



UNIVERSITI PUTRA MALAYSIA

**ECONOMETRIC FORECASTING MODELS FOR
SHORT TERM NATURAL RUBBER PRICES**

**AYE AYE KHIN
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**ECONOMETRIC FORECASTING MODELS FOR
SHORT TERM NATURAL RUBBER PRICES**

By

AYE AYE KHIN

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

February 2010



Dedication

To

**My parents, sisters, brothers, husband and son
for their love and support**



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

**ECONOMETRIC FORECASTING MODELS FOR SHORT TERM
NATURAL RUBBER PRICES**

By

Aye Aye Khin

February 2010

Chairman: Associate Professor Dr. Eddie Chiew Fook Chong, PhD

Faculty: Agriculture

This study presents a number of short-term *ex-post* forecasts of single equation model, Multivariate Autoregressive Moving Average (MARMA) model, simultaneous supply-demand and price system equation model, and Autoregressive Integrated Moving Average (ARIMA) model, and ARCH-type models of natural rubber (NR) SMR20 (Standard Malaysia Rubber of grade 20) prices in the world NR market. The ARCH-type models (Autoregressive Conditional Heteroskedasticity) used include the GARCH (1,1) (Generalized ARCH) model, EGARCH (1,1) (The Exponential GARCH) model, PARCH (1,1) (The Power ARCH) and CGARCH (1,1) (The Component GARCH) model. These were developed for *ex-post* forecast of short-term monthly SMR20 prices in the world NR market.

Natural rubber is a vital commodity used in the manufacture of a wide range of rubber-based products. Over 20 million families are dependent on rubber cultivation for their livelihood in the world NR market. The years 1997 to 1999 and as well as in the year 2000 were turbulent years for the economies in South-East and East Asia. In 2008, the



extremely low prices due to the outbreak of the global recession. It experienced during these years contributed to price volatility and instability in many countries, especially rubber smallholders in South East Asia. Moreover, the crude petroleum oil price is an important component of synthetic rubber. A fall in the crude petroleum oil price relates to synthetic rubber. It influences a declining share of synthetic rubber in total rubber consumption, and also a weak currency exchange affects in the NR producing countries because most commodities are traded in US dollar. This could be a good reason for taking the current NR price forecasting study. It would be also a direction of short term NR price movement for policy formulation. Furthermore, the conceptual economic framework of this study was a good starting point for discussion and perceptive of short-term *ex-post* forecast of NR price forecasting models developed, with the opportunity of using some of these factors later in the other study for the forecasting of rubber prices.

The model specifications were developed in order to discover the inter-relationships between NR production, consumption and prices of SMR20, to forecast the NR price of SMR20 using single equation model, MARMA model, simultaneous system equation of supply-demand and price forecasting model, ARIMA model, and ARCH-type models, to analyze and compare the various NR price forecasting models individually in terms of their comparative price forecasting accuracy and to determine which between the models are more efficient. The models were utilized using monthly data from January 1990 to December 2008 as estimation period, providing a total of 228 observations and data was used as an *ex-post forecasts*. All data (variables) were tested for unit root test using the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test and were found to be stationary at first difference. The Granger causality test was tested for the direction of a Granger causality relationship between two variables.



Based on these forecasts, world natural rubber price (SMR20) is solved dynamically for *ex-post* forecasts and estimated to decrease to around USD 1386.43 per MT in December 2008, a decrease of 60.7 percent from July 2008 with USD 3530.96 per MT. The values of the forecasting accuracy of the Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Root Mean Percent Error (RMPE), Theil's Inequality Coefficients (U) criteria and Akaike Information Criterion (AIC) and Schwarz Bayesian Information Criterion (SC) of simultaneous supply-demand and price system equation model were comparatively smaller than the values generated by single equation model, MARMA model and ARIMA model, and ARCH-type models. These statistics suggested that the forecasting performance of the simultaneous supply-demand and price system equation model was more efficient than single equation model, MARMA model and ARIMA model, and ARCH-type models for *ex-post forecast* in estimating the price of SMR20 in the next 6 months or so in the world NR market.

If the growth of the global economy, especially in developed countries and large developing countries continues to be stable, over the forecasting periods, further strengthening of natural rubber price would be expected. Comparative *ex-post* and *ex-ante* forecasts of NR prices and determination of *long-term* and *short-term* forecasts of NR supply, demand and prices using the various forecasting models which were not attempted for this study, could also be potentially beneficial for future work. Significantly, short-term *ex-post* forecast of NR price forecasting generated from the single equation model, MARMA model, simultaneous supply-demand and price system equation model, and ARIMA model, and ARCH-type models developed in this study could be provided a useful test of the validity of the model and also beneficial to producers and consumers as well as traders and planners for policy analysis in the world NR market.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doctor of Philosophy.

**MODEL EKONOMETRIK UNTUK RAMALAN HARGA BAGI GETAH
ASLI DALAM JANGKA MASA PENDEK**

Oleh

Aye Aye Khin

Februari 2010

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Kajian ini membentangkan sejumlah ramalan ex-post jangka pendek bagi model satu tempoh, model Multivariate Autoregressive Moving Average (MARMA), serentak model bekalan permintaan dan persamaan sistem harga, dan model Autoregressive Integrated Moving Average (ARIMA), dan model ARCH-type harga getah asli (NR) SMR20 (Malaysia Standard Rubber gred 20) dalam dunia pasaran NR. Model ARCH-type (Taklik Autoregresif Heteroskedasticity) digunakan termasuk model GARCH (1,1) (GERBANG Am), model EGARCH (1,1) (GARCH Eksponen), model PARCH (1,1) (GERBANG Kuasa) dan CGARCH (1,1) (Komponen GARCH). Model ini dibangunkan untuk ramalan ex-post bulanan jangka pendek harga SMR20 dalam dunia NR.

Getah asli adalah satu komoditi amat penting yang digunakan secara meluas pengeluaran getah berasaskan produk. Lebih 20 juta keluarga bergantung pada penanaman getah sebagai punca rezeki mereka dalam dunia pasaran NR. Pada tahun 1997 hingga 1999 dan tahun 2000 merupakan tahun kegawatan ekonomi itu di Tenggara dan Asia Timur. Pada 2008, harga sangat rendah kerana kemelesetan global. Tahun-tahun ini telah menyumbang kemudahrupaan harga dan ketidakstabilan dalam kebanyakan negara,

terutama pekebun kecil getah di Asia Tenggara. Tambahan pula, harga minyak petroleum mentah adalah satu komponen penting getah sintetik . Kejatuhan dalam harga minyak petroleum mentah berkait rapat dengan getah sintetik. Ia mempengaruhi penurunan saham getah sintetik dalam penggunaan getah keseluruhan, dan pertukaran mata wang yang rendah lemah akan member kesan kepada negara-negara yang mengeluarkan NR kerana kebanyakan komoditi dalam beli dolar AS. Ini mungkin satu alasan yang baik untuk mengambil jual beli kajian ramalan harga NR semasa. Ia akan juga suatu arahan pergerakan harga NR dalam tempoh singkat untuk pembentukan dasar. Tambahan pula, rangka ekonomi konsepsi kajian ini adalah permulaan untuk yang baik perbincangan dan perseptif ramalan ex-post dalam jangka masa pendek bagi model ramalan harga NR yang telah dibangunkan, dengan peluang menggunakan beberapa faktor-faktor ini dalam kajian yang lain untuk ramalan harga getah.

Model-model itu telah dibangunkan dengan tujuan untuk mendapatkan hubung kait antara pengeluaran NR, penggunaan dan harga SMR20, untuk meramalkan harga NR SMR20 menggunakan model satu tempoh, model MARMA, persamaan sistem serentak bekalan permintaan dan model ramalan harga, model ARIMA, dan model ARCH-type, bagi menganalisis dan bandingkan pelbagai model ramalan harga NR secara individu dalam soal ramalan harga mereka yang ketepatan komparatif dan bagi menentukan yang antara model-model itu lebih efisien. Model-model itu menggunakan data bulanan daripada tempoh Januari 1990 hingga Disember 2008 sebagai tempoh anggaran, menyediakan sejumlah 228 pengawasan dan data telah digunakan seperti satu ramalan-ramalan ex-post. Semua data (pembolehubah-pembolehubah) telah diuji untuk unit ujian punca menggunakan ujian Augmented Dickey-Fuller (ADF) dan ujian Phillips-Perron (PP) dan telah didapati pegun pada perbezaan pertama. Ujian Granger telah diuji untuk mengarahkan hubungan Granger dengan dua pembolehubah.

Berdasarkan ramalan-ramalan ini, harga getah asli dunia (SMR20) telah diselesaikan secara dinamik untuk ramalan ex-post dan dianggarkan berkurangan kepada USD 1386.43 se MT pada bulan Disember 2008, pengurangan 60.7 peratus mulai Julai 2008 dengan USD 3530.96 se MT. Nilai-nilai ketepatan ramalan Root Mean Square Error (RMSE), min ralat mutlak (MAE), Root Mean Percent Error (RMPE), Theil Inequality Coefficients (U) kriteria dan Akaike Information Criterion (AIC) dan Schwarz Bayesian Information Criterion (SC) serentak bekalan permintaan dan model persamaan sistem harga secara perbandingan adalah lebih kecil daripada nilai-nilai yang dihasilkan oleh model satu tempoh, model MARMA, persamaan sistem serentak bekalan permintaan dan model ramalan harga, model ARIMA, dan model ARCH-type. Perangkaan ini telah mencadangkan prestasi ramalan serentak bekalan permintaan dan model persamaan sistem harga lebih efisien daripada model satu tempoh, model MARMA dan model ARIMA, dan model ARCH-type untuk ramalan ex-post dalam menganggarkan harga SMR20 dalam tempoh datang 6 bulan yang akan datang atau dalam dunia pasaran NR.

Jika pertumbuhan ekonomi global, terutama sekali dalam negara-negara maju dan negara-negara besar sedang membangun berterusan untuk stabil, mengenai tempoh ramalan, harga getah asli dijangka lebih kuat akan datang. Ex-post perbandingan dan ex-ante ramalan harga dan keazaman NR dalam ramalan jangka masa panjang dan pendek bagi bekalan NR, permintaan dan harga menggunakan model peramalan pelbagai yang bukan dicuba untuk kajian ini, boleh menjadi berpotensi bermanfaat untuk kerja akan datang. Secara signifikan, ramalan ex-post jangka masa pendek bagi peramalan harga NR dihasilkan dan pada model satu tempoh, model MARMA, model bekalan permintaan serentak and persamaan system harga dan model ARIMA and model ARCH-type telah dibangunkan dalam kajian ini dapat menyediakan ujian kesahihan model yang berguna dan berfaedah kepada pergeluar dan pengguna serta peniaga-peniaga dan perancang analisis polisi dalam dua pasaran NR.

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I certify that a Thesis Examination Committee has met on 11 of February 2010 to conduct the final examination of Aye Aye Khin on her thesis entitled “Econometric Forecasting Models For Short Term Natural Rubber Prices” 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 for the degree of 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.

AYE AYE KHIN

Date:

TABLE OF CONTENTS

	Page
DEDICATION	ii
ABSTRACT	iii
ABSTRAK	vi
ACKNOWLEDGEMENTS	ix
APPROVAL	xii
DECLARATION	xiv
LIST OF TABLES	xviii
LIST OF FIGURES	xx
LIST OF ABBREVIATIONS	xxii
CHAPTER	
1 INTRODUCTION	1
1.1 Background of World Natural Rubber Industry	1
1.1.1 Malaysia Natural Rubber Production, Consumption, Export and Import	2
1.2 Economic Development of World Natural Rubber Industry	6
1.2.1 World Natural Rubber Production, Consumption, Export and Import	6
1.2.2 Trends in Natural Rubber Prices	11
1.2.3 Stability in Natural Rubber Prices	13
1.3 Factors Influenced Prices in Current World Natural Rubber Industry	15
1.3.1 World Supply-Demand Position of Natural Rubber and Natural Rubber Supply Surplus/Deficit Situation	15
1.3.2 Natural Rubber New Planted Area and Replanted Area	17
1.3.3 World Natural Rubber Stocks	19
1.3.4 Trend of Crude Petroleum Oil Price, Natural Rubber Price and Synthetic Rubber Price	20
1.3.5 Exchange Rate and World Natural Rubber Price	23
1.4 Problem Statement	24
1.5 Objectives of the Study	28
1.6 Significance of the Study	29
1.7 Organization of the Study	31
2 LITERATURE REVIEW	33
2.1 Theoretical Framework	33
2.1.1 The Fundamentals Influencing Natural Rubber Prices	33
2.1.2 Natural Rubber Supply Characteristics	36
2.1.3 Supply and Demand Factors of the Rubber Industry	38
2.2 Empirical Review	44
2.2.1 Long-term Factors for World Natural Rubber Supply, Demand and Price Forecasting	45
2.2.2 Short-term Factors for World Natural Rubber Supply, Demand and Price Forecasting	48
2.3 The Methods of Estimation	52
2.3.1 Econometric Models	52

2.3.2	Univariate Models	66
2.3.3	The Related Researches of Price Forecasting Models	70
2.4	Conclusion	78
3	METHODOLOGY I	80
	MODELS SPECIFICATION AND SIMULATION	
3.1	Introduction	80
3.2	Conceptual Framework of Econometric Models	81
3.2.1	Single Equation Models of Natural Rubber Supply, Demand and Price	81
3.2.2	Multivariate Autoregressive Moving Average (MARMA) Model	88
3.2.3	Simultaneous Supply-Demand and Price System Equation Model	90
3.2.4	Models Estimation	95
3.3	Conceptual Framework of ARIMA Model	106
3.3.1	Autoregressive-Integrated-Moving Average (ARIMA) Model	106
3.3.2	Models Estimation	110
3.4	Data Collection	111
3.5	Preliminary Data Analysis	114
3.5.1	Descriptive Analysis	115
3.5.2	Data Stationarity Test (Unit Root Test)	116
3.6	The Forecasting Process	122
3.7	Simulation Time Horizons of Ex-post simulation, Ex-post forecast and Ex-ante forecast	124
3.8	Conclusion	127
4	METHODOLOGY II	128
	ARCH-TYPE MODELS SPECIFICATION AND EVALUATION	
4.1	Introduction	128
4.2	Autoregressive Conditional Heteroskedasticity (ARCH) Type Forecasting Models	130
4.2.1	Generalized ARCH (GARCH) Model	132
4.2.2	The Exponential GARCH (EGARCH) Model	137
4.2.3	The Power ARCH (PARCH) Model	138
4.2.4	The Component GARCH (CGARCH) Model	139
4.3	Models Evaluation	141
4.4	Conclusion	148
5	RESULTS AND DISCUSSION OF FORECAST	149
5.1	Introduction	149
5.2	Descriptive Analysis	151
5.3	Unit Root Test	151
5.4	Short-term Natural Rubber Prices Econometric Forecasting Models	153
5.4.1	Single Equation Natural Rubber Price Econometric Model	153
5.4.2	Multivariate Autoregressive-Moving Average (MARMA) Model	161
5.4.3	Simultaneous Supply-Demand and Price System Equation Model	164
5.5	Short-term Natural Rubber Prices ARIMA Forecasting Models	166
5.5.1	Autoregressive-Integrated-Moving Average (ARIMA) Model	166
5.6	Short-term Natural Rubber Prices ARCH-type Forecasting Models	173
5.6.1	Generalized ARCH (GARCH) Model	173
5.6.2	The Exponential GARCH (EGARCH) Model	176

5.6.3 The Power ARCH (PARCH) Model	178
5.6.4 The Component GARCH (CGARCH) Model	180
5.7 Model Evaluation	183
5.8 Conclusion	187
6 SUMMARY, CONCLUSION AND RECOMMENDATIONS FOR FUTURE RESEARCH	188
6.1 Summary and Conclusion	188
6.2 Policy Implications	196
6.3 Recommendations for Further Research	200
REFERENCES	202
BIODATA OF STUDENT	214
LIST OF PUBLICATIONS	216



LIST OF TABLES

Table	Page
1.1 Malaysia natural rubber production, consumption, export and import ('000 MT)	4
1.2 World natural rubber production, consumption, exports and imports ('000 MT) ('000 MT unless otherwise indicated)	8
1.3 Price total variability and instability index of 2007 to 2009	14
1.4 World supply-demand position of natural rubber and natural rubber supply surplus/deficit situation ('000 MT)	16
1.5 Natural rubber new planted area and replanted area during 2003-08 ('000 ha)	17
1.6 World natural rubber stocks (million MT)	19
5.1 Descriptive analysis of monthly time series variables for natural rubber price model from January 1990 to December 2008	151
5.2 Unit root tests of monthly time series variables for natural rubber price model from January 1990 to December 2008	152
5.3 Results of single equation NR price econometric model to determine structural equation	154
5.4 Results of cointegration rank test of NR price econometric model	158
5.5 Results of the direction of a Granger causality relationship test for natural rubber price model from January 1990 to December 2008	159
5.6 Results of MARMA model to determine structural equation	162
5.7 Results of simultaneous supply-demand and price system equation model to determine structural equations	165
5.8 Results of ARIMA model to determine structural equation	167
5.9 Ex-post forecast of monthly natural rubber price SMR20 (USD per MT) of single equation, MARMA, simultaneous system equation and ARIMA models from January 2007 to June 2007	169
5.10 Ex-post forecast of monthly natural rubber price SMR20 (USD per MT) of single equation, MARMA, simultaneous system equation and ARIMA models from July 2007 to December 2007	170



5.11	Ex-post forecast of monthly natural rubber price SMR20 (USD per MT) of single equation, MARMA, simultaneous system equation and ARIMA models from January 2008 to June 2008	170
5.12	Results of GARCH (1,1) model to determine structural equation	174
5.13	Results of EGARCH (1,1) model to determine structural equation	177
5.14	Results of PARCH (1,1) model to determine structural equation	179
5.15	Results of CGARCH (1,1) model to determine structural equation	181
5.16	Ex-post forecast and model evaluations of monthly natural rubber price SMR20 (USD per MT) of single equation, MARMA, simultaneous system equation, ARIMA, GARCH (1,1), EGARCH (1,1), PARCH (1,1) and CGARCH (1,1) models from January 2008 to December 2008	185



LIST OF FIGURES

Figure		Page
1.1	Malaysia Natural Rubber Production ('000 MT) from 2004 to 2008	3
1.2	World Natural Rubber Production ('000 MT) from 2004 to 2008	6
1.3	World Natural Rubber Supply by Countries from 2004 to 2008	9
1.4	World Natural Rubber Demand by Countries from 2004 to 2008	10
1.5	SMR20 Price (Standard Malaysia Rubber Grade 20) in Malaysia and RSS1 Price (Ribbed Smoke Sheet Rubber Grade 1) in New York in January 1990 to December 2008 in the World NR Market	12
1.6	World Natural Rubber Supply, Demand and Supply Surplus/Deficit Situation from 2004 to 2008	16
1.7	World Natural Rubber Stocks Increased and Decreased Situation of Year by Year from 2004 to 2008	20
1.8	Crude Petroleum Oil (COP), Natural Rubber (SMR20) and Synthetic Rubber Prices in January 1990 to December 2008	22
1.9	Exchange Rate and World Natural Rubber Price	23
2.1	The Framework for Analyzing Price Formation	34
2.2	Natural Rubber Supply Characteristics	37
2.3	Theoretical Framework of the Rubber Industry	38
2.4	The Long-term Model was depicted schematically of World Natural Rubber Industry	46
2.5	Long-term, Medium-term and Short-term Analysis of the World Natural Rubber Industry	48
2.6	The Determinants of World Natural Rubber Short-term Price Forecasting Model	51
2.7	Characteristics of Forecasting Methods and Their Relationships	58
3.1	The Single Equation Models of Short-term Supply, Demand and Price in the World Natural Rubber Industry	83

3.2	Simultaneous Supply-Demand and Price Model of Natural Rubber	94
3.3	The Model Estimation Procedure	114
3.4	The Plots and Descriptive Statistics of Monthly NR price of SMR20 in the World Market	116
3.5	The Forecasting Process	124
3.6	Simulation Time Horizons	125
5.1	Impulse Responses in the Price of PSMR20-TPNR-TCNR-STONR- COP-EXM from Recursive VAR	157
5.2	Simulation Time Horizons from January 1990 to December 2008	168
5.3	Ex-post Forecast of World Natural Rubber Price SMR20 (USD per MT) of Single-Equation, MARMA, Simultaneous Supply-Demand and Price System Equation, and ARIMA Models from January 2008 to December 2008	171
5.4	Ex-post Forecast of World Natural Rubber Price SMR20 (USD per MT) of GARCH (1,1), EGARCH (1,1), PARCH (1,1) and CGARCH (1,1) Models from January 2008 to December 2008	182
5.5	Ex-post Forecast of World Natural Rubber Price SMR20 (USD per MT) of Simultaneous Supply-Demand and Price System Equation Model and EGARCH (1,1) Model from January 2008 to December 2008	186



LIST OF ABBREVIATIONS

ADF	Augmented Dickey-Fuller Test
AIC	Akaike Information Criterion
ANRPC	Association of Natural Rubber Producing Countries
ARCH	Autoregressive Conditional Heteroskedasticity Model
ARIMA	Autoregressive Integrated Moving Average Model
CGARCH	The Component GARCH Model
EGARCH	The Exponential GARCH Model
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
GARCH	Generalized ARCH Model
IMF	International Monetary Fund
IRC	International Rubber Conference
IRCo	International Rubber Consortium of Thailand, Indonesia and Malaysia
IRRDB	International Rubber Research Development Board
IRSG	International Rubber Study Group
MAE	Mean Absolute Error
MARMA	Multivariate Autoregressive Moving Average Model
MRB	Malaysian Rubber Board
MRE	Malaysia Rubber Exchange
MRELB	Malaysian Rubber Exchange and Licensing Board
MRRDB	Malaysia Rubber Research and Development Board
OECD	Organization for Economics Co-operation and Development
OPEC	Organization of Petroleum Exporting Countries
PARCH	The Power ARCH Model



PP	Phillips-Perron Test
RAS	The Rubber Association of Singapore
RMPE	Root Mean Percent Error
RMSE	Root Mean Square Error
RRIM	Rubber Research Institute of Malaysia
RSS1	Ribbed Smoke Sheet Rubber of Grade 1
SC	Schwarz Bayesian Information Criterion
SICOM	Singapore Commodity Exchange Inc
SMR20	Stand Malaysia Rubber of Grade 20
TOCOM	Tokyo Commodity Exchange Inc
U	Theil's Inequality Coefficients Criteria
UNCTAD	United Nations Conference on Trade and Development
USDA	United States Department of Agriculture



CHAPTER I

INTRODUCTION

The chapter begins with a discussion of the background of world natural rubber (NR) industry followed by economic development of world NR industry, factors influenced NR prices in current world NR industry and the research problem. The objectives of the study are then described. An elaboration on the significance of the study and organization of the study concludes this chapter.

1.1 Background of World Natural Rubber Industry

Rubber is a vital commodity used in the manufacture of a wide range of rubber-based products. Rubber plays a major role in the socio-economic fabric of many developing countries. Rubber is derived from latex, a milky fluid obtained from the *Hevea brasillensis* (Euphorbiaceae) tree. Rubber is a native of the Amazon basin in South America and has spread to other countries of South-East and South Asia such as Malaysia, Indonesia, Thailand, Sri Lanka and India during late 19th century (The Encyclopedia of Malaysia, 2007).

In 1818, the rubber industry started with Charles Macintosh in Europe. He was an industrial chemist of the chemical industry, and was eager to make use of the waste products of the new coal gasification process. James Syme, a medical student, found that coal tar naphtha was a good solvent for rubber. So, Macintosh's specific skill came in exploiting the naphtha-based rubber solution as a waterproofing layer

