. Another contributing factor was the overcrowding of micro-scale manufacturers in the industry which is prevalent until now. Since these manufacturers are based in the rural areas, they can be very accessible to end-users who are mostly small- and medium-scale farmers. Moreover, the bulky nature of the machines also serves as a natural obstacle to importing, which in turn requires higher freight expenses.

According to the most recent data on the industry, imports of power-driven agricultural machinery only reflect sophisticated or state-of-the-art machines now available. These machines, either new or used units, are usually employed only in large farm estates. Furthermore, these machines are equipped with more technically advanced components and require more power intake. The major

Table 11
Import Statistics of Selected Agricultural Machineries: 1978-1991

Year	Hand Tractor		Power Thresher	
	Units	Value (CIF $)	Units	Value (CIF $)
1978	3,684	1,866,843	1,035	7,975
1979	2,903	1,498,730	27	6,826
1980	678	413,050	3	1,208
1981	455	457,963	35	16,548
1982	247	1,150,785	40	19,200
1983	259	144,004	32	14,530
1984	72	22,256	—	—
1985	207	46,660	30	12,900
1986	280	71,150	37	9,042
1987	344	103,240	—	—
1988	180	51,970	20	3,112
1989	186	73,980	91	18,049
1990	209	64,216	47	10,439
1991	291	107,851	2	445

Source: *Foreign Trade Statistics*, 1978 to 1991, National Statistics Office.

suppliers of these so-called "hi-tech" farm machines are Japan, United States, United Kingdom, and West Germany.

Exports

The industry's products are mainly geared to the local market so exports are very minimal (Table 12). Industry informants, however, claimed that majority of exports were not traded on a commercial basis but were sent as prototypes to other developing countries. These countries were said to have similar physical conditions as the Philippines for machine adaptability considerations. Exports were coursed through international agencies like IRRI and UNDP's Regional Network for Agricultural Machinery. It can be gleaned that the country has export capabilities since locally fabricated machines are used as models for other agriculture-based economies like Nigeria, Chile, Papua New Guinea, and others.

Industrial Market Structure

Market Concentration

The study uses 4-plant concentration ratio (CR4) and Herfindahl index to measure market concentration at the level of the subsector and industry. It is important to note at this point that concentration measures ignore the share of imports, thus, technically they relate more to production concentration rather than to seller concentration.

A subsector or industry is considered highly concentrated if CR4 is above 60 percent and the estimated Herfindahl index is greater than 1/n (where n represents the total number of plants) and is close to 1. The CR4 means that the largest four plants account for more than 60 percent of the size of the subsector or industry while the Herfindahl index signifies the degree of dispersion in the size of plants within the subsector or industry. Thus, the former refers only to the performance of the four largest plants in the subsector or industry, while the latter captures all plant sizes, thereby also evaluating the degree of

Table 12
Export Statistics of Selected Agricultural Machineries: 1978-1991

Year	Hand Tractor		Power Thresher	
	Units	Value (FOB $)	Units	Value (FOB $)
1978	—	—	1	745
1979	307	5,423	1	2,055
1980	678	375,771	—	—
1981	27	42,750	38	65,312
1982	12	32,733	4	6,730
1983	2	5,940	11	17,371
1984	12	16,168	8	18,029
1985	8	20,920	52	69,919
1986	—	—	67	108,929
1987	—	—	25	33,952
1988	—	—	66	75,932
1989	3	9,318	3	4,662
1990	—	—	1	1,456
1991	—	—	6	16,320

Source: *Foreign Trade Statistics*, 1978 to 1991. National Statistics Office.

internal (domestic) competition. Both measures are in terms of revenue and census value added.

Before discussing the results of the study's concentration indicators, it is vital to mention that based on data from the 1983 and 1988 census, the industry was mainly composed of small-scale establishments (or plants) in terms of employment size. A small-scale plant is comprised of 5 to 99 workers; medium-scale has 100 to 199 workers; and large-scale has greater than or equal to 200 workers. It was only in 1983 when there was a sole medium-scale plant recorded in the industry, specifically in the power thresher subsector. No establishment employing more than or equal to 200 workers was listed in both 1983 and 1988. Thus, both subsectors in 1988 were composed of small-scale establishments, all with similar product design indicating a relatively fixed market price to end-users.

The degree of concentration in terms of the CR4 and the Herfindahl index measures in the agricultural machinery industry lessened between 1983 and 1988 (Table 13). At the subsector level, both measures decreased. The hand tractor subsector appeared to be more concentrated and less dispersed than the power thresher subsector. This is probably due to the fact that there were only a few number of plants in the manufacture of hand tractor compared with the other activity. Nonetheless, the decline in market concentrations can be attributed to increased internal competition due to the TRP. In the case of the hand tractor subsector, a plausible reason for the decline may be the entrance of another plant in 1988. For the other subsector, it may be due to the exit of the medium-scale producer in 1988 (albeit an increase in protection rate), leaving small ones to continue and vie for a portion of the market share it had left behind.

Profitability

The price-cost margin approach is utilized to indicate relative profitability. Thus, the price-cost margin is used to examine the association between concentration and profitability, thereby determining the extent of market power accumulated by domestic plants.

Table 13

Concentration Indicators and Price-Cost Margin: 1983 and 1988

	Hand Tractor			Power Thresher			Industry		
	1983	1988	% Change	1983	1988	% Change	1983	1988	% Change
1/N	0.200	0.167	-16.50	0.400	0.420	5.00	0.033	0.033	0.00
Herfindahl Index-Revenue	0.389	0.255	-34.45	0.162	0.113	-30.25	0.114	0.087	-23.68
Herfindahl Index-CVA	0.440	0.286	-35.00	0.153	0.113	-26.14	0.118	0.099	-16.10
4-Plant Concentration Ratio-Revenue	0.982	0.652	-33.60	0.716	0.382	-46.65	0.601	0.325	-45.92
4-Plant Concentration Ratio-CVA	0.983	0.898	-8.72	0.695	0.578	-16.82	0.610	0.540	-11.55
Price Cost Margin	0.450	-0.062	-113.77	0.258	0.117	-54.65	0.316	0.090	-71.52

Note: CVA = Census Value Added

Source: Computed from the *Census of Establishments*, 1983 and 1988. National Statistics Office.

Moreover, it is also used to indicate the presence or gauge the height of entry barriers.

There was a substantial drop in price-cost margins at the level of the subsector and industry (see Table 13). As can be observed, the hand tractor manufacturing activity recorded more reduction in price-cost margin as manifested by its negative value of 0.062 in 1988 from its positive value of 0.450 in 1983. On the other hand, the power thresher subsector marked a price-cost margin of 0.117 in 1988 from 0.258 in 1983, indicating a 54.65 percent loss in market power.

Barriers to Entry and Expansion

Based on the survey data, almost all firms revealed that they have easily entered the market. This can be merited to the fact that majority of these firms are into small-scale manufacturing venture. Cruz (1991) cited that the popularity of small-scale manufacturing is due to the following: entry in the industry is relatively open; it requires low capital and high labor; and there is little economies of scale.

However, the survey also disclosed that the most prevalent barriers to expansion are: lack of access to financial resources; difficulty of technology acquisition; high interest cost demanded by banks; and too many firms competing in an industry with a depressed demand. As an industry characterized by demand conditions, local manufacturers do not find it feasible to increase their current level of output. The majority of the end-users' lack of financial capability as well as the low level of adoption of mechanized technologies in the country are perceived as the foremost reasons why manufacturers are not motivated to produce at the maximum potential output. Furthermore, the industry's market orientation is only geared domestically, thereby constraining the avenue for any excess production.

Recapitulation

Overall, there was a reduction in both concentration ratios and price-cost margins for the agricultural machinery industry and its subsectors between 1983 and 1988. Hence, parallel movements between the two concentration ratios and the price-cost margins could thus be observed. That is, a fall in concentration ratio was accompanied by a fall in price-cost margin. The subsector (i.e., the hand tractor subsector) which seemed to be more concentrated and less dispersed had also shown a large decline in its price-cost margin between 1983 and 1988. Moreover, low levels of price-cost margins suggest less profitability, weak market power and low presence of barriers to entry in the industry.

EFFICIENCY PERFORMANCE

Two measures namely, the domestic resource cost (DRC) and the technical efficiency coefficient (TEC), are utilized to analyze the efficiency performance of the agricultural machinery industry and its subsectors. In particular, the DRC is used to evaluate allocative efficiency and comparative advantage whereas the TEC represents technical efficiency position of the industry. As pointed out by Kirkpatrick *et al.* (1984), allocative efficiency measures the degree to which the best combination of different factors is achieved, having regard for their relative prices; while technical efficiency measures the degree of economy in resource inputs used to produce a given output. It is thus hypothesized in the study that the advent of trade liberalization (i.e., TRP) will generally lead to improvements in efficiency performance.

Allocative Efficiency and Comparative Advantage

The DRC is a widely used approach for measuring the cost of production in terms of the domestic resources used relative to the net gains in foreign exchange through export or import substitution. In the *ex post* sense, the DRC can be used to represent the social cost of promoting exports or of protecting import-substituting industries under an existing trade regime.

Census of establishment data, 1983 and 1988

At DRC in shadow prices, the hand tractor subsector was socially efficient in allocating its resources in 1988, thus indicating allocative efficiency and comparative advantage (Table 14). This evidence was supported by its DRC/SER value of 0.84 in 1988. The power thresher subsector, on the other hand, seemed to be moderately inefficient in social terms in 1988 with a DRC/SER value of 1.33. The industry as a whole was moderately inefficient in 1988, that is, with a DRC/SER ratio of 1.30. Results, however, reveal that there had been improve-

Table 14
Protection and Efficiency Levels: 1983 and 1988

	Hand Tractor		Power Thresher		Industry	
	1983	1988	1983	1988	1983	1988
EPR (%)	19.04	15.96	5.66	40.84	7.29	37.95
DRC*	***	22.05	29.19	35.12	54.48	34.35
DRC/SER	***	0.84	2.10	1.33	3.92	1.30
DRCM**	***	25.94	52.15	38.69	199.20	37.94
DRCM/OER	***	1.23	4.69	1.83	17.93	1.80
Average TEC (%)	—	—	—	—	71.29	52.26

Notes:

* Domestic Resource Costs at Shadow Prices
** Domestic Resource Costs at Market Prices
*** Negative Net Foreign Exchange Savings
SER: 1983 = 13.89
1988 = 26.36
OER: 1983 = 11.11
1988 = 21.09

ments in allocative efficiency and comparative advantage position of the industry and its subsectors.

DRC/SER and establishment size

Table 15 tries to show the relationship between the DRC/SER values and the establishment or plant size. It must be noted that due to census data limitation, it could not be identified which of the plants in 1983 remained in 1988, therefore the corresponding DRC/SER movements between the the two points of reference could neither be determined.

In 1983, three small-scale plants in the hand tractor subsector were recorded as dissavers of foreign exchange, while one was an inefficient user. However, the scenario changed in 1988 wherein three were socially efficient among the four small-scale plants, while the remaining firm was not.

In the power thresher subsector, there was only one medium-scale manufacturer in 1983, and it was inefficient. By 1988, this medium-scale producer was not registered anymore. Among the 16 small-scale plants in 1983, five were efficient, seven were moderately inefficient, one was inefficient and three were dissavers of foreign exchange. However, small-scale socially efficient plants increased to 13 in 1988. In addition, two were moderately inefficient and seven were recorded as inefficient.

DRC and EPR

To relate the DRC and the EPR between 1983 and 1988, the subsector that received a lower EPR registered a lower DRC estimate as expected. This would indicate that plants in the hand tractor subsector were forced to adopt efficient measures to allocate resources in order to survive in the industry. In the case of the power thresher subsector, the increase in the EPR resulted in an increase in the DRC estimate, marking inefficient performance. However, when its DRC was compared with SER, it became moderately inefficient in 1988, compared with its inefficient performance in 1983. In general, these results would imply that the Trade Reform has achieved not only its objective of reducing protection but also its

Table 15
Distribution of Establishments by Employment (by DRC/SER ratios)

Establishment Size (Employment)	Number of Establishments									
	0 < DRC/SER ≤ 1.2 Efficient		1.2 < DRC/SER ≤ 1.5 Moderate Inefficient		DRC/SER > 1.5 Inefficient		DRC/SER ≤ 0 Dissaving Foreign Exchange		Total	
	1983	1988	1983	1988	1983	1988	1983	1988	1983	1988
Hand tractor										
Small (5-99)	—	3	—	—	1	1	3	—	4	4
Medium (100-199)										
Sub-Total	—	3	—	—	1	1	3	—	4	4
Power thresher										
Small (5-99)	5	13	7	2	1	7	3	—	16	22
Medium (100-199)	—	—	—	—	1	—	—	—	1	
Sub-Total	5	13	7	2	2	7	3	—	17	22
Industry										
Small (5-99)	5	16	7	2	2	8	6	—	20	26
Medium (100-199)	—	—	—	—	1	—	—	—	1	
Total	5	16	7	2	3	8	6	—	21	26

Source: Computed from the *Census of Establishments*, 1983 and 1988. National Statistics Office.

objective of increasing incentives to neglected subsectors/industries at the lower end of the protection scale.

Likewise, the relative efficiency performance of the subsector or industry can perhaps be partly attributed to the changes in the market structure. Increased internal competition due to the TRP could have induced plants to be efficient in order to keep their place in the market.

Survey data, 1986 and 1991

The results from the survey, covering the period 1986 and 1991, also followed a similar trend with that of the results from the Census data for 1983 and 1988 (Table 16). Such movement though only points to two firms which have 1986 and 1991 information because the rest of the firms started their operations after 1986. These two firms were socially efficient or low cost users of foreign exchange in 1991, indicating comparative advantage. Among firms with only 1991 data, two were efficient in social terms while only one was moderately inefficient.

Firms One and Two have been in the business since 1964 and 1976, respectively. Firms Four and Five started their operations in 1988, while the remaining firm entered later in 1991. As can be observed, firms that have been in the market longer were relatively more efficient than those firms who entered the industry much later. Efficiency might have been due to the cost-cutting measures the old firms adopted through the years that they have been in the market. The data also indicate the entrance of efficient plants during the period of the Trade Reform.

All firms began as micro-scale operators and all are family-owned and -managed. In addition, all firms produced a number of agricultural machines and equipment, but the main product line of Firms One and Two is power thresher, while the rest is hand tractor.

All of the firms claimed that they were very greatly affected by the institution of the value added tax (VAT) because such a policy increases the prices of raw materials. As a result, they had to raise the prices of their end-products in order to stay in business. Also, all the firms are aware of trade liberalization but claimed that they did not

Table 16

Efficiency Levels of Some Respondents: 1986 and 1991

	Firm 1		Firm 2		Firm 3	Firm 4	Firm 5
	1986	1991	1986	1991	1991	1991	1991
DRC	34.05	26.45	13.81	16.02	42.15	32.07	31.29
DRC/SER	1.27	0.80	0.51	0.49	1.28	0.97	0.95
DRCM	51.16	31.75	13.84	14.79	49.41	36.24	40.01
DRCM/OER	1.55	0.96	0.64	0.54	1.50	1.09	1.21

Note: Firms 3, 4 and 5 started production operations after 1986.

Source: Survey Data and Financial Statements from the Securities and Exchange Commission (SEC), 1986 and 1991.

directly feel its probable effects on their operations, except for one firm whose ratio of imported to local inputs is higher than the rest.

Technical Efficiency

Since both subsectors of the industry used the same technology (i.e., using the same manpower, technical skills, and fabrication equipment in the manufacturing process), they were lumped together to derive the average or the industry's TEC. The calculation obtained an average TEC of 71.29 percent and 52.26 percent in 1983 and 1988, respectively. The 1983 average TEC was just slightly below the qualified efficient range of 75-100 percent, suggesting that the industry was not far from the industry's "best practice." Unfortunately, the picture changed differently in 1988 wherein the industry became technically inefficient.

The contrasting movement of the industry's DRC estimate and TEC between 1983 and 1988 implies that although the industry was efficient in allocating its resources, it was not able to use these resources efficiently. This conflicting evidence may be due to the fact that DRC measure has more to do with the opportunity costs of resource misallocation, while TEC measure has more to do with plant-specific factors, such as, the level of technology and the management techniques employed.

Another possible reason for the contrasting movement of the industry's DRC and TEC measures is that some of the efficient plants in the industry may have improved in their technical efficiency more than the others, thereby widening the average gap between actual and maximum possible output. It is also plausible that the more efficient plants had a lesser share in industry output, thereby affecting the average TEC.

Nonetheless, the evidence showed the importance of plant-specific or non-price factors on technical efficiency. Technical inefficiency in 1988 may be attributed to the following problems enumerated by a number of firms in the industry: (a) low demand due to lack of financing for farmers who wanted to mechanize; (b) sub-standard quality of locally-sourced inputs; and (c) outmoded production technology. As noted in Chapter 5, industry sources have indicated the need to upgrade production technology which would involve a substantial amount of money for research and development (R&D).

Factor Productivity and Intensity

The variation in performance among firms or subsectors and changes in performance indicators can perhaps be explained by factor productivity and intensity (Table 17). Firms or subsectors in an industry differ in their relative use of capital and labor resources. For this study, capital and labor productivities were computed based on the value of output and census value added (both in real terms). On the other hand, capital intensity was obtained from the ratio of capital (at replacement cost) to labor.

A possible explanation for the general improvements of the DRCs in both subsectors and the industry as a whole in 1988 is the rise in capital productivities. In particular, there was a very high growth in the hand tractor subsector's capital productivities. That is, capital productivity in terms of its value of output per capital went up from 0.03 in 1983 to 1.38 in 1988, while its census value added per capital increased from 0.02 in 1983 to 0.18 in 1988. Capital productivity in terms of its value of output per capital of the power thresher subsector also expanded, from 0.09 in 1983 to 0.25 in 1988. In addition, its census value added per capital went up to 0.10 in 1988 from 0.05 in 1983.

As regards labor productivities, the hand tractor subsector recorded reductions in terms of its value of output per worker and census value added per worker between 1983 and 1988, at 35.09 percent and 87.33 percent, respectively. Power thresher subsector, on the other hand, improved in 1988 by 60.05 percent in terms of value of output per worker and by 12.80 percent in terms of census value added per worker. At the aggregate level, labor productivity in terms of value of output per worker improved by 37.57 percent in 1988 but it registered a 14.55 percent fall in terms of its census value added per worker. The general reduction in labor productivities could have influenced the average TEC since technical efficiency is associated

Table 17
Factor Productivity and Intensity: 1983 and 1988

	Hand Tractor		Power Thresher		Industry	
	1983	1988	1983	1988	1983	1988
Capital Productivity						
Value of output/capital	0.03	1.38	0.09	0.25	0.06	0.28
Census value added/capital	0.02	0.18	0.05	0.10	0.04	0.10
Labor Productivity						
Value of output/worker	24,887	16,155	19,304	30,897	20,192	27,778
Census value added/worker	16,845	2,135	10,766	12,144	11,733	10,026
Capital Intensity						
Capital-labor ratio	801,464	11,717	221,326	123,708	313,620	100,014

Note: Value of output, census value added and capital (at replacement cost) in constant 1972 prices.
Source: Computed from *Census of Establishments*, 1983 and 1988. National Statistics Office.

with plant-specific factors such as the level of technology and management style.

Concerning capital-labor ratio or capital intensity, the ratios for each subsector at the industry level dropped markedly in 1988. However, the fall in the power thresher subsector's capital intensity was not as much as what the other subsector had experienced due to its heavy capital expenditures.

It could be inferred from the above results that capital productivity is inversely related to capital-labor ratio. That is, a substantial decrease in the capital-labor ratio had caused a corresponding increase in capital productivity.

Results showed that the subsector with a more favorable DRC estimate (i.e., hand tractor subsector in this case) in 1988 registered a higher capital productivity, lower labor productivity, and a lower capital intensity ratio. The latter indicates labor-intensiveness in the subsector's/industry's production process. Thus, more utilization of labor would have a major influence on efficiency.

Competitiveness/Competitive Advantage

While comparative advantage refers to social profitability, competitive advantage refers to private profitability. One way of measuring competitive advantage or international competitiveness is through the DRC in market prices (DRCM). In this case, the DRCM is compared with the official exchange rate (OER) to determine whether a firm or an industry has competitive advantage or not. In defining competitive advantage, the same qualifications in comparative advantage are used.

Table 14 illustrates that the DRC estimates in market prices followed the same pattern with that of the DRCs in shadow prices, but with higher values, which reflect the existence of market distortions. It is important to recall that both estimates only differ in the numerator of the DRC equation wherein the DRCM used actual prices, meaning its numerator was undeflated. As such, distortions present in the market also stem from the domestic tax system as well as from the country's wage structure.

In 1988, the hand tractor subsector was moderately inefficient and thus moderately profitable in private terms as revealed by its DRCM/OER ratio of 1.23. This result is quite an improvement from the subsector's dissaver position in 1983. On one hand, the other subsector remained inefficient even in 1988. At the aggregate level meanwhile, the industry was still inefficient in 1988. Nevertheless, there had been improvements in the subsector's/industry's competitive advantage between 1983 and 1988.

Although the hand tractor subsector was efficient in social terms in 1988, it was moderately inefficient in private terms. This implies that the subsector was not earning some profits due to market distortions already cited. In comparison, the hand tractor subsector still exhibited a competitive edge over the power thresher subsector.

The DRCM results using data from the survey are also shown in Table 16. Firms One and Two also followed a downward trend but they were earning profits. Firm Five was also privately efficient while the remaining two firms were just moderately inefficient in private terms.

Comparison With the Agricultural Machinery industry of Thailand

The agricultural machinery industry of Thailand has the same general background with that of the Philippines'. Except for two-axle tractors (or large tractors) and a few technically advanced units, majority of farm machinery and equipment in Thailand are locally produced. Machine designs are also copied and modified to suit local physical conditions and tastes. The production technology is also highly labor-intensive. Most of the manufacturing firms are small and family-owned and -managed. Import tariffs are lower for completely-built-up (CBU) machines than its imported material inputs, such as sheet metal and bearings to mention a few.

However, the agricultural machinery industry of Thailand managed to achieve a high growth rate than the Philippines ever did. One of the major contributing factors is the efficient as well as the adequate distribution of agricultural machinery and fuel and a good maintenance and repair system (Rijk 1989). The presence of these factors is encouraged by the extensive and well-maintained road network and efficient transport system of Thailand. In addition, the active involvement of the private sector in supply and maintenance also helped a lot. In the Philippines, however, inadequate technical back-up of after-sales services and inavailability of spare parts have dampened the farmer's desire for agricultural machines. Long machine downtimes have adversely affected the farmer's income and, as a result, have affected his capability to meet on schedule the amortization payments on his agricultural machinery loans. Another contributing factor to the growth of Thailand's agricultural machinery industry is the credit-in-kind scheme of the Bank for Agriculture and Agricultural Cooperatives (BAAC). The BAAC was established in 1980 and has since then become the most important marketing channel for BAAC-registered local manufacturers to distribute and sell their products. Aside from this, BAAC's lending operations also extend on a cash basis, thereby making the acquisition of farm machines less burdensome. Moreover, Thailand's higher demand for agricultural machinery and equipment is mainly in response to the demand for more power input as a result of rapid area expansion rather land cropping intensification.

7

Conclusion and Policy Recommendations

THIS study analyzed the structure, performance and competitiveness of the Philippine agricultural machinery industry in the light of the Trade Policy Reform which was initiated in the early 1980s.

The findings of the study revealed that the TRP had considerably rationalized the protection structure of the industry and its subsectors between 1983 and 1988. Although both subsectors and the industry as a whole received low levels of effective protection, they have managed to improve their allocative efficiency, comparative advantage, and competitive advantage position. These results somehow disclose the indigenous innovation the domestic firms of the industry have exerted in order to survive and stay in the market. However, their effort has not been substantial enough to bring the industry to the level of technical efficiency where in fact, the average technical efficiency coefficient (TEC) of the industry has plummeted. The manufacture of agricultural machinery was near the industry "best practice" in 1983, but it veered away in 1988.

Albeit improvements in allocative efficiency and competitiveness were obtained between 1983 and 1988, technical efficiency of the industry showed a different picture. This conflicting movement of the DRC and TEC measures could be attributed to the fact that the former has more to do with the opportunity cost of resource misallocation, while the latter has more to do with the plant's level of technology, management style and other plant-specific factors. Another possible explanation would be the change in the discrepancy between the actual and potential output of the industry due to the instance in 1988 wherein some of the efficient plants improved their technical efficiency more than the others. Added to this, or another explanation might be that the shares of the more efficient plants were lesser during that time.

The improvements in allocative efficiency and competitiveness could be traced to the changes in the industrial market structure. Both concentration ratios used in the study declined between 1983 and 1988, and a parallel movement was exhibited by the price-cost margin, which indicates less profitability, weak market power, and low presence of barriers to entry in the industry. Hence, increased internal (domestic) competition could have conditioned the behavior of firms in the subsector or industry.

However, the study only covered the period until the transition towards the post-trade reform (since the TRP will be concluded in 1995) and thus the results outlined above only entail the adjustment process of the firms in the subsector or industry. Although these results were only partial in the light of the Trade Policy Reform, positive effects on the efficiency performance, particularly allocative efficiency, and competitiveness of the agricultural machinery industry could be gleaned. As such, the reduction of tariff rates on the input side is commendable since the industry still depends on some imported items like bearings and chains to mention a few. Such a stance will not only benefit the industry but the economy as a whole because inefficient local producers of material inputs will be forced to adopt appropriate measures in producing quality products to counteract the surge in import penetration.

The results of the study also showed the importance of non-price factors. One of the most prevalent demand constraints which have plagued local manufacturers, thereby threatening the growth of the industry is the limited access to credit or financial resources for farmers who desire to mechanize their agricultural technology. Credit assistance is needed due to low purchasing power of the majority of farmers who are into small-scale farming. The creation of a more rational credit scheme for small-scale farmers as well as manufacturers is thus suggested.

More research and development efforts must also be spent on upgrading the production technology of the industry as well as its product designs — not only on the output side must attention be given but on the after-sales capability of the firms in the industry as well. Lack of machine spare parts and inferior quality products have plagued end-users. In comparison, the rapid growth of Thailand's agricultural machinery industry is attributed to the availability of quality standard raw materials, machine parts, and components. Aside from these, Thailand also provides a good maintenance and repair system. The Philippines should learn from Thailand's experience.

Moreover, the future of the industry lies on the will of the government to pursue and concretize its agro-industrialization objectives. The creation of the Philippine Agricultural Mechanization Program Act is one good factor, if properly implemented, for the growth of the industry.

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Appendix 1

Institutional Support System

DA-IRRI Industrial Extension Program

Launched in 1980, the Program was a joint effort of the Department of Agriculture (DA) and the International Rice Research Institute (IRRI). It was initially funded by the United States Agency for International Development (USAID) until 1987. However, its functions are being continued by the Agricultural Engineering Division of the DA's Bureau of Plant Industry (BPI). The Program aims to promote the local manufacture of IRRI-designed agricultural machines and equipment in a wider scope. It also provides technical assistance to both farmers and manufacturers.

International Rice Research Institute (IRRI)

The Institute, through its Agricultural Engineering Division, has been doing research and development studies on appropriate agricultural mechanization technologies. Through the DA-IRRI Program, it provides free blueprints of agricultural machine designs to any interested individuals for commercial production and marketing.

Committee on Agricultural Mechanization (CAM)

By the abolition of the Agricultural Mechanization Inter-Agency Committee (AMIC) in 1991, CAM was created incorporating some of the functions of AMIC. CAM is being handled by the DA's National Agriculture and Fishery Council (NAFC). The committee, as a consultative forum, aims to consolidate all efforts made by private and public agencies concerning agricultural mechanization technologies.

Agricultural Mechanization Development Program (AMDP)

AMDP was established in 1979 as a seal of commitment to its membership to the United Nations Regional Network for Agricultural Machinery (RNAM).

Agricultural Machinery Testing and Evaluation Center (AMTEC)

To set quality and performance standards for agricultural machinery and equipment, the DA, in cooperation with the University of the Philippines at Los Baños, established AMTEC in 1977. This was in response to the provision of the fourth credit line of the CB-IBRD Credit Program. The center also formulates test procedures and conducts evaluation of after-sales capabilities of local firms. In the process, AMTEC contributes to the improvement and redesigns of existing agricultural machines.

Technical Committee on Machinery for Agriculture and Fishery (TC#19)

TC #19 is responsible in formulating product quality standards under Philippine conditions. This was created by the Department of Trade and Industry (DTI) under the Bureau of Product Standards (BPS) in 1984 in response to the need to give farmers/end-users more protection from 'fly-by-night' manufacturers. TC #19 works hand-in-hand with AMTEC.

Agricultural Machinery Manufacturers and Distributors Association (AMMDA)

The association, composed of local manufacturers and distributors, was organized in 1964. It is recognized as the official spokesman of the agricultural machinery and equipment industry in the country.

Appendix 2
Agricultural Mechanization Statistics of the Philippines: 1985-1986

Total population (in million)	56.002
Farming population (in percent)	59.50
Total area (in million ha)	30.00
Cultivated area (in million ha)	8.40
Average farm size (in ha)	2.84
Major Crops	Palay Corn Coconut Sugarcane
Average rice yield (t/ha)	2.67
Average farm labor wage (US$/day)	1.70
Average hp/ha	0.53
Machinery population:	
Power tillers	21,736
Tractors	7,147
Reapers	512
Combine harvesters	n.a.
Threshers	10,551
Irrigation pumps	986
Seeders	260
Sprayers	n.a.
Dryers	265
Rice transplanters	341

Note: n.a. = Information not available.
Source: Regional Network for Agricultural Machinery, 1988.

Appendix 3

CB-IBRD Loan Grants for Farm Machinery as of June 30, 1980 (In P000)

	First (1966-1968)		Second (1969-1973)		Third (1974-1977)		Fourth (1978-1980)		Total	
	Number	Value	Number	Value	Number	Value	Number	Value	Number	Value
Four-wheel tractors			1,694	92,910	1,952	180,226	688	100,432	9,749	457,040
	2,080	18,851		-	-					
Power tillers			942	12,477	1,191	24,547	1,202	27,597		-
Irrigation systems and wells and distribution works	279	982	318	2,912	233	2,719	40	875	870	7,488
Sprayers, grain driers, threshers and other farm machinery	38	236	43	763	63	1,371	46	2,133	190	4,503
Rice mills	—	—	—	—	—	—	345	23,095	345	23,095
Total	2,397	20,069	2,997	109,062	3,439	208,863	2,321	154,132	11,154	492,126

Note: First Rural Credit Project covers International Bank for Reconstruction and Development (IBRD) and Central Bank (CB) funds only while the Second, Third and Fourth Rural Credits Projects cover IBRD, CB AND RB/SLA funds at prescribed proportion.

Source: Sycip, Gorres, Velayo and Co. and University of the Philippines Business Research Foundation, CB-IBRD Farm Mechanization Study.

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