

Bottom–Up Studies for Regional Models (Ajou Univ.)

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Key Design Characteristics

- Participating Model: ARDL, Panel, AIDS Model, etc.
- Model Type: Econometric models applied to energy sectrs
- Participating Modelers: Y.G.Kim (KEI), Hoesung Lee (IPCC), Choon-Geol Moon (Hanyang Univ.), Suduk Kim (Ajou Univ.)
- *Time Step:* Hourly to Monthly or Yearly
- *Time Frame:* using1997-2009 to medium range forecast
- ◆ Solution Type: stochastic, dynamic recursive

Equilibrium Type: no market general equilibrium type, but mostly demand side analysis with no future structural change

Underlying Computing Framework: GAUSS, C++







Inputs and Outputs

Key inputs

- Demographics: regional information if necessary
- Economic: PI or GDP, CPI, energy prices and consumption, government policies including taxation, subsidy on energy sources
- Resources: fossil fuel related sources, not renewables
- > **Technology:** no explicit consideration

Key outputs

- Economic: energy demand forecast, subsequent impact
- *Energy:* sectoral, regional energy demand
- > **Agriculture:** NA
- Emissions: sector-wise CO2 emission
- Climate: NA





Regional Scope & Other Detail

Regional Details:

- Regional Scope: national
- > Number of Sub-Regions: depending on data availability
- Asian Regions: NA

Other Details:

- Energy Demand: detailed behavioral information on final demand including short, long-term own price elasticity, income elasticity, and cross price elasticity
- Energy Supply: NA (most of the occasions)
- CGE under criticism of the use of parameters without thorough empirical validity while econometric model can provide additional information for this purpose







Asian Baselines

National Baseline:

- National energy master plan by MKE(ministry of knowledge, economy) – 'Low Carbon Green Growth'
- Baseline conditions

		0010	0045		0005		per annum(%)			
	2006	2010	2015	2020	2025	2030	06-10	10-20	20-30	06-30
GDP(Bil.USD)	632.7	763.7	951.8	1163.5	1361.9	1530.0	4.8	4.3	2.8	3.7
Population(Thou.)	48297.0	48875.0	49277.0	49326.0	49108.0	48635.0	0.3	0.1	-0.1	0

	2006	2010	2015	2020	2025	2030
Agri., fishery	3.7	3.2	2.6	2.2	2	1.8
Industry	33.8	33.4	33.5	33.3	32.6	31.4
(Manufacture)	(33.5)	(33.2)	(33.3)	(33.2)	(32.5)	(31.3)
SOC	10.4	10.6	10.3	10	9.7	9.3
Service Sector	52.1	52.9	53.6	54.4	55.7	57.4
Total Value Added	100	100	100	100	100	100

 Crude oil price (real) – \$118.7 by 2030 (based on International Energy Outlook 2008, EIA)













Previous Work on Korea (AIDS, manufacture)





Previous Work on Korea (City Gas, Panel Model)

Dependent Variable: $\ln y = \ln(\text{city gas demand for industrial sector})$						
Sample: Jan. 199	9 to Dec. 2007					
Number of obser	vations: 108					
Crass sastians in	valudadi 14					
Cross-sections included: 14						
Var.	Estimates	std.	t-value	P-value		
cnst	1.02429	0.14940	6.85598	0.00000		
ln y(-1)	0.77934	0.02095	37.20587	0.00000		
In P_citygas	-0.11629	0.04620	-2.51725	0.01190		
In PI	0.22565	0.03954	5.70667	0.00000		
In P_elec	0.30936	0.10588	2.92181	0.00350		
ln P_BC	0.05167	0.02548	2.02780	0.04280		
In Nhous	-0.17172	0.02353	-7.29727	0.00000		
Feb.	-0.07528	0.01996	-3.77075	0.00020		
Mar.	-0.03986	0.02045	-1.94866	0.05160		
Apr.	-0.13598	0.02095	-6.49146	0.00000		
May	-0.11201	0.02172	-5.15733	0.00000		
Jun	-0.10067	0.02157	-4.66617	0.00000		
Jul	-0.13385	0.02636	-5.07746	0.00000		
Aug	-0.17295	0.02926	-5.91117	0.00000		
Sep	-0.06007	0.02166	-2.77294	0.00560		
Oct	-0.00534	0.02211	-0.24172	0.80900		
Nov	0.04051	0.02173	1.86467	0.06250		
Dec	0.06514	0.02066	3.15295	0.00170		
Fixed Effects						
Seoul	-0.16636					
Pusan	0.16463					
Deaku	0.11348					
Daejeon	-0.24738					
Kwangju	-0.10208					
Incheon	0.22428					
Ulsan	0.34503					
Kyunggi	0.37006					
Kyungnam	-0.24388					
Jeonbuk	-0.21600					
Jeonnam	-0.31556					
Chungbuk	-0.28629					
Chungnam	0.19966					
Kangwon	-0.29807					
R-squared	0.98543	Mean of Y	3.81	1644		
Adi R-squared	0.98509	SD of Y	1 21001	9		
log likelihood	666 392	AIC	_0.06	3446		
F-stat	2903.91	AIC -0.903440 SIC 0.841502				
prob(E-stat)	0.00000	Burbin-Watson	2 0662	7		

Model: panel data model estimation with crostyssection fixed-effects and partial adjustment scheme (2008.10) - **Industrial Gas Demand**

Own Price Elasticity

- Short-Run: -0.116 (Significant, inelastic)
- Long-Run: -0.527 (Significant, inelastic)

Electricity (Cross Price Elasticity)

- Short-Run: 0.309 (Significant, inelastic)
- Long-Run: 1.402 (Significant, elastic)

*Substitution effect of electricity in the analysis of city gas demand should be explicitly considered.

BC Oil (Cross Price Elasticity)

- Short-Run: : 0.052 (Significant, inelastic)
- Long-Run: : 0.234 (Significant, inelastic)

*Substitution effect of BC oil in the analysis of city gas demand should be explicitly considered

Done for KOGAS (Korea Gas Corporation)







Previous Work on Korea (Industrial Power Demand, ARDL)

Short-Run Model Results for Power Demand					Long-Run Model Results for Power Demand				
Var.	Estimate	stđ	t-value	prob.> t	Var.	Estimate	stđ	t-value	prob.> t
y_{t-1}	0.7690	0.0530	14.5034	****0.0000	y_{t-1}	-	-	-	-
cnst	2.0790	0.4814	4.3185	****0.0000	cnst	9.0005	0.1448	62.1558	****0.0000
dĺ	-0.0052	0.0071	-0.7339	0.4645	dl	-0.0227	0.0321	-0.7070	0.4811
d2	-0.0394	0.0077	-5.1017	****0.0000	d2	-0.1705	0.0587	-2.9048	****0.0044
d3	0.0153	0.0084	1.8319	*0.0696	d3	0.0664	0.0391	1.6992	*0.0921
d4	-0.0194	0.0073	-2.6419	***0.0094	đ4	-0.0839	0.0338	-2,4848	**0.0144
d5	-0.0186	0.0077	-2,4292	**0.0167	d5	-0.0806	0.0345	-2,3340	**0.0214
d6	0.0012	0.0074	0.1575	0.8751	d6	0.0051	0.0323	0.1565	0.8759
ď7	0.0274	0.0102	2.6884	****0.0083	ď7	0.1186	0.0357	3.3219	****0.0012
d8	0.0186	0.0116	1.6031	0.1117	d8	0.0806	0.0407	1.9781	*0.0504
d9	-0.0239	0.0075	-3.1648	****0.0020	eb	-0.1034	0.0440	-2,3484	**0.0206
d10	-0.0374	0.0073	-5.0952	****0.0000	d10	-0.1621	0.0500	-3.2400	****0.0016
d11	0.0099	0.0069	1.4377	0.1533	d11	0.0427	0.0326	1.3081	0.1935
d98	0.0042	0.0095	0.4396	0.6611	d98	0.0181	0.0402	0.4504	0.6533
Р	-0.1521	0.0471	-3.2317	****0.0016	Р	-0.6583	0.1661	-3.9635	****0.0001
PRD	0.5444	0.0365	14.9127	****0.0000	PRD	0.8152	0.1172	6.9534	****0.0000
PRD_{t-1}	-0.3561	0.0553	-6.4365	***0.0000	PRD _{t-}	-	-	-	-
P^{g}	0.0477	0.0175	2.7319	****0.0073	P^{g}	0.2065	0.0720	2.8668	****0.0050
P^{bc}	-0.0092	0.0090	-1.0197	0.3100	P^{bc}	-0.0398	0.0404	-0.9862	0.3262
Valid cases:131Dependent variable:yR-squared:0.993Rbar-squared:0.992Total SS:3.786Degrees of freedom:112F(18,112):851.636Probability of F:0.000Residual SS:0.027Std error of est:0.016Durbin-Watson:2.012								0.992 0.000	





Previous Work on Korea (KNOC, ARDL)

Valid case	·s:	146	Depende	Q			
Total SS:		1.479	Degrees	127 0.595			
R-squared:		0.645	Rbar-sq				
Residual S	s:	0.524	Std err	Std error of est:			
F(18,127):		12.846	Probabi	0.000			
Durbin-Wat	son:	2.025					
		Standard		Prob S	tandardized		
Variable	Estimate	Error	t-value	> t	Estimate		
Q(-1)	0.125084	0.091202	1.371496	0.172639	0.125	•	
0(-2)	0.264195	0.083304	3.171449	0.001902	0.265		
Q(-3)	0.167253	0.080320	2.082322	0.039320	0.169		
cnst	8.488540	2.212738	3.836215	0.000196			
DUM02	-0.074334	0.027493	-2.703747	0.007796	-0.203		
DUMO3	0.058166	0.030123	1.930935	0.055719	0.159		
DUM04	0.062590	0.027833	2.248725	0.026253	0.177		
DUM05	0.106969	0.027267	3.923017	0.000142	0.303		
DUM06	-0.002512	0.026507	-0.094782	0.924638	-0.007		
DUM07	0.082149	0.027641	2.971990	0.003540	0.224		
DUMOS	0.180198	0.027230	6.617578	0.000000	0.492		
DUM09	0.059521	0.028044	2.122428	0.035743	0.162		
DUM10	-0.024690	0.028603	-0.863170	0.389671	-0.067		
DUM11	0.015631	0.030183	0.517858	0.605458	0.043		
DUM12	0.074210	0.027142	2.734164	0.007148	0.203		

-3.585234

-0.518335

3.106103

-0.125510

0.000479

8.685127

0.002339

0.900318

-0.684 -0.183

0.704

-0.007

Petroleum Product Demand Analysis -Gasoline

-For KNOC(Korea National Oil Company)

• Long-term

Short-term

	Standard		Prob
Estimate	Error	t-value	> t
19.141238	1.296452	14.764327	0.000000
-0.167619	0.074936	-2.236838	0.027041
0.131162	0.081301	1.613299	0.109162
0.141137	0.080678	1.749378	0.082641
0.241210	0.097869	2.464619	0.015052
-0.005665	0.059734	-0.094841	0.924590
0.185241	0.082222	2.252951	0.025978
0.406337	0.123542	3.289058	0.001301
0.134216	0.067729	1.981654	0.049678
-0.055674	0.069679	-0.799005	0.425779
0.035246	0.067113	0.525177	0.600376
0.167340	0.074995	2.231346	0.027412
-0.506760	0.165082	-3.069740	0.002620
-0.009413	0.074978	-0.125537	0.900297
	Estimate 19.141238 -0.167619 0.131162 0.141137 0.241210 -0.005665 0.185241 0.406337 0.134216 -0.055674 0.035246 0.167340 -0.506760 -0.089413	Standard Estinate Error 19.141238 1.296452 -0.167619 0.874936 0.131162 0.881301 0.141137 0.886678 0.241210 0.97869 -0.05655 0.59734 0.185241 0.882222 0.486337 0.123542 0.134216 0.667729 -0.855674 0.809679 0.835246 0.667113 0.167340 0.874995 -0.566760 0.165082 -0.809413 0.874978	Standard Estimate Error t-value 19.141238 1.296452 14.764327 -0.167619 0.874936 -2.236838 0.131162 0.881301 1.613299 0.141137 0.806678 1.749378 0.241210 0.997869 2.464619 -0.065665 0.659734 -0.094841 0.185241 0.682222 2.252951 0.466337 0.123542 3.289058 0.134216 0.667729 1.981654 -0.855674 0.609679 -8.799805 0.35246 0.667113 0.525177 0.467340 0.874995 2.231346 -0.566760 9.165082 -3.069740 -0.809413 0.874978 -0.125537



RP

Car

RP(-1)

RP(-2)

-0.812321

-0.211608

0.799197

-0.004174

0.226574

0.408246

0.257299

0.033257





Previous Work on Korea

Impact of Wind Power Generation on Peak Time Power Demand (2030)











Previous Work on Korea





Energy Modeling Lab.'s Research Plan for the Future







Additional Thoughts for Asia Model

- With over 90% of GHG being produced from energy sector in Korea, detailed specification of elasticities for this sector (both demand and supply side) with empirical validity being pursued.
- Over 2000TOE of energy consuming companies' census data available from KEMCO for future analysis.
 - With market clearing price system being calculated from demand and supply in most of models, would it be possible to test 'desirable' relative price structure of energy within the general equilibrium type of model?
- It would be giving us the better choice of parameters in the process of model calibration, say, utility function and CES production function in CGE model..
- Study a way to incorporate the estimates for demand side price elasticities (including cross price elasticity).
- Trade-off between time to be taken to refine models and 'warming globe'!
- Building an integrated econometric model for its comparison with CGE for the robust performance of ongoing Korean model within the context of Asian model.

