UNIVERSITI PUTRA MALAYSIA

EFFICIENCY AND COMPETITIVENESS OF MALAYSIAN PROCESSED PALM OIL INDUSTRY

ZAHRA SHAHVERDI

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By

ZAHRA SHAHVERDI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Doctor of Philosophy

September 2013

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DEDICATION

To

My parents

For their endless love and support all through my life

My parents in Law

For their great support and encouragement

My husband, Kaveh

Who has been a great source of love, motivation and inspiration

My little angel, Niki

For her patience

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

EFFICIENCY AND COMPETITIVENESS OF MALAYSIAN PROCESSED PALM OIL INDUSTRY

By

ZAHRA SHAHVERDI

September 2013

Chair: Suhaila Hj. Abd. Jalil, PhD

Faculty: Economics and Management

Malaysia as the dominant producer and exporter of processed palm oil (PPO) in the world, has experienced very sharp decrease in its market share from 93.8% in 1989 to 67% in 2009. Furthermore, the difference between the average price of crude palm oil (CPO) and PPO in the world market has decreased considerably. Therefore, competitiveness of this industry in the world market is doubtful. Hence, this study investigates the source of the decrease in competitiveness of Malaysian palm oil refining industry during 1989 to 2009 by looking at the efficiency of the industry as a performance index. Here we apply 2-stage data envelopment analysis (DEA) approach with variable returns to scale (VRS) assumption on a sample comprises 27 out of 51 actively operating refineries in Malaysia in 2010.

We apply the data from our sample to investigate the impact of six different factors on the inefficiency of the refineries, by applying Banker's test statistics in 1993 & 1995 on inefficiency scores based on Banker, Charnes and Cooper (BCC) model, to find solutions for increasing the efficiency, and as a result, the competitiveness of Malaysian PPO in the world market.

Since trade liberalization is inevitable in the long run, its impact on the refineries' competitiveness in the world market will be one of the main future concerns of the country. Therefore we apply dominant firm- competitive fringe market structure model on data from 1989 to 2009 and then simulate our model under free trade over the same period to find the effect of trade liberalization on competitiveness of this industry.

The results show decreasing technical efficiency between 1996 and 2009, and low levels of cost and allocative efficiency over the same period. We also find out that vertical integration and involvement of foreign investors have increased inefficiency. Joint ventures between private firms and government tends to be less inefficient, and refineries in peninsular Malaysia are more inefficient than those located in Sabah and Sarawak. These could be due to the CPO tax cut in Sabah and Sarawak that leads to decrease inefficiency of the refineries in 2001 and 2002.

Briefly, this study shows that inefficiency in Malaysia's refineries during 1996-2009 was mostly related to spare capacity of them, which was due to any reason that increased the CPO price or decreased the difference between CPO and PPO prices.

Besides, trade liberalization appears to result in a small reduction in market power of Malaysia refining industry in the world market because of new entrances and more production costs that poses competition to the Malaysia refined palm oil industry.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

KECEKAPAN DAN DAYA SAING
INDUSTRI MINYAK SAWIT PROSES DI MALAYSIA

Oleh

ZAHRA SHAHVERDI

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Malaysia merupakan pengeluar yang dominan dan pengeksport minyak sawit proses (PPO) dunia , kini mengalami kemerosotan yang ketara dalam pasaran daripada 93.8 % pada tahun 1989 kepada 67% pada tahun 2009. Tambahan pula, perbezaan di antara harga purata minyak sawit mentah (MSM) dan PPO telah menurun. Oleh itu, daya saing industri ini di pasaran dunia membinbangkan. Oleh itu, kajian ini melihat punca penurunan dalam daya saing industri penapisan minyak sawit Malaysia pada 1989-2009 berpandukan kecekapan industri sebagai indeks prestasi. Data kajian di analisis menggunakan pendekatan *2-stage envelopment analysis*(DEA) dan *variable returns to scale* (VRS) sampel kajian terdiri daripada 27 daripada 51 kilang penapisan yang beroperasi secara aktif di Malaysia pada tahun 2010

Data yang diperoleh dikaji untuk melihat kesan enam faktor yang berbeza terhadap ketidakcekapan kilang penapis , menggunakan statistik ujian Banker pada tahun 1993 & 1995 skor ketidakcekapan dinilai berdasarkan model Banker, Charnes dan Cooper (BCC) , untuk mencari penyelesaian dan meningkatkan kecekapan daya saing PPO Malaysia dalam pasaran dunia.

Sejak liberalisasi perdagangan tidak dapat dielakkan dalam jangka masa panjang , kesannya terhadap daya saing kilang dalam pasaran dunia akan menjadi salah satu daripada kebimbangan utama terhadap masa depan negara. Oleh itu, kajian ini cuba mengaplikasikan model pasaran struktur data kompetitif dominan 1989-2009 dan kemudian diubahsuai berdasarkan perdagangan bebas dalam tempoh yang sama untuk mencari kesan liberalisasi perdagangan terhadap daya saing industri ini.

Keputusan kajian menunjukkan terdapat penurunan kecekapan teknikal di antara tahun 1996 dan 2009, dan tahap yang rendah terhadap kos dan alocativekecekapan dalam tempoh yang sama . Hasil kajian ini juga mendapati bahawa integrasi menegak dan penglibatan pelabur-pelabur asing membantu meningkkatkan ketidakcekapan. Usaha sama antara syarikat-syarikat swasta dan kerajaan berkecenderungan menjadi kurang cekap, dan kilang penapis di Semenanjung Malaysia memperlihatkan kurang kecekapan berbanding dengan kilang penapisan sawit di Sabah dan Sarawak. Ini berkemungkinan disebabkan oleh pengurangan cukai MSM di Sabah dan Sarawak yang membawa kepada pengurangan ketidakcekapan penapisan sawit pada tahun 2001 dan 2002

Secara ringkasnya, kajian ini menunjukkan bahawa ketidakcekapan dalam penapisan sawit Malaysia bagi 1996-2009 kebanyakannya mempunyai hubungkait dengan kapasiti gantian, yang menyebabkanpeningkatan hargaMSM atau menurunkan perbezaan harga MSM dan harga PPO

Selain itu, liberalisasi perdagangan mengakibatkan sedikit pengurangan dalam kuasa pasaran industri penapisan sawit Malaysia di pasaran dunia kerana enteran baru dan lebih kos pengeluaran yang menyebabkan persaingan industri penapisan sawit Malaysia.

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I certify that a Thesis Examination Committee has met on 25 September 2013 to conduct the final examination of Zahra Shahverdi on her thesis entitled "Efficiency and Competitiveness of Malaysian Processed Palm Oil Industry" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

_____

ZAHRA SHAHVERDI

Date:

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LIST OF ABBREVIATIONS

2SLS	Two Stage Least Squares
3SLS	Three Stage Least Squares
BCC	Banker, Charnes and Cooper
BLUE	Best Linear Unbiased Estimator
CCR	Charnes, Cooper and Rhodes
COLS	Corrected Ordinary Least Squares
CPI	Consumer Price Index
CPO	Crude Palm Oil
CRS	Constant Returns to Scale
DEA	Data Envelopment Analysis
DMU	Decision Making Unit
DOLS	Dynamic Ordinary Least Square
D-W test	Durbin-Watson test
EU	European Union
FP	Fractional Program
FTA	Free Trade Agreements
GDP	Gross Domestic Product
GNI	Gross National Income
K-B test	Koenker-Bassett test
KPSS	Kwiatkowski, Phillips, Schmidt, and Shin
K-S	Kolmogorov-Smirov
KWH	Kilo Watt Hour
LM test	Lagrange Multiplier test
LP	Linear Program
MC	Marginal Cost
MPE	Mean Percent Error
MPOB	Malaysia Palm Oil Board
MR	Marginal Revenue
MSE	Mean Simulation Error
OLS	Ordinary Least Squares

PFAD	Palm Fatty Acid Distillate
PPO	Processed Palm Oil
PPP	Purchasing Power Parity
PSO	Processed Soybean Oil
R&D	Research and development
RBD	Refined Bleached Deodorized
RBDPO	Refined Bleached Deodorized Palm Oil
RCA	Revealed Comparative Advantage
RM	Ringgit Malaysia
SBM	Slacks Based Measure
SCP	Structure- Conduct- Performance
SFA	Stochastic Frontier Analysis
SME	Small- Medium sized Enterprises
TOPS	Technically Optimal Productive Scale
UK	United Kingdom
UN	United Nations
US	United States
VRS	Variable Returns to Scale
WITS	World Integrated Trade Solution
WTO	World Trade Organization

CHAPTER 1

INTRODUCTION

1.1 Background of Study

The palm oil revenue is one of the important components in the Malaysian gross domestic product (GDP), since almost 4.7%[1] of GDP in 2010 was equivalent to the value of export of processed palm oil (PPO) products. Rasiah (2006) indicated that although it seems Malaysia has evolved from its dependence on tin and rubber to export-oriented electronics assembly manufacturing, the major pillar of Malaysia's industrialization is the palm oil industry. The rationality behind Rasiah's belief is that the entire value chains of palm oil firms are Malaysian based, while the electronic firms are dependent on the technology of overseas parent companies without the possibility of extending their value-added to higher segments.

The importance of the commodity has been reemphasized in the ninth Malaysian national plan based on more modern and commercial scale production of primary agro-based products. In this regard, the established oil palm and rubber subsectors have been characterized as being important for increasing diversification into high value-added downstream products. In addition, two main macroeconomic strategies have been

[1] It has been calculated based on data from the Malaysian Palm Oil Board (MPOB) and the CIA World Fact Book.

highlighted in the ninth Malaysia plan period (Ninth Malaysian Plan, 2005-2010) as follows:

1) Strengthening the competitiveness to sustain demand for Malaysian products and services;
2) Raising the efficiency of capital by increasing efficiency in the production process.

The revealed comparative advantage (RCA) is a well known indicator to compare the competitiveness of the exporters in the world market. Figure 1.1 shows the RCA[2] of main PPO producers and exporters in the world. Although the RCAs of the other world exporters than Malaysia and Indonesia are not too high, their positive RCA values show that they have competitive advantage. Some of them like the Netherlands, Germany and Thailand reflect an increasing RCA trend, so they can be considered as Malaysia's competitors. Malaysia's RCA shows a downward trend while Indonesia's RCA signifies an accelerating upward trend as it is more than Malaysia's RCA in 2006. Based on the RCA indicators, Malaysia has experienced a decline in its competitiveness in the world, especially in comparison with Indonesia.

[2] $RCA = (\frac{E_{ij}}{E_{it}})/(\frac{E_{nj}}{E_{nt}})$ where E: export value in US $, i: Country index, n: set of countries, j: commodity index, and t: set of commodities.

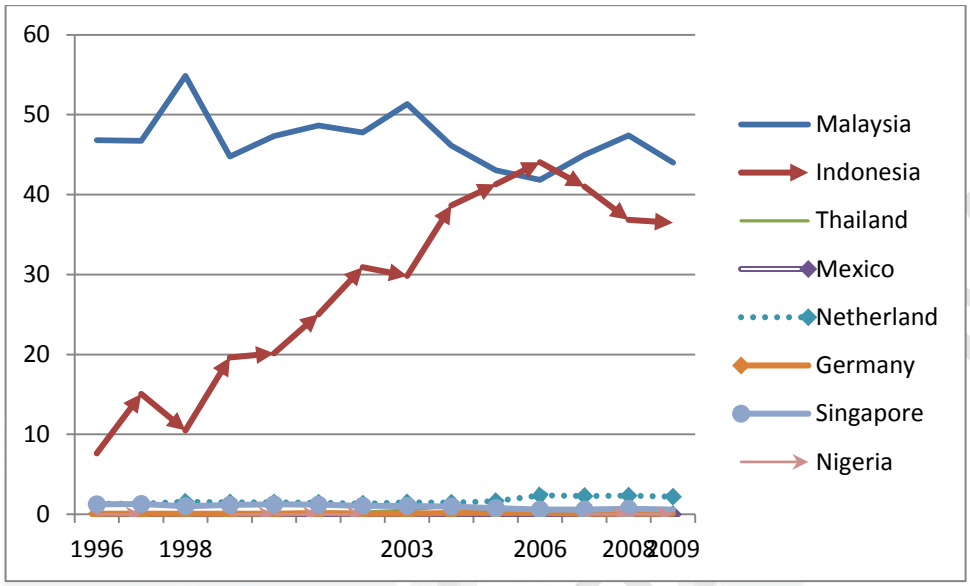

Figure 1.1. RCA of Main PPO Producers and Exporters (1996 to 2009)
Note: Graph has been drawn based on extracted data from UN-data website.

The considerable difference between CPO and PPO prices in the world market during the last decades, together with the Malaysian government incentive policies, paved a proper way for palm oil refining industry to progress in Malaysia. However, the price difference and government incentives (with exception of CPO export tax) have since been removed and as a result, the advantages of the capital intensive PPO industry are in doubt. Figure 1.2 shows changes in the real world weighted average prices of PPO and CPO during 1989 to 2009. These price changes show that the profit margin of the palm oil refineries has been reduced especially after 2001, when the preferential tariff treatment for soy bean oil was introduced. Prior to 2001, the oil world European Union (EU) premium price of soy oil over palm oil fluctuated around zero. As a result, palm oil exporters reduced palm oil prices to a level where it could compete with soy oil prices (Carter, Finley, Fry, Jackson, & Willis, 2007).

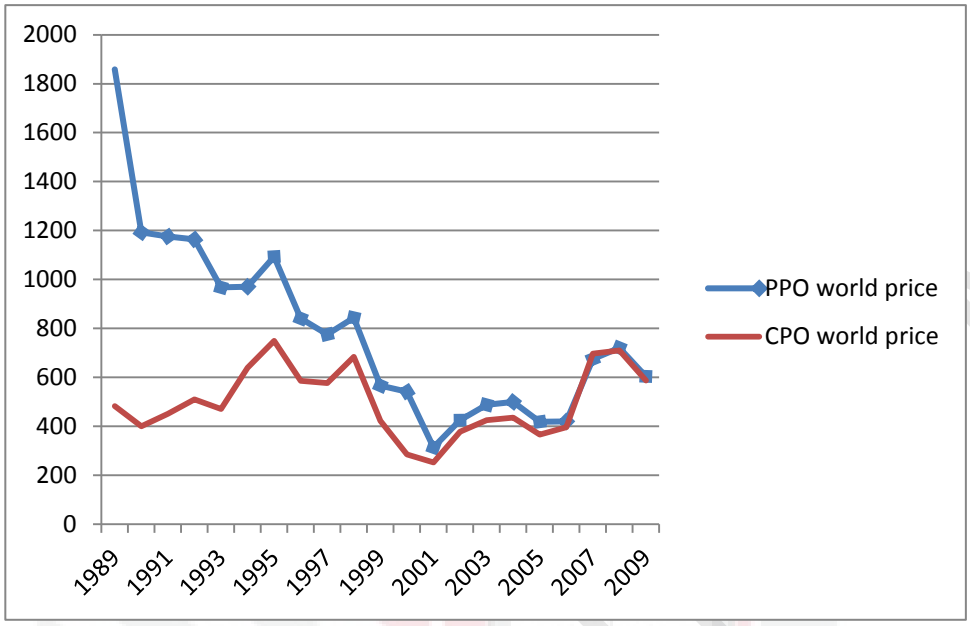

Figure 1.2. Real PPO and CPO World Price Changes (1989- 2009)
Note: Graph has been drawn based on extracted data from UN-data website.

Figure 1.3 shows the Malaysia PPO market share in the international market from 1989 to 2009. The figure shows that, although Malaysia is a dominant PPO exporter in the world, its share has been reduced considerably from 93% in 1989 to 54% in 2009, while the Indonesian PPO market share has increased significantly from less than one percent in 1989 to 35% in 2009, (UN-data). The reduction in Malaysian market share implies a reduction in the competitiveness of the Malaysian refineries in comparison with those of the Indonesian.

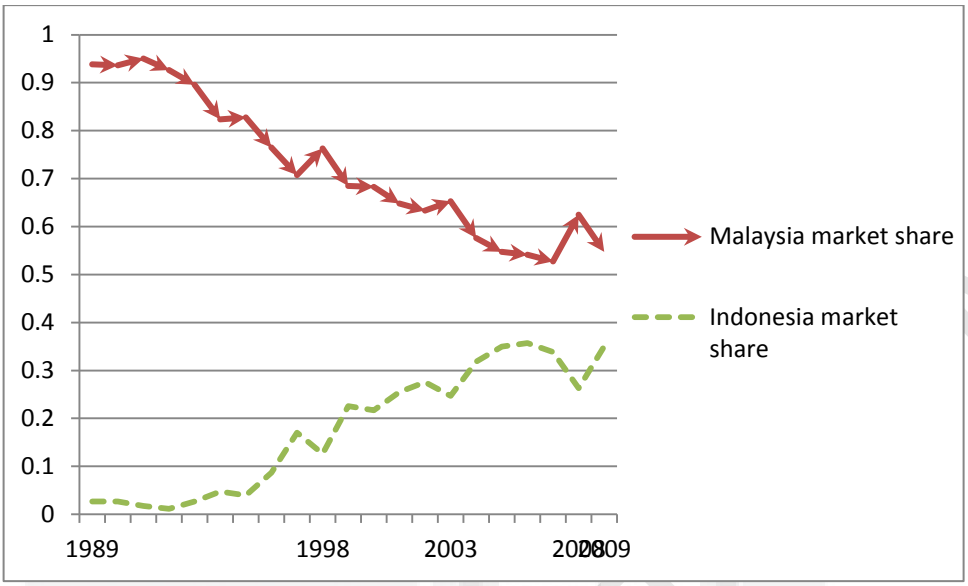

Figure 1.3. Malaysia and Indonesia PPO Market Share (1989-2009)
Note: Graph has been drawn based on extracted data from UN-data website.

The effect of trade liberalization on the refineries' competitiveness is also an important issue for consideration. Trade liberalization refers to limiting and eliminating governmental restrictions on trade between the nations. The trade liberalization process started in the early 1970s with its main objectives to reduce tariffs and eliminate non-tariff barriers as agreed by 102 countries in the Tokyo round of the world trade organization (WTO). Hence importance of such trade liberalization for the economic growth of the member countries was widely recognized.

Henceforth, refineries in Malaysia face zero import tariffs on crude palm oil (CPO) and PPO. However, it has only minor effect on the palm oil industry protection and the import tariff cut by the Malaysian government has very little significance. The other important aspects of trade liberalization in the Malaysian refining palm oil industry are the effects of CPO and PPO tariff reductions by the importing countries and export tax

reductions by Malaysia itself. Theoretically, it is expected that tariff reductions by CPO importing countries increase production costs of the Malaysian refineries through increases in the price of CPO in the world and domestic markets. Consequently, export tax reductions by Malaysia and PPO tariff reductions by PPO importing countries increase CPO demand. Hence, CPO demand growth causes further upward pressure on CPO prices. As a result, production costs for refineries increase due to trade liberalization. On the other hand, trade liberalization by PPO tariff reductions may have positive effect on refineries. Since PPO tariff reductions by importing countries would increase the PPO price and import demand in the world market refineries would benefit from the increased revenue. So trade liberalization on palm oil in the global market will have both positive and negative effects on Malaysian refineries' competitiveness in the world market.

It is well known that the global oils and fats markets are highly competitive, and the world market for CPO and PPO as a part of these competitive markets would be influenced by trade liberalization. For instance, Early, Early, and Straub (2005) indicated that export tax reduction on CPO reduces oil refining in Malaysia because of lack of the CPO in the domestic market since CPO producers tend to export more CPO.

Based on classical trade theory by Smith (1937), if one country produces a commodity more efficiently than the others, that country will benefit from international trade. Therefore, one way to increase the competitiveness of the PPO refineries in the world market is to increase their efficiency.

In recent years, some theoretical and empirical studies have been done by researchers on measurement of efficiency. Based on the data envelopment analysis (DEA) method, one way to promote efficiency in the refining sector of the palm oil industry is to introduce the efficient refineries as benchmarks. The efficiency of the inefficient firms can also be improved by encouraging managers to follow the efficient benchmark firms in applying inputs to produce each unit of production.

1.2 Problem Statement

Malaysian palm oil products are highly dependent on the stability of the world market because major share of the products are produced for export. In 2010, the value of PPO export is almost equivalent to 4.7 % of Malaysia GDP. Since trade liberalization is inevitable in the long run, its impact on the refineries' competitiveness in the world market will be one of the main future concerns of the country.

A study done by Ahmad & Tawang (1999) showed that reduction in CPO tariffs by importing countries would increase the price and export of Malaysian CPO. Similarly results were found in two other studies which are related to the effects of export tax reduction on PPO and CPO respectively(Shamsudin, Fatimah, & Fauziah, 1997; Talib, Jani, Mamat, & Zakaria, 2007). So far, as it has been mentioned in the background of this study, studies on the combined effects of CPO and PPO tariff reductions together with CPO tax reduction have not been done. Such effects could significantly highlight the strengths and weaknesses of the sector to show whether the palm oil refining sector could deal with tougher current and future competition in the world market.

Although Malaysia is currently the dominant producer and exporter of PPO in the world with an increasing export trend, there are some concerns regarding the competitiveness of this Malaysian industry in the world market. Indicated by the RCA shown in Figure 1.3 during the period of 1989 to 2009; the competitiveness of the Malaysian refineries in the world has decreased considerably. Since most of the refineries in Malaysia have their own CPO mills, the reduction in the difference between CPO and PPO prices may have made them indifferent between exporting the CPO or PPO to the world market. In certain instances the palm oil producers of both CPO and PPO may prefer to export CPO instead of PPO to prevent more cost on refining process. This would certainly bring about under capacity utilization of the refineries and consequently more inefficiency will occur. Furthermore reduction in PPO market share of Malaysia comparing to Indonesia shows that its competitiveness in the region has decreased. Downward trend in Malaysia market share shows reduction in its competitiveness and it could be due to reduction in efficiency of refineries. In 2010, production of CPO was nearly 17 million tons, of which 2.7 million tons were exported while the total refining capacity for the year was 22.8 million tons and CPO import to compensate underutilized capacity was not considerable. It shows that the refineries are working well below available capacity. This problem has also been highlighted by Jalil (1996). Under such situation inefficiency and reduction in competitiveness of the industry due to misallocation of available resources occur.

Based on previous studies of the palm oil industry in Malaysia, Bushara (2001) found out that there has been a low degree of technical and allocative efficiency throughout the

palm oil industry including the refining sector from 1985 to 1993. Thus, one of the main issues that need to be addressed is the inefficiency of the industry that has long been a problem in the palm oil refining sector.

The next important factors related to the inefficient performance of the refineries are vertical integration, ownership, experience (length of establishment), foreign investment, location and liberalization due to CPO export tax cut.

Since integrated refineries can purchase CPO at prices cheaper than spot market prices because they are not forced to pay premium prices as in the spot market production costs can be reduced. Furthermore overhead costs could be shared through the production chain, (Jalil, 1996). Based on these reasons, it would be interesting to know if the integrated refineries have a lower degree of inefficiency than the non-integrated ones.

The effect of ownership on inefficiency in the Malaysian refining industry is also important to look at. In the past decades, the role of the Malaysian government in managing some of the refineries was considerable. During the 1990s the government started privatization process of the refineries. Currently, some of these refineries are completely private and in some of them still have the government interest of about 35% share.

The experience of the refineries based on the year of their establishment varies from less than five years to more than 40 years in Malaysia. Therefore the different level of efficiency is expected to exist among these refineries. Besides, the refineries in Malaysia

are either local or both foreign and local owned. This fact does have some bearing on quality of the management and decision-making thus this also brings about differences in terms of inefficiency levels among the refineries.

The geographical location of Sabah and Sarawak (East Malaysia) can also highlight the inefficiency level and competitiveness of the refineries relative to those in peninsular Malaysia. According to their access to the market and having the wide boundary with Indonesia to compensate for CPO shortage in the Malaysia domestic market can also show different levels of the performance. In 2001 and 2002, the Malaysian government temporarily lifted the CPO export tax in Sabah and Sarawak. This could be considered as tariff liberalization. However it is still not known to what extent such steps could have contributed towards the increase in performance of the refineries located over there.

1.3 Objectives of Study

The general objective of the study is to investigate the performance of the refining sector of the palm oil industry through a well-designed structure to assess the refineries' efficiency using DEA approach. The study will also compare the refineries' inefficiencies based on the integration level, experience, liberalization, type of investor (local/ foreigner) , location and ownership. Furthermore, the effect of trade liberalization on refineries and its impact on refinery competitiveness is another important factor that will be considered.

The specific objectives of the study can be described in three parts as follows:

1) to determine the technical, allocative and cost efficiency of the Malaysian palm oil refining sector.
2) to investigate the effect of the six different factors namely; integration, ownership, location, liberalization, length of establishment and foreign and local investment and trade liberalization due to CPO export tax cut by Malaysia on the inefficiency of the industry.
3) to assess the competitiveness of the sector resulting from trade liberalization in respect to CPO and PPO tariff reduction by importers together with CPO export tax cut by Malaysia.

1.4 Significance of Study

In a competitive industry like palm oil and palm oil products, a firm's survival depends on its efficiency and optimized performance especially after trade liberalization.

By providing insight and information based on this study, refinery managers would first be able to assess their production efficiency versus their local competitors and poorly managed refineries become better managed firms. Second, Investigating the effect of different factors on inefficiency of the refineries could help policy makers to be able to encourage the refineries to move toward the best structures based on the demonstrated effects found for these factors by applying proper policies. Furthermore, Malaysian industry sustainability in a world market encountering trade liberalization will be highlighted.

1.5 Organization of Study

Chapter 2 reviews the Malaysia PPO world market structure. Chapter 3 provides a theoretical background for measuring efficiency, followed by a literature review on efficiency measures, DEA and stochastic frontier analysis (SFA) as different methods of assessing efficiency. The definition of trade liberalization in this market and its effects will also be discussed.

In Chapter 4, the methodology that formulates the DEA model would be explained. Then statistical hypotheses would be applied to compare the inefficiency of refineries according to some factors that can affect the level of inefficiency. A market power model will be used to estimate the effects of trade liberalization on competitiveness of the Malaysian refining industry in the world market. The data collection procedure for the study will be also explained.

In Chapter 5 consists of data analysis of the technical efficiency and to compare the refineries' inefficiency and assess the actual effects of trade liberalization. Chapter 6 provides a summary of the results, conclusions, contribution and policy implications of the study.

BIBLIOGRAPHY

Adams, F. G. (1978). Implementation of commodity market theory in empirical econometric models. In *Econometric modelling of world commodity policy* (pp. 47-70). Lexington: Lexington Books.

Ahmad, T. M. A. T., & Tawang, A. (1999). Effects of trade liberalization on agriculture in Malaysia: commodity aspects. *Working Papers*.

Ahn, T., Charnes, A., & Cooper, W. W. (1988). Efficiency characterizations in different DEA models. *Socio-Economic Planning Sciences*, *22*(6), 253-257.

Aigner, D., Lovell, C. A., & Schmidt, P. (1977). Formulation and estimation of stochastic frontier production function models. *Journal of econometrics*, *6*(1), 21-37.

Amin, A. M. (2007). *Evaluation of Competitiveness of the Indonesian Food Manufacturing Industry.* PhD Thesis. Universiti Putra Malaysia.

Amiruddin, M. N. (2003). Palm oil products exports, prices and export duties: Malaysia and Indonesia compared. *Oil Palm Industry Economic Journal*, *3*(2), 15-20.

Andersen, P., & Petersen, N. C. (1993). A procedure for ranking efficient units in data envelopment analysis. *Management science*, 1261-1264.

Arasan, J., & Lunn, M. (2008). Alternative interval estimation for parameters of bivariate exponential model with time varying covariate. *Computational Statistics*, *23*(4), 605-622.

Azzam, A. M. (1997). Measuring Market Power and Cost-efficiency Effects of Industrial Concentration. *The Journal of Industrial Economics*, *45*(4), 377-386.

Balakrishnan, P., Parameswaran, M., Pushpangadan, K., & Babu, M. S. (2006). Liberalization, Market Power, and Productivity Growth in Indian Industry. *The Journal of Policy Reform*, *9*(1), 55-73.

Ballestero, E., & Maldonado, J. A. (2004). Objective measurement of efficiency: applying single price model to rank hospital activities. *Computers & Operations Research*, *31*(4), 515-532.

Bangun, D. *INDONESIAN PALM OIL INDUSTRY*. Paper presented at the National Institute of Oilseed Products Annual Convention, Arizona, U.S.A., March 21-25, 2006.

Banker, R. D. (1993). Maximum likelihood, consistency and data envelopment analysis: a statistical foundation. *Management science*, 1265-1273.

Banker, R. D., & Chang, H. (1995). A simulation study of hypothesis tests for differences in efficiencies. *International Journal of Production Economics, 39*(1), 37-54.

Banker, R. D., & Chang, H. (2006). The super-efficiency procedure for outlier identification, not for ranking efficient units. *European journal of operational research, 175*(2), 1311-1320.

Banker, R. D., Charnes, A., & Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management science*, 1078-1092.

Banker, R. D., Das, S., & Datar, S. M. (1989). Analysis of cost variances for management control in hospitals. *Research in Governmental and Nonprofit Accounting, 5*(1989), 269-291.

Banker, R. D., & Gifford, J. L. (1988). A relative efficiency model for the evaluation of public health nurse productivity. School of Urban and Public Affairs: Carnegie Mellon University.

Banker, R. D., Janakiraman, S., & Natarajan, R. (2004). Analysis of trends in technical and allocative efficiency: An application to Texas public school districts. *European journal of operational research, 154*(2), 477-491.

Basiron, Y. (2005). Palm oil. In *Bailey's Industrial Oil and Fat Products* (sixth ed.): John Wiley & Sons, Inc.

Battese, G. E., & Coelli, T. J. (1988). Prediction of firm-level technical efficiencies with a generalized frontier production function and panel data. *Journal of econometrics, 38*(3), 387-399.

Battese, G. E., & Coelli, T. J. (1992). Frontier production functions, technical efficiency and panel data: with application to paddy farmers in India. *Journal of Productivity Analysis, 3*(1), 153-169.

Battese, G. E., Coelli, T. J., Colby, T. C., & University of New England. Dept. of, E. (1989). *Estimation of frontier production functions and the efficiencies of Indian farms using panel data from ICRISAT's village level studies*: Department of Econometrics, University of New England.

Blackorby, C., & Russell, R. R. (1999). Aggregation of efficiency indices. *Journal of Productivity Analysis, 12*(1), 5-20.

Bosetti, V., Cassinelli, M., & Lanza, A. *Using data envelopment analysis to evaluate environmentally conscious tourism management*. Paper presented at the conference Tourism and Sustainable Development- Macro and Micro Economic Issues, Chia, Italy, September 19-20, 2003.

Boussofiane, A., Martin, S., & Parker, D. (1997). The impact on technical efficiency of the UK privatization programme. *Applied Economics, 29*(3), 297-310.

Bresnahan, T. F. (1982). The oligopoly solution concept is identified. *Economics Letters, 10*(1), 87-92.

Buschena, D. E., & Perloff, J. M. (1991). The creation of dominant firm market power in the coconut oil export market. *American Journal of Agricultural Economics, 73*(4), 1000-1008.

Bushara, M. O. A. (2001). *Economic Efficiency of Malaysian Oleochemical Enterprises.* PhD Thesis, Universiti Puta Malaysia.

Carlton, D. W., & Perloff, J. M. (2000). *Modem industrial organization* (3 ed.): Addison- wesley.

Carter, C., Finley, W., Fry, J., Jackson, D., & Willis, L. (2007). Palm oil markets and future supply. *European Journal of Lipid Science and Technology, 109*(4), 307-314.

Chalil, D., & Ahmadi-Esfahani, F. *Modelling market power in the Indonesian palm oil industry*. Paper presented at the AARES 49th Annual Conference of the Australian Agricultural and Resource Economics Society, Coffs Harbour. February 2005.

Chandra, P., Cooper, W. W., Li, S., & Rahman, A. (1998). Using DEA To evaluate 29 Canadian textile companies-Considering returns to scale. *International Journal of Production Economics, 54*(2), 129-141.

Charnes, A., & Cooper, W. W. (1962). Programming with linear fractional functionals. *Naval Research logistics quarterly, 9*(3â€4), 181-186.

Charnes, A., Cooper, W. W., Lewin, A. Y., & Seiford, L. M. (1994). *Data envelopment analysis: methodology, and application*. Boston: Kluwer Academic publishers.

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European journal of operational research, 2*(6), 429-444.

Chen, Y., Du, J., David Sherman, H., & Zhu, J. (2010). DEA model with shared resources and efficiency decomposition. *European Journal of Operational Research, 207*(1), 339-349.

Coccorese, P. (2009). Market power in local banking monopolies. *Journal of Banking & Finance, 33*(7), 1196-1210.

Coelli, T., & Perelman, S. (2000). Technical efficiency of European railways: a distance function approach. *Applied Economics, 32*(15), 1967-1976.

Coelli, T. J., Rao, D. S., O'Donnell, C. J., & Battese, G. E. (2002). *An Introduction to Efficiency and Productivity Analysis* (2 ed.). New York, New Jersey. : Springer.

Cook, W. D., & Seiford, L. M. (2009). Data envelopment analysis (DEA)-Thirty years on. *European journal of operational research, 192*(1), 1-17.

Cooper, W. W., Huang, Z., Li, S. X., Parker, B. R., & Pastor, J. T. (2007). Efficiency aggregation with enhanced Russell measures in data envelopment analysis. *Socio-Economic Planning Sciences, 41*(1), 1-21.

Cooper, W. W., Seiford, L., & Tone, K. (2000). *Data Envelopment Analysis: a Comprehensive Text with Models, Applications, References and DEA solver software.* Norwell, MA: Kluwer Academic Publishers.

Cooper, W. W., Seiford, L. M., & Tone, K. (2006). *Introduction to data envelopment analysis and its uses: with DEA-solver software and references*. university of Texas: Springer Verlag.

Cullinane, K., Ji, P., & Wang, T. (2005). The relationship between privatization and DEA estimates of efficiency in the container port industry. *Journal of Economics and Business, 57*(5), 433-462.

Debreu, G. (1951). The coefficient of resource utilization. *Econometrica: Journal of the Econometric Society*, 273-292.

Delis, M. D., & Tsionas, E. G. (2009). The joint estimation of bank-level market power and efficiency. *Journal of Banking & Finance, 33*(10), 1842-1850.

Diaz-Balteiro, L., Casimiro Herruzo, A., Martinez, M., & Gonzalez-Pachon, J. (2006). An analysis of productive efficiency and innovation activity using DEA: An application to Spain's wood-based industry. *Forest Policy and Economics, 8*(7), 762-773.

Dios-Palomares, R., & MartÃnez-Paz, J. M. (2011). Technical, quality and environmental efficiency of the olive oil industry. *Food Policy, 36*(4), 526-534.

Durevall, D. (2007). Demand for coffee in Sweden: The role of prices, preferences and market power. *Food Policy, 32*(5), 566-584.

Early, J., Early, T., & Straub, M. (2005). Specific Environmental Effects of Trade Liberalisation: Oilseeds. *IPC Issue Brief*(16).

Emrouznejad, A., Parker, B. R., & Tavares, G. (2008). Evaluation of research in efficiency and productivity: A survey and analysis of the first 30 years of scholarly literature in DEA. *Socio-Economic Planning Sciences, 42*(3), 151-157.

Ernawati. (2004). *Trade Libralization Impact on the Ondonesian Palm Oil Industry.* PhD Thesis, Universiti Putra Malaysia.

Fang, H., Wu, J., & Zeng, C. (2009). Comparative study on efficiency performance of listed coal mining companies in China and the US. *Energy Policy, 37*(12), 5140-5148.

Fare, R. (1988). *Fundamentals of production theory*. New York: Springer-Verlag Berlin.

Fare, R., Grosskopf, S., & Lovell, C. A. K. (1985). *The measurement of efficiency of production*. Boston: Kluwer Academic publishers.

Fare, R., Grosskopf, S., & Lovell, C. A. K. (1994). *Production frontiers*. UK: Cambridge Univercity Press.

Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society. Series A (General), 120*(3), 253-290.

Farsi, M., & Filippini, M. (2009). An analysis of cost efficiency in Swiss multi-utilities. *Energy Economics, 31*(2), 306-315.

Felthoven, R. G. (2001). *The measurement of Capacity Utilization, and Economic Performance: An application to North Pacific Ground fish Fisheries.* PhD Thesis, University of California.

Fold, N. (2000). Oiling the palms: restructuring of settlement schemes in Malaysia and the new international trade regulations. *World Development, 28*(3), 473-486.

Geske Dijkstra, A. (2000). Trade liberalization and industrial development in Latin America. *World Development, 28*(9), 1567-1582.

Globerman, S. (1990). Trade liberalization and competitive behavior: A note assessing the evidence and the public policy implications. *Journal of Policy Analysis and Management, 9*(1), 80-88.

Goldstein, N. (2007). *Globalization and Free Trade*. New York: Infobase Publishing.

Greene, W. H. (1997). *Econometric Analysis*. New Jersey: Prentice Hall.

Griffiths, R. (2001). *Product market competition, efficiency and agency costs: an empirical analysis*. London: Institute for Fiscal Studies.

Gujarati, D. N., & Porter, D. C. (2009). *Basic Econometric* (5 ed.). New York: The McGraw-hill.

Haddad, M. (1993). *How trade liberalization affected productivity in Morocco*: World Bank Publications.

Hadi, S. (2004). *Comparative Analysis of the Competitiveness of the Indonesian and Malaysian Palm Oil Industry.* PhD Thesis. Universiti Putra Malaysia.

Harrison, A. (1996). Openness and growth: A time-series, cross-country analysis for developing countries. *Journal of Development Economics, 48*(2), 419-447.

Hasnah, Fleming, E., & Coelli, T. (2004). Assessing the performance of a nucleus estate and smallholder scheme for oil palm production in West Sumatra: a stochastic frontier analysis. *Agricultural Systems, 79*(1), 17-30.

Hassan, M. K., Isik, I., & Mamun, A. (2010). Trade liberalization and industry performance in Bangladesh. *Journal of Policy Modeling, 32*(3), 399-417.

He, H., & Weng, Q. (2012). Ownership, Autonomy, Incentives and Efficiency: Evidence from the Forest Product Processing Industry in China. *Journal of forest economics*, doi:10.1016/j.jfe.2012.1002.1001.

Hicks, J. R. (1935). Annual survey of economic theory: The theory of monopoly. *Econometrica: Journal of the Econometric Society*, 1-20.

Horn, H., Lang, H., & Lundgren, S. (1994). Competition, long run contracts and internal inefficiencies in firms. *European Economic Review, 38*(2), 213-233.

Hyde, C. E., & Perloff, J. M. (1998). Multimarket market power estimation: the Australian retail meat sector. *Applied Economics, 30*(9), 1169-1176.

Iwata, G. (1974). Measurement of conjectural variations in oligopoly. *Econometrica: Journal of the Econometric Society*, 947-966.

Jalil, S. H. A. (1996). *Capacity Utilization in the Malaysian Palm Oil Refining Industry.* PhD Thesis, Universiti Putra Malaysia.

Just, R. E., & Chern, W. S. (1980). Tomatoes, technology, and oligopsony. *The Bell Journal of Economics*, 584-602.

Kang, C. C. (2010). Liberalization policy, production and cost efficiency in Taiwan's telecommunications industry. *Telematics and Informatics, 27*(1), 79-89.

Kao, C., & Hwang, S. N. (2008). Efficiency decomposition in two-stage data envelopment analysis: An application to non-life insurance companies in Taiwan. *European journal of operational research, 185*(1), 418-429.

Kehinde, A. L., Awoyemi, T. T., Omonona, B. T., & Akande, J. A. (2010). Technical efficiency of sawnwood production in Ondo and Osun states, Nigeria. *Journal of forest economics, 16*(1), 11-18.

Kennedy, P. L., & Rosson, C. P. (2002). Impacts of globalization on agricultural competitiveness: The case of NAFTA. *Journal of Agricultural and Applied Economics, 34*(02).

Kim, E. (2000). Trade liberalization and productivity growth in Korean manufacturing industries: price protection, market power, and scale efficiency. *Journal of Development Economics, 62*(1), 55-83.

Kirjavainen, T., & Loikkanent, H. A. (1998). Efficiency differences of Finnish senior secondary schools: an application of DEA and Tobit analysis. *Economics of Education Review, 17*(4), 377-394.

Koopman, T. C. (1951). *Activity Analysis of Production and Allocation*. New York: Wiley.

Kumbhakar, S. C. (1990). Production frontiers, panel data, and time-varying technical inefficiency. *Journal of econometrics, 46*(1-2), 201-211.

Lai, Y.-H. (2004). *Efficiency of Taiwanese Laptop Manufacturers.* PhD Thesis. Lynn University.

Lau, L. J. (1982). On identifying the degree of competitiveness from industry price and output data. *Economics Letters, 10*(1-2), 93-99.

Lee, C. C. (2009). Analysis of overall technical efficiency, pure technical efficiency and scale efficiency in the medium-sized audit firms. *Expert Systems with Applications, 36*(8), 11156-11171.

Lindquist, K. G. (2001). The response by the Norwegian aluminium industry to changing market structure. *International journal of industrial organization, 19*(1), 79-98.

Liu, S. T., & Wang, R. T. (2009). Efficiency measures of PCB manufacturing firms using relational two-stage data envelopment analysis. *Expert Systems with Applications, 36*(3), 4935-4939.

Lopez, G. P., Laan, T., International Institute for Sustainable, D., & International Institute for Sustainable Development. Global Subsidies, I. (2008). *Biofuels, at what Cost?: Government Support for Biodiesel in Malaysia*: International Institute for Sustainable Development.

Lopez, R. A., Azzam, A. M., & Liron-Espana, C. (2002). Market power and/or efficiency: A structural approach. *Review of Industrial Organization, 20*(2), 115-126.

Lovell, C. A. K. (1993). Production Frontiers and Productive Efficiency. In H. O. Fried, C. A. K. Lovell & S. S. Schmidt (Eds.), *The measurement of productive efficiency: techniques and applications* (pp. 3-67). New York: Oxford University Press.

Lozano, S., & Villa, G. (2010). Gradual technical and scale efficiency improvement in DEA. *Annals of Operations Research, 173*(1), 123-136.

Ma, J., Evans, D. G., Fuller, R. J., & Stewart, D. F. (2002). Technical efficiency and productivity change of China's iron and steel industry. *International Journal of Production Economics, 76*(3), 293-312.

Mansson, J. (2004). Vertical integration and efficiency: Ownership in the Swedish sawmill Industry. *Review of Industrial Organization, 24*(1), 25-36.

Margaritis, D., & Psillaki, M. (2010). Capital structure, equity ownership and firm performance. *Journal of Banking & Finance, 34*(3), 621-632.

Martin, S. (1988). Market power and/or efficiency? *The review of Economics and Statistics*, 331-335.

Movshuk, O. (2004). Restructuring, productivity and technical efficiency in China's iron and steel industry, 1988-2000. *Journal of Asian Economics, 15*(1), 135-151.

MPOB. Malaysian Palm Oil Board website, Official reports 2003 & 2008 & 2009. Retrieved April 2012, from http://www. mpob. gov. my.

Neary, J. P. (2006). Measuring competitiveness. *Economic and Social review, 37*(2), 197.

Ninth Malaysian Plan (2005-2010). Retrieved May 2012, from /http://www. epu. jpm. my/rm9/html/english. htmS.

Onut, S., & Soner, S. (2007). Analysis of energy use and efficiency in Turkish manufacturing sector SMEs. *Energy conversion and management, 48*(2), 384-394.

Peltzman, S. (1977). The gains and losses from industrial concentration. *Journal of Law and Economics, 20*(2), 229-263.

Perloff, J. M., & Shen, E. Z. (2012). Collinearity in linear structural models of market power. *Review of Industrial Organization*, 1-8.

Pilat, D. (1996). Competition, productivity and efficiency. *OECD Economic Studies, 27*(2), 107-146.

Pindyck, R. S., & Rubinfeld, D. L. (1998). *Econometric Models and Economic Forecasts*. Boston: IrwinrMcGraw- Hill.

Pletcher, J. (1991). Regulation with growth: the political economy of palm oil in Malaysia. *World Development, 19*(6), 623-636.

Porter, M. E. (1990). *The competitive advantage of nations*. London: Macmillan.

Prior, D. (2003). Long-and short-run non-parametric cost frontier efficiency: An application to Spanish savings banks. *Journal of Banking & Finance, 27*(4), 655-671.

Radam, A. (2007). *Efficiency and productivity of Malaysian Food Manufacturing Industry 1983-2000.* PhD Thesis. Universiti Putra Malaysia.

Radam, A., Abu, M., & Abdullah, A. M. (2008). Technical efficiency of small and medium enterprise in Malaysia: A stochastic frontier production model. *Journal of Economics and Management, 2*(2), 395-408.

Rasiah, R. (2006). Explaining Malaysia's Export Expansion in Palm Oil and Related Products. In *Technology, Adaptation, and Exports: How Some Developing Countries Got It Right* (pp. 163-192).

Sahinler, S., & Topuz, D. (2007). Bootstrap and jackknife resampling algorithms for estimation of regression parameters. *Journal of Applied Quantitative Methods, 2*(2), 188-199.

Salvatore, D. (2004). *International Economics* (8 ed.). New York: John Wiley & Sons.

Seiford, L. M., & Zhu, J. (1999). Profitability and marketability of the top 55 US commercial banks. *Management science*, 1270-1288.

Setiawan, M., Emvalomatis, G., & Oude Lansink, A. (2012). The relationship between technical efficiency and industrial concentration: Evidence from the Indonesian food and beverages industry. *Journal of Asian Economics*.

Sexton, T. R., & Lewis, H. F. (2003). Two-stage DEA: an application to major league baseball. *Journal of Productivity Analysis, 19*(2), 227-249.

Shamsudin, M. N., Fatimah, M. A., & Fauziah, A. B. U. H. (1997). The effect of export duty liberalization on the Malaysian palm oil industry. *Faculty of Economics and Management, University Putra Malaysia, Serdang, Selangor, Malaysia*.

Shao, J., & Tu, D. (1995). *The Jackknife and Bootstrap*. New York: Springer-Verlag.

Shephard, R. W., Gale, D., & Kuhn, H. W. (1970). *Theory of cost and production functions*: Princeton University Press Princeton.

Sinner, J. (2002). Addressing Competitiveness Impacts of Climate Change Policies. *Report to Ministry of Economic Development, Government of New Zealand, New Zealand*.

Smith, A. (Ed.). (1937). *The Wealth of Nations (1776)*: New York: Modern Library.

Staub, R. B., Da Silva E Souza, G., & Tabak, B. M. (2010). Evolution of bank efficiency in Brazil: A DEA approach. *European journal of operational research, 202*(1), 204-213.

Steen, F., & Salvanes, K. G. (1999). Testing for market power using a dynamic oligopoly model. *International journal of industrial organization, 17*(2), 147-177.

Stock, J. H., & Watson, M. W. (1993). A simple estimator of cointegrating vectors in higher order integrated systems. *Econometrica: Journal of the Econometric Society*, 783-820.

Talib, B. A., Jani, M. F. M., Mamat, M. N., & Zakaria, R. (2007). Impact Assessment of Liberalizing Trade on Malaysian Crude Palm Oil. *Oil Palm Industry Economic Journal, 7*(1), 9-17.

Tamaschke, R., Docwra, G., & Stillman, R. (2005). Measuring market power in electricity generation: A long-term perspective using a programming model. *Energy Economics, 27*(2), 317-335.

Tang, J., & Wang, W. (2005). Product market competition, skill shortages and productivity: evidence from Canadian manufacturing firms. *Journal of Productivity Analysis, 23*(3), 317-339.

Tanski, J. M., & French, D. W. (2001). Capital Concentration and Market Power in Mexico's Manufacturing Industry: Has Trade Liberalization Made a Difference? *Journal of Economic Issues*, 675-711.

Tita, A. (1998). Globalization: a new political and economic space requiring supranational governance. *Journal of World Trade, 32*, 47-56.

Todaro, M. P. (1989). *Economic Development* (4 ed.). London: Longman.

Tone, K. (1997). *DEA with Controllable Category Levels.* Paper presented at the National Conference of the Operations Research Society of Japan, Japan, 126-127.

Tone, K. (2001). On returns to scale under weight restrictions in data envelopment analysis. *Journal of Productivity Analysis, 16*(1), 31-47.

Tongzon, J., & Heng, W. (2005). Port privatization, efficiency and competitiveness: Some empirical evidence from container ports (terminals). *Transportation Research Part A: Policy and Practice, 39*(5), 405-424.

Tybout, J., De Melo, J., & Corbo, V. (1991). The effects of trade reforms on scale and technical efficiency:: New evidence from Chile. *Journal of International Economics, 31*(3-4), 231-250.

Tybout, J. R., & Westbrook, M. D. (1995). Trade liberalization and the dimensions of efficiency change in Mexican manufacturing industries. *Journal of International Economics, 39*(1), 53-78.

UN-data. United Nations website. Retrieved August 2011, from http://data.un.org/Explorer.aspx?d=ComTrade

World. World Bank website. Retrieved August 2011, from http://data.worldbank.org/indicator

WTIS. World Integrated Trade Solution website. Retrieved August 2011, from http://wits. worldbank. org/WITS

Wu, Z. B., Yeung, G., Mok, V., & Han, Z. (2007). Firm-specific knowledge and technical efficiency of watch and clock manufacturing firms in China. *International Journal of Production Economics, 107*(2), 317-332.

Yang, J. C. (2006). The efficiency of SMEs in the global market: Measuring the Korean performance. *Journal of Policy Modeling, 28*(8), 861-876.

Yang, S. P. (2005). Market power and cost efficiency: the case of the US aluminum industry. *Resources Policy*, *30*(2), 101-106.

Zhu, J. (2000). Multi-factor performance measure model with an application to Fortune 500 companies. *European journal of operational research*, *123*(1), 105-124.