PE-GE Model

SENSITIVITY ANALYSIS ON ARMINGTON ELASTICITIES

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Outline

- What are Armington elasticities?
- Initial experiment undertaken in PE-GE model
- 1st Extention:
  - Doubling Armington elasticities in the PE-GE model
- 2nd Extention:
  - Systematic Sensitivity Analysis (around both the original and doubled values)

What are Armington elasticities?

- Derived from Paul Armington in “A Theory of Demand for Products Distinguished by Place of Production” (1969)
- Give the degree of substitution between imported and domestic goods
- Estimated from econometric analysis

Initial experiment undertaken in PE-GE model

- PE-GE model focuses on automobile in India such as:
  - Aggregated auto sector in GE model
  - Disaggregated into 5 industries (i.e. Motocycles, Motocycles parts, Automobiles, Engine parts and Other transport) in PE model

- Initial simulation:
  - Multilateral* full trade liberalization in the 5 automobile industries

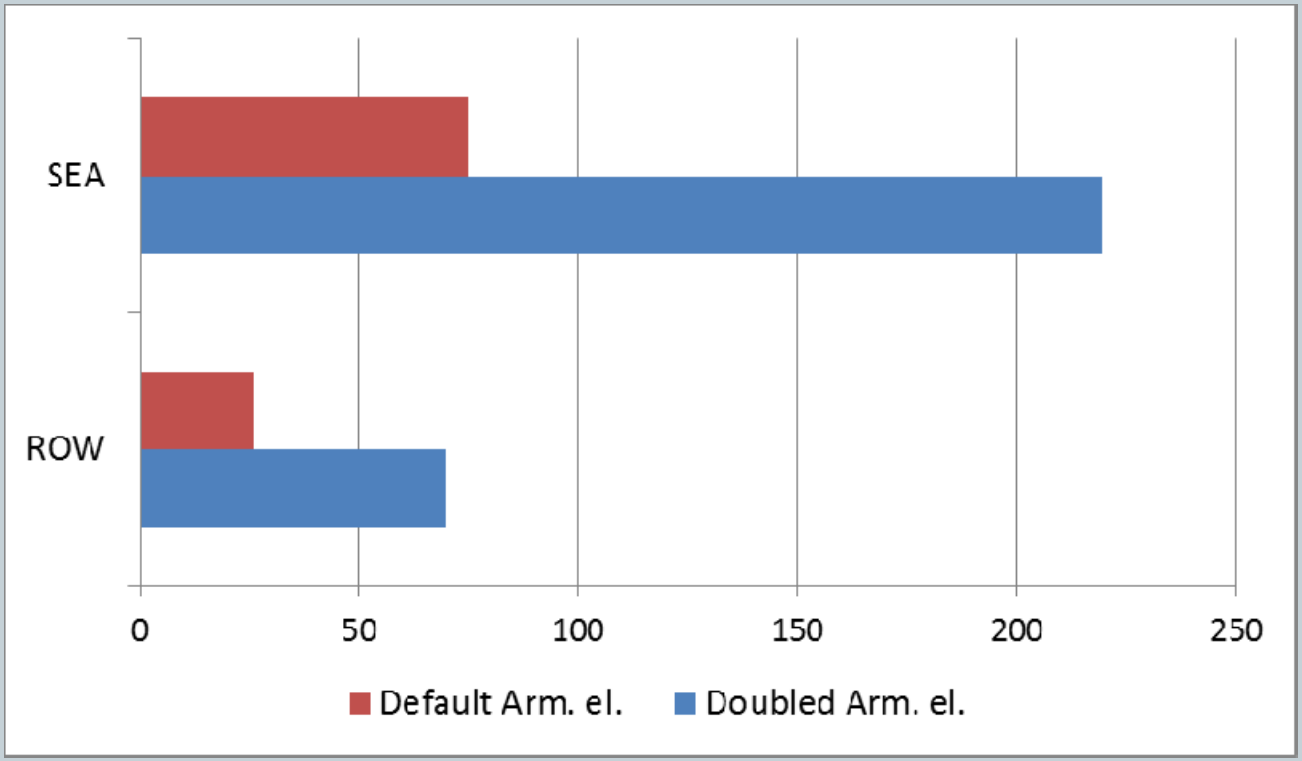
*(*all 3 regions of the model fully liberalize)*

1st Extension: Doubling Armington elasticities in PE-GE model - Shocks

- Corresponding parameters and default values in PE-GE model:
  - Elasticities of substitution between domestic and imports of disaggregated industries: *ESUBDK(k) = 3,2*
  - Elasticities of substitution among imports of disaggregated industries in Armington structure: *ESUBMK(k) = 6,4*
- Shocks to be implemented – Doubling above values of elasticities such as:
  - *ESUBDK(k) = 6,4*
  - *ESUBMK(k) = 12,8*

1st Extension: Doubling Armington elasticities in PE-GE model – Key results

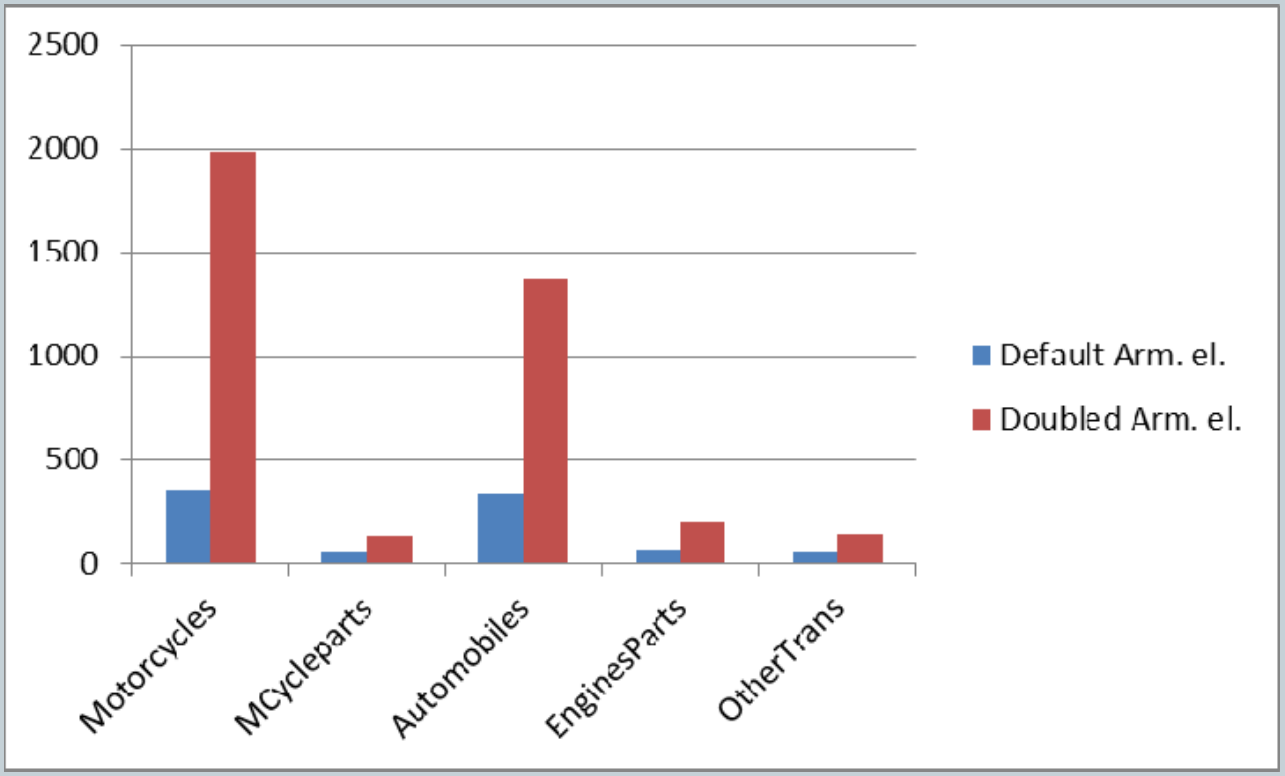
- Changes in India's aggregated auto industry imports from SouthEast Asia (SEA) and Rest of the World (ROW) following multilateral full trade lib'n - Default vs. Doubled Arm. el. - %



Source: Authors' calculations based on GTAP model

1st Extension: Doubling Armington elasticities in PE-GE model – Key results

- Changes in India's disaggregated auto industry imports from SouthEast Asia (SEA) following multilateral full trade lib'n - Default vs. Doubled Arm. el. - %



Source: Authors' calculations based on GTAP model

1st Extension: Doubling Armington elasticities in PE-GE model – Key results

- Changes in India's welfare (decomposition) - %

	Total welfare	Allocation efficiency	Terms of Trade	Investment-Savings
Default Arm. el.	57,2	67,2	-20,0	9,9
Doubled Arm. el.	327,5	260,9	36,8	29,8

Source: Authors' calculations based on GTAP model

  - *Thanks to doubled Armington elasticities, India's terms of trade even become positive (Indian consumers paying less for imported goods; decomposition of terms of trade indicates that most of the ToT gains come from a fall in import price of engine parts)*

2nd Extension: Systematic Sensitivity Analysis

Two Sensitivity analyses

- SSA around original elasticities

ESUBDK(k) = 3,2

ESUBMK(k) = 6,4

- SSA around double original elasticities

ESUBDK(k) = 6,4

ESUBMK(k) = 12,8

- *ESUBDK(k)* = Elasticities of substitution between domestic and imports of disaggregated industries
- *ESUBMK(k)* = Elasticities of substitution among imports of disaggregated industries in Armington structure

2nd Extension: Systematic Sensitivity Analysis

Sensitivity analyses

- *ESUBDK(k) ± 50% & ESUBMK(k) ±50%*
- *2*ESUBDK(k) ± 50% & 2*ESUBMK(k) ±50%*
- *2*ESUBDK(k) ± 25% & 2*ESUBMK(k) ±25%*

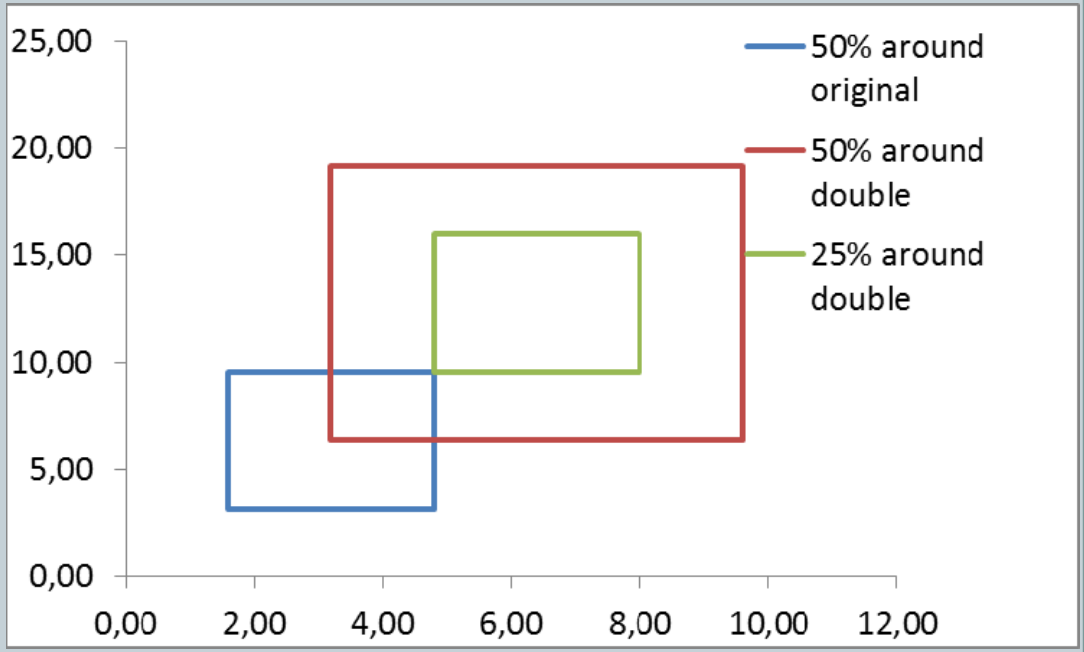
2nd Extension: Systematic Sensitivity Analysis

Upper and lower bounds of each variable

Chebyshevs inequality:

The probability that the value of Y lies within k standard deviations of the mean is no less than 1-1/(k^2) ,which is 0.95 for k=Sqrt(20)

Upper Bound	M+k*SD
mean	M
Lower Bound	M-k*SD
standard dev.	SD



2nd Extension: Systematic Sensitivity Analysis

- *SSA around original 50%*

qimk[*INDIA]	1 Motorcycle	2 MCyclepar	3 Automobi	4 EnginesPa	5 OtherTrans
Upper Bound	918,60	107,19	394,17	123,82	50,09
mean	342,19	54,06	167,70	58,48	24,51
Lower Bound	-234,22	0,93	-58,77	-6,86	-1,07
standard dev.	128,89	11,88	50,64	14,61	5,72

- *SSA around double 50%*

qimk[*INDIA]	1 Motorcycle	2 MCyclepar	3 Automobi	4 EnginesPa	5 OtherTrans
Upper Bound	6763,97	251,60	1550,58	341,14	132,08
mean	2002,62	130,41	607,90	156,71	66,52
Lower Bound	-2758,73	9,22	-334,78	-27,72	0,96
standard dev.	1064,67	27,10	210,79	41,24	14,66

2nd Extension: Systematic Sensitivity Analysis

- *SSA around original*

pimk[*INDIA]	1 Motorcycle	2 MCyclepar	3 Automobi	4 EnginesPa	5 OtherTrans
Upper Bound	-36,68	-16,24	-27,72	-15,93	-8,54
mean	-36,86	-16,60	-27,99	-16,11	-8,67
Lower Bound	-37,04	-16,96	-28,26	-16,29	-8,80
standard dev.	0,04	0,08	0,06	0,04	0,03

- *SSA around double*

pimk[*INDIA]	1 Motorcycle	2 MCyclepar	3 Automobi	4 EnginesPa	5 OtherTrans
Upper Bound	-36,77	-15,65	-27,96	-16,00	-8,62
mean	-37,04	-16,32	-28,09	-16,36	-8,84
Lower Bound	-37,31	-16,99	-28,22	-16,72	-9,06
standard dev.	0,06	0,15	0,03	0,08	0,05

2nd Extension: Systematic Sensitivity Analysis

- *SSA around original 50%*

qxsk[**INDIA]	1 SEAsiaOther				
	1 Motorcycles	2 MCycleparts	3 Automobile	4 EnginesPar	5 OtherTrans
Upper Bound	987,95	109,20	769,87	147,18	99,04
mean	378,31	55,49	349,80	73,03	55,35
Lower Bound	-231,33	1,78	-70,27	-1,12	11,66
standard dev.	136,32	12,01	93,93	16,58	9,77
	3 ROW				
	1 Motorcycles	2 MCycleparts	3 Automobile	4 EnginesPar	5 OtherTrans
Upper Bound	631,48	74,67	297,60	91,44	41,50
mean	210,43	28,25	113,12	35,00	16,68
Lower Bound	-210,62	-18,17	-71,36	-21,44	-8,14
standard dev.	94,15	10,38	41,25	12,62	5,55

2nd Extension: Systematic Sensitivity Analysis

- *SSA around double 50%*

qxsk[**INDIA]	1 SEAsiaOther				
	1 Motorcycles	2 MCycleparts	3 Automobile	4 EnginesPar	5 OtherTrans
Upper Bound	7602,21	257,19	3498,80	436,81	280,91
mean	2269,28	133,85	1400,29	205,65	149,97
Lower Bound	-3063,65	10,51	-698,22	-25,51	19,03
standard dev.	1192,48	27,58	469,24	51,69	29,28
	3 ROW				
	1 Motorcycles	2 MCycleparts	3 Automobile	4 EnginesPar	5 OtherTrans
Upper Bound	3916,88	154,39	1027,82	206,14	104,36
mean	1079,89	67,90	363,84	77,83	45,28
Lower Bound	-1757,10	-18,59	-300,14	-50,48	-13,80
standard dev.	634,37	19,34	148,47	28,69	13,21

2nd Extension: Systematic Sensitivity Analysis

- *SSA around original*

qdmk[*INDIA	1 Motorcycle	2 MCyclepar	3 Automobi	4 EnginesPa	5 OtherTrans
Upper Bound	1,31	0,69	0,87	-1,16	-1,27
mean	-1,33	-10,58	-6,55	-7,06	-5,21
Lower Bound	-3,97	-21,85	-13,97	-12,96	-9,15
standard dev.	0,59	2,52	1,66	1,32	0,88

- *SSA around double*

qdmk[*INDIA	1 Motorcycle	2 MCyclepar	3 Automobi	4 EnginesPa	5 OtherTrans
Upper Bound	14,42	8,60	15,18	6,00	6,18
mean	5,16	-17,38	-14,92	-10,19	-4,33
Lower Bound	-4,10	-43,36	-45,02	-26,38	-14,84
standard dev.	2,07	5,81	6,73	3,62	2,35

2nd Extension: Systematic Sensitivity Analysis

- *SSA around original 50%*

qimk[*INDIA]	1 Motorcycle	2 MCyclepar	3 Automobi	4 EnginesPa	5 OtherTrans
Upper Bound	918,60	107,19	394,17	123,82	50,09
mean	342,19	54,06	167,70	58,48	24,51
Lower Bound	-234,22	0,93	-58,77	-6,86	-1,07
standard dev.	128,89	11,88	50,64	14,61	5,72

- *SSA around double 25%*

qimk[*INDIA]	1 Motorcycle	2 MCyclepar	3 Automobi	4 EnginesPa	5 OtherTrans
Upper Bound	4076,43	190,76	1050,81	247,16	98,71
mean	1810,49	130,03	594,43	154,99	66,02
Lower Bound	-455,45	69,30	138,05	62,82	33,33
standard dev.	506,68	13,58	102,05	20,61	7,31

2nd Extension: Systematic Sensitivity Analysis

- *SSA around original 50%*

pimk[*INDIA]	1 Motorcycle	2 MCyclepar	3 Automobi	4 EnginesPa	5 OtherTrans
Upper Bound	-36,68	-16,24	-27,72	-15,93	-8,54
mean	-36,86	-16,60	-27,99	-16,11	-8,67
Lower Bound	-37,04	-16,96	-28,26	-16,29	-8,80
standard dev.	0,04	0,08	0,06	0,04	0,03

- *SSA around double 25%*

pimk[*INDIA]	1 Motorcycle	2 MCyclepar	3 Automobi	4 EnginesPa	5 OtherTrans
Upper Bound	-36,91	-15,96	-28,05	-16,18	-8,71
mean	-37,04	-16,32	-28,09	-16,36	-8,84
Lower Bound	-37,17	-16,68	-28,13	-16,54	-8,97
standard dev.	0,03	0,08	0,01	0,04	0,03

2nd Extension: Systematic Sensitivity Analysis

- *SSA around double 25%*

qxsk[**INDIA]	1 SEAsiaOther				
	1 Motorcycles	2 MCycleparts	3 Automobile	4 EnginesPar	5 OtherTrans
Upper Bound	4598,22	195,31	2425,89	319,07	214,08
mean	2057,96	133,51	1377,53	203,64	149,06
Lower Bound	-482,30	71,71	329,17	88,21	84,04
standard dev.	568,02	13,82	234,42	25,81	14,54
	3 ROW				
	1 Motorcycles	2 MCycleparts	3 Automobile	4 EnginesPar	5 OtherTrans
Upper Bound	2278,86	109,63	681,95	140,30	74,47
mean	953,14	66,65	350,39	76,57	44,91
Lower Bound	-372,58	23,67	18,83	12,84	15,35
standard dev.	296,44	9,61	74,14	14,25	6,61

2nd Extension: Systematic Sensitivity Analysis

- *SSA around original 50%*

qdmk[*INDIA	1 Motorcycle	2 MCyclepar	3 Automobi	4 EnginesPa	5 OtherTrans
Upper Bound	1,31	0,69	0,87	-1,16	-1,27
mean	-1,33	-10,58	-6,55	-7,06	-5,21
Lower Bound	-3,97	-21,85	-13,97	-12,96	-9,15
standard dev.	0,59	2,52	1,66	1,32	0,88

- *SSA around double 25%*

qdmk[*INDIA	1 Motorcycle	2 MCyclepar	3 Automobi	4 EnginesPa	5 OtherTrans
Upper Bound	9,70	-4,50	0,87	-2,09	0,89
mean	5,09	-17,51	-14,69	-10,18	-4,43
Lower Bound	0,48	-30,52	-30,25	-18,27	-9,75
standard dev.	1,03	2,91	3,48	1,81	1,19

Thank you