

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

Copyright[©] by Chiang Mai University All rights reserved

TABLE OF CONTENTS

	Page
Acknowledgements	iii
Abstract (Thai)	V
Abstract (English)	vii
Table of Contents	ix
List of Tables	xii
List of Figures	xiii
Chapter 1 Introduction	1
1.1 Statement of the Problem and the Significance of the Study	1
1.2 Objectives of the Study	6
1.3 Educational/Application Advantages	6
1.4 Research Scope	7
1.5 Sources of Data	8
1.6 Definitions of Air Pollutions	10
Chapter 2 Relevant Theory and Literature Review	16
2.1 Relevant Theory	16
2.1.1 Environmental Kuznets Curve (EKC)	16
2.1.2 Time Series Analysis	23
2.1.3 Autoregressive Moving Average (ARIMA)	25
2.1.4 Environmental Principle	41
2.1.5 Economic Instruments	43
2.2 Literature Review	48
2.2.1 Review of the EKC	48
2.2.2 Review of Time Series Analysis of Air Pollution	54
2.2.3 Previous empirical studies and survey of air pollution	
in Chiang Mai province	55

Chapter 3 Research Methodology	57
3.1 Descriptive Statistical Analysis	57
3.2 Time Series Analysis	57
Chapter 4 Results and Discussion	63
4.1 Descriptive Statistical Analysis	63
4.2 Time Series Plots	64
4.3 Unit Root Test	74
4.4 ARMA Modeling	75
4.4.1 Identification	75
4.4.2 Estimation	77
4.4.3 Diagnostic Checking	81
4.4.4 Forecasting	81
4.5 Discussions	86
4.5.1 Survey of Environmental Kuznets Curve	86
- Revisit the Time Series Curve of PM ₁₀ in Chiang Mai	86
- Structural Change Path Way of Chiang Mai	86
- The difficulty in demonstrating a relationship	88
4.5.2 Recent Situation of PM ₁₀ in Chiang Mai	89
4.5.3 Major Sources of PM ₁₀ and Smoke Problem in Chiang Mai	92
4.5.4 Potential Shocks of Smoke Problem in Chiang Mai	92
Chapter 5 Conclusion and Recommendation	95
5.1 Summary and Conclusion of the Study	95
5.2 Policy Implication	99
5.3 Limitation of the Study and Recommendation for Further Study	100
References	102

Appendices	106
Appendix A: Unit Root Test	107
Appendix B: Correlograms	123
Appendix C: Model Estimates	129
Appendix D: Residual Correlograms	133
Appendix E: Forecast Statistics	137
Curriculum Vitae	141

ลิบสิทธิ์มหาวิทยาลัยเชียงใหม่ Copyright[©] by Chiang Mai University All rights reserved

LIST OF TABLES

	LIST OF TABLES	
Table		Page
1.1	Air quality monitoring stations in the Northern part of Thailand	9
1.2	Monitoring data and measurement methods	9
1.3	Ambient Air Standard	13
1.4	AQI and level of health concern	14
1.5	Comparison of concentration data from five air pollutants and AQI	15
2.1	Literature review of EKC Hypothesis	49
2.2	Literature review of Time Series Analysis of Air Pollution	54
2.3	PM ₁₀ levels	55
4.1	Statistical data of air pollution data set	63
4.2	Ambient Air Standard	64
4.3	Summary in year basis: PM ₁₀ exceeds Ambient Air Standard	71
4.4	Summary in month: PM ₁₀ exceeds Ambient Air Standard	72
4.5	Summary in Feb - Mar: PM ₁₀ exceeds Ambient Air Standard	73
4.6	Unit root test summary (ADF-test)	75
4.7	Model Estimation	78
4.8	Model Selection Criterion	79
4.9	Diagnostic checking of models	81
4.10	Statistic for Historical Forecast	82
4.11	Statistic for Ex-post Forecast	83
4.12	Summary in yearly basis: PM ₁₀ exceeds Ambient Air Standard	
	and Important Situations	93

LIST OF FIGURES

	LIST OF FIGURES	
Figure	Elist of Fiderica	Page
1.1	Open burning spots all over the world (Feb – June, 2003)	4
1.2	Smoke from biological burning over Thailand (April 2003)	5
1.3	Red Burning Spot in Chiang Mai, March 2007 by Satellite	5
1.4	Maps of 53 air quality monitoring stations	8
2.1	Environmental Kuznets Curve Hypothesis	16
2.2	Various Shapes of Environmental Kuznets Curve	20
	(a) A monotonically increasing linear relationship	20
	(b) A monotonically decreasing linear relationship	20
	(c) Inverted-U curve	20
	(d) N-Shaped	20
2.3	Integrated Graph of Environmental Kuznets Curve Hypothesis	21
2.4	Social costs of pollution	33
2.5	Social costs of abatement	34
2.6	Social costs of pollution and abatement	35
2.7	Total social costs of pollution/abatement	35
2.8	The role of economic instruments in internalizing external costs	
	with full- cost pricing.	46
3.1	Unit Root Test-no constant term and no linear trend	60
3.2	Unit Root Test-a constant term but no linear trend	61
4.1	Time series plots of daily air pollution concentration	65
4.2	(a) Time series plots of monthly concentration – PM_{10}	67
	(b) Time series plots of monthly concentration – O ₃	68

\dot{xiv}

	(c) Time series plots of monthly concentration – SO ₂	68
	(d) Time series plots of monthly concentration – NO ₂	69
	(e) Time series plots of monthly concentration – CO	69
	(f) Comparison of monthly concentration – PM ₁₀ , O ₃ , NO ₂	70
4.3	Forecast plots of daily air pollution concentration	71
4.4	Months and Days of PM ₁₀ concentration exceeds Ambient Air Standard	72
4.5	Top 4 months of high PM ₁₀ concentration	73
4.6	High PM ₁₀ concentration in Feb – Mar	74
4.7	PM ₁₀ Correlogram	76
4.8	(a) Historical Forecast of PM ₁₀ Concentration from Eq. (4.1)	82
	(b) Historical Forecast of PM_{10} Concentration from Eq. (4.2)	83
4.9	(a) Ex-post Forecast of PM ₁₀ Concentration from Eq. (4.1)	84
	(b) Ex-post Forecast of PM ₁₀ Concentration from Eq. (4.2)	84
4.10	Forecast and S.E. of PM ₁₀ Concentration from Eq. (4.1)	85
4.11	Forecast of PM ₁₀ Concentration from Eq. (4.1)	85
4.12	Gross Provincial Product (GPP) of Chiang Mai from 1995-2008	87
4.13	Gross Provincial Product (GPP) Per Capita of Chiang Mai	
	from 1995-2008	87

Gross Provincial Product (GPP) of Chiang Mai from 1995-2008

88

4.14

4.15	PM ₁₀ Concentration: Historical, Forecast, and New Actual Data	90

4.16 PM₁₀ Concentration: Forecast and New Actual Data 91



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่ Copyright[©] by Chiang Mai University All rights reserved