



ILO Statistics and the GTAP Labor Module

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The views expressed in this presentation and these slides do not necessarily reflect the views of the U.S. International Trade Commission or any of its individual commissioners.

Unpublished simulation results in these slides are from hypothetical scenarios intended to illustrate possible insights from expanding labor statistics.

U.S.-Korea FTA: Potential Economy-wide and Selected Sectoral Effects, 2007, based on the Global Trade Analysis Project (GTAP) model, a multi-regional CGE model on global trade

Table 2.1 U.S.-Korea FTA: Simulated effects of trade liberalization on U.S. GDP and welfare from a projected 2008 baseline

Indicator	Change from 2008 baseline	
	Million dollars	Percent of GDP
GDP	10,092 to 11,883	0.1 to 0.1
Payments to factors		
Land	409 to 692	0.6 to 1.0
Unskilled labor	2,674 to 3,119	0.1 to 0.1
Skilled labor	1,785 to 2,027	0.1 to 0.1
Capital	3,932 to 4,497	0.1 to 0.1
Natural resources	-71 to 0	-0.0 to 0.0
Welfare	1,785 to 2,070	0.0 to 0.0
Efficiency	44 to 67	0.0 to 0.0
Changes in the price of capital goods	450 to 528	0.0 to 0.0
Terms of trade (relative price of imports to exports)	1,282 to 1,483	0.0 to 0.0

Source: Commission calculations and GTAP version 6.1.

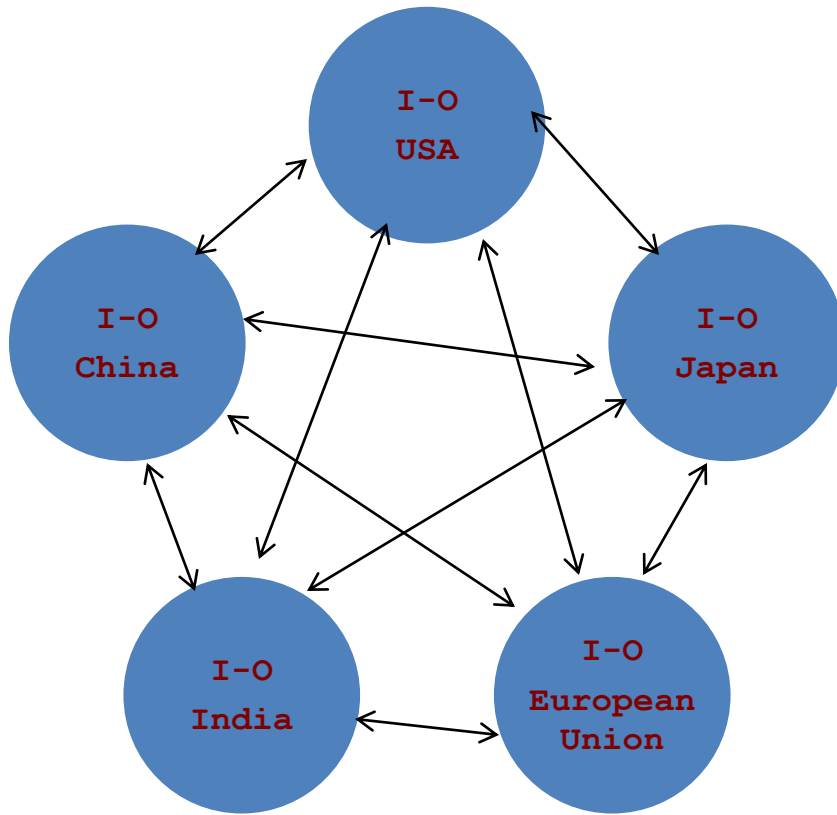
Note: Zero values indicate values less than 0.05 percent in absolute value. The difference between the sum of payments to factors and GDP is due to changes in net tax payments.

What is the Global Trade Analysis Project (GTAP)?

www.gtap.agecon.purdue.edu

- GTAP is coordinated by the Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University
- The GTAP Consortium consists of 28 national and international agencies which provide guidance and base-level support for the project
- GTAP provides
 - [GTAP Data Base](#) – A global data base: bilateral trade, production, consumption and intermediate use of commodities and services.
 - [GTAP Satellite Data and Utilities](#) - Additional data and utilities available to licensees of the GTAP Data Base, e.g., migration and emissions.
 - [GTAP CGE Model](#) - Documented in the [GTAP Book](#) and in [various papers](#).
 - [RunGTAP](#) – A visual interface to various programs for solving the GTAP model.
 - [Annual Short Course](#) – To introduce participants to GTAP.
 - [Annual Conference on Global Economic Analysis](#) – To promote the exchange of ideas among economists conducting quantitative analysis of global economic issues.
 - [Data Contribution](#) – Most of the datasets used to construct GTAP, e.g., I-O tables, are supplied by members of the GTAP Network.

GTAP 8.1 Data Base Release Candidate (Feb 2013)



- Base years 2004 and 2007
- 134 economies
- 57 industries/commodities
- Domestic data based on input-output (I-O) statistics
- Economies linked via international trade

Input-Output Data

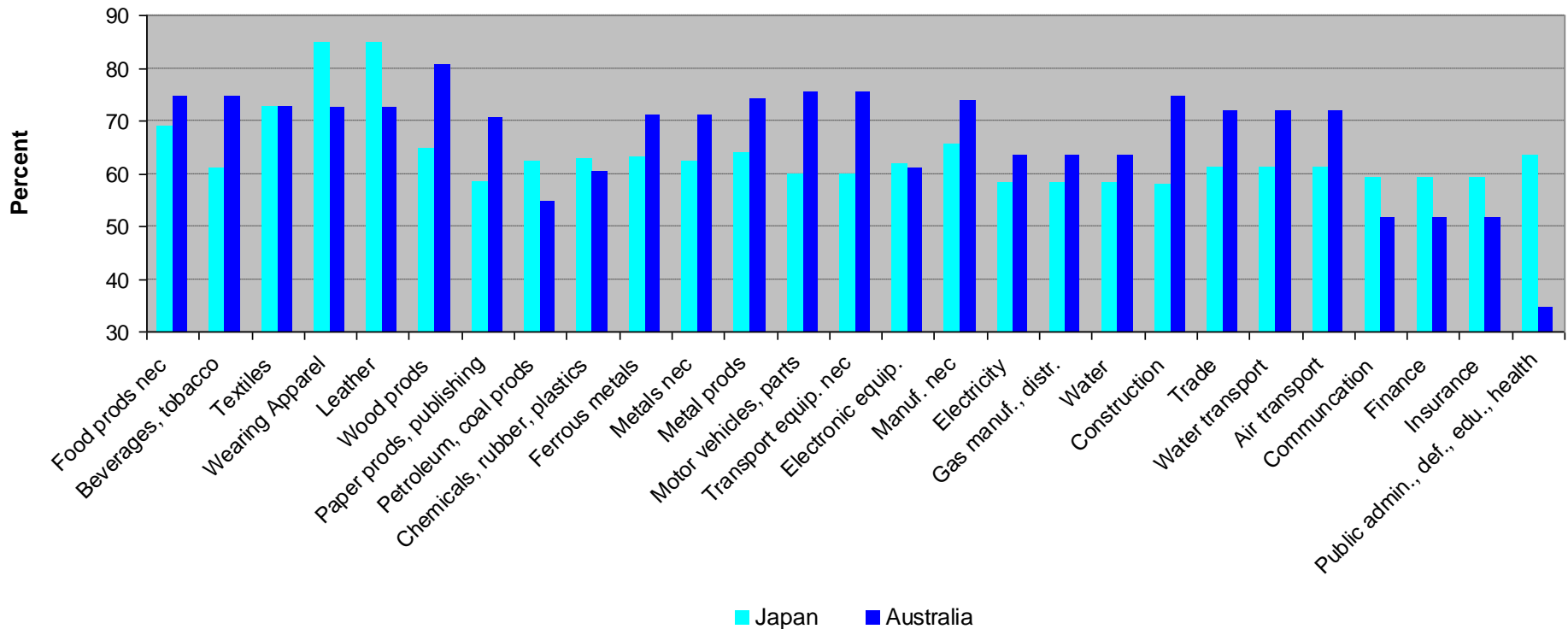
	Producers	Final Demand
Domestic Inputs		
Imported Inputs		
Primary Factors		

GTAP data version 8.1

Current GTAP data split labor payments for each industry into two categories: skilled and unskilled

Share of unskilled labor for selected sectors in Japan and Australia

Share=wage bill for unskilled labor/total labor wage bill



What are the sources of labor statistics in current GTAP database?

Sources of Wage and Employment Data for Original GTAP Work

Region	Year	Source	Data limitations and adjustments
USA	1992	1992 CPS	
Canada	1986	1986 Census	US distribution by industry used to find splits from Canadian employment and earnings by occupation
Australia	1991	ORANI CGE model	
EU	1988	Eurostat	Australian data used to find splits from manual/non-manual labor definitions
Japan	1970 & 1992	Japan Wage Survey	Income levels used to infer presence of skilled labor
Taiwan	1979 & 1990	DG-Budget & Dept of Agriculture	
South Korea	1991	Korea National Statistical	Taiwanese data used to find splits from operative/office-worker labor definitions
Brazil	1992	ILO	
Indonesia	1992	Sakarnas Survey	Skilled workers defined by high upper-secondary education
Philippines(a)	1986	APEX model	Skilled workers defined by high school completion.
Thailand(a)	1985	PARA CGE model	Skilled workers defined by long-term (at least monthly) employment arrangement.
Hong Kong	1991	1991 CPS	
India	1981	1981 Census	

Source: Liu, *et al.* (1998)

(a) The Philippines and Thailand were later dropped from sample because both showed "serious overestimation of skilled labor payment share" (Liu, *et. al*, 1998).

Scenario: Global trade liberalization

Results for U.S. wages

Standard GTAP framework

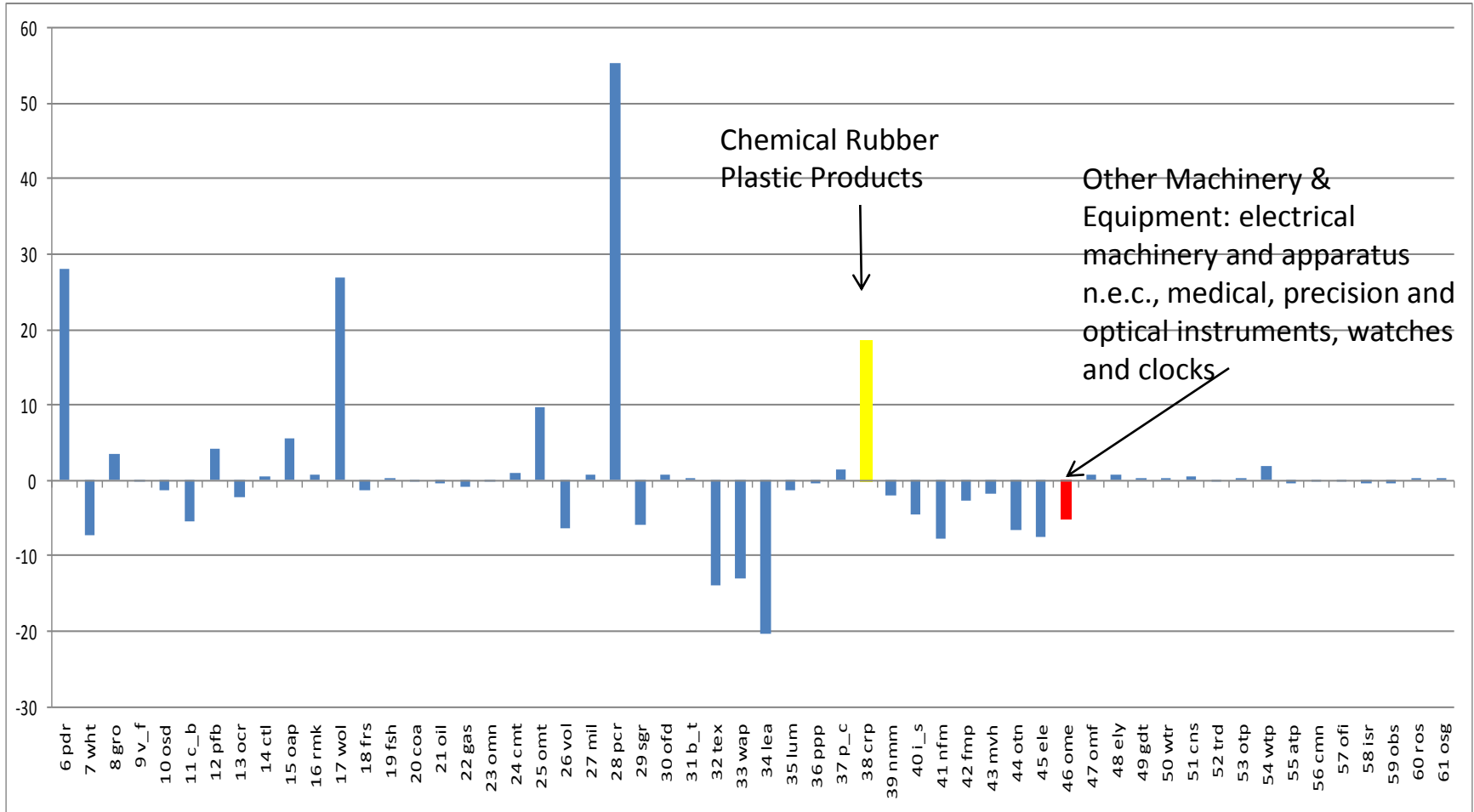
- We simulate the absence of duties levied on imports of goods by all economies
- Simulation result
 - U.S. labor wages would increase
 - unskilled labor 0.74%
 - skilled labor 0.77%

Source: Caricco and Tsigas, “Enriching U.S. Labor Results in a Multi-Regional CGE Model,” 2012, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2163242&download=yes

Scenario: Global trade liberalization

Results for U.S. output, by sector, percent change

Standard GTAP framework



Source: Caricco and Tsigas, "Enriching U.S. Labor Results in a Multi-Regional CGE Model," 2012,
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2163242&download=yes

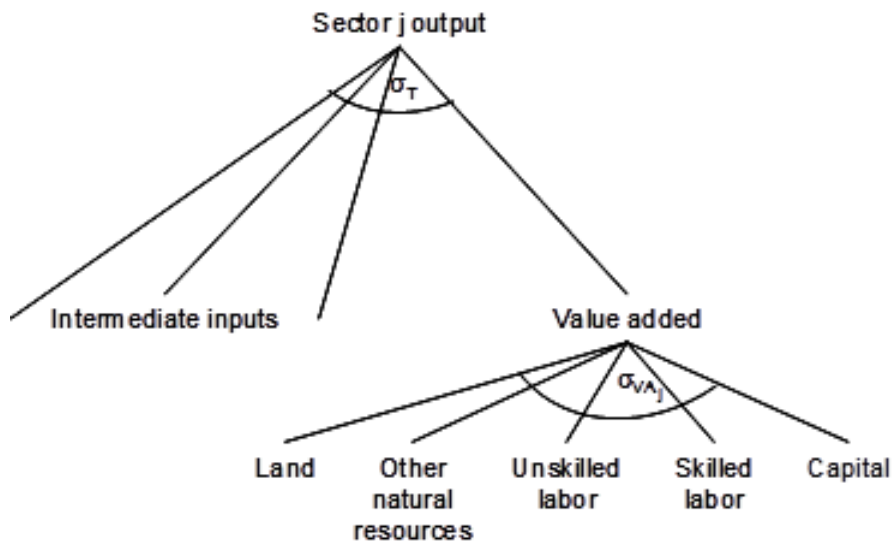
The 22 major occupational groups with mean weighted wage

SOC Major Group	SOC code	SOC Description	Weighted Mean Wage
11	management	Management Occupations	91,658
13	bus_finance	Business and Financial Operations Occupations	62,393
15	comp_math	Computer and Mathematical Occupations	72,157
17	arch_enginr	Architecture and Engineering Occupations	68,249
19	sciences	Life, Physical, and Social Science Occupations	62,014
21	social_serv	Community and Social Services Occupations	40,548
23	legal	Legal Occupations	88,397
25	education	Education, Training, and Library Occupations	46,611
27	entertain	Arts, Design, Entertainment, Sports, and Media Occupations	48,383
29	health_prac	Healthcare Practitioners and Technical Occupations	65,030
31	health_sup	Healthcare Support Occupations	25,599
33	protective	Protective Service Occupations	38,750
35	food_service	Food Preparation and Serving Related Occupations	19,436
37	build_maint	Building and Grounds Cleaning and Maintenance Occupations	23,551
39	pers_care	Personal Care and Service Occupations	23,976
41	sales	Sales and Related Occupations	35,236
43	admin_supp	Office and Administrative Support Occupations	31,218
45	farm_occup	Farming, Fishing, and Forestry Occupations	22,152
47	constructn	Construction and Extraction Occupations	40,616
49	maint_repr	Installation, Maintenance, and Repair Occupations	39,928
51	production	Production Occupations	31,310
53	transport	Transportation and Material Moving Occupations	30,399

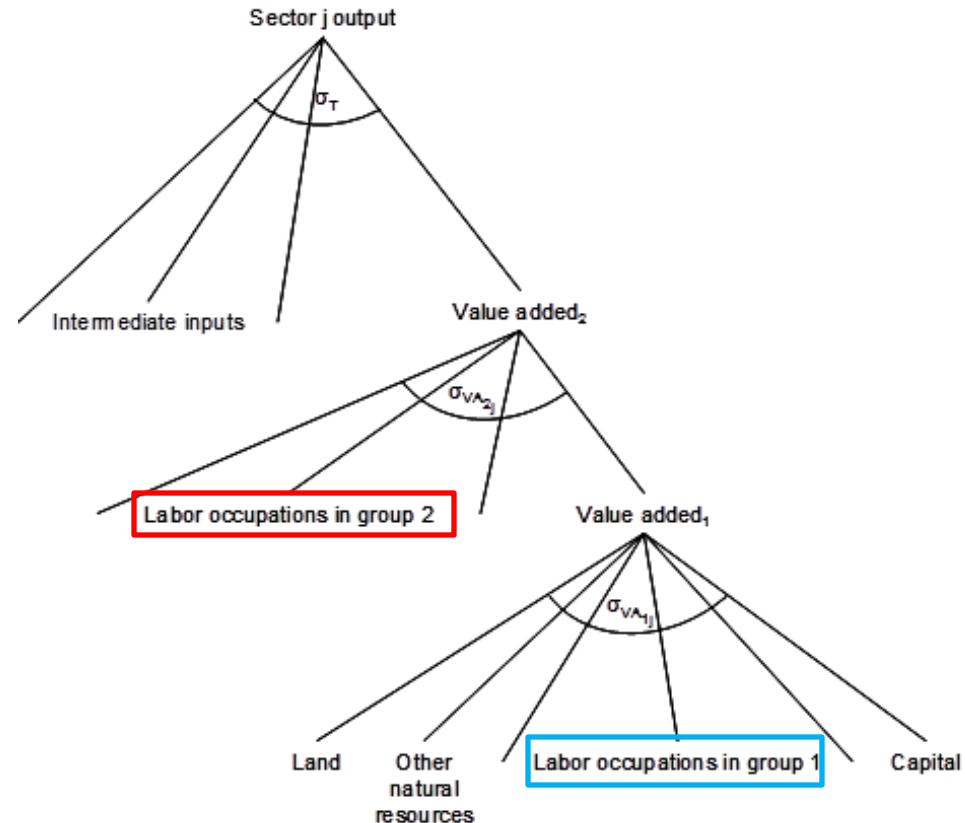
Source: May 2007 Bureau of Labor Statistics (BLS) Occupational Employment Statistics (OES) survey.

Modifying the production theory in GTAP to better model the labor market

Standard GTAP Model



Revised GTAP Model

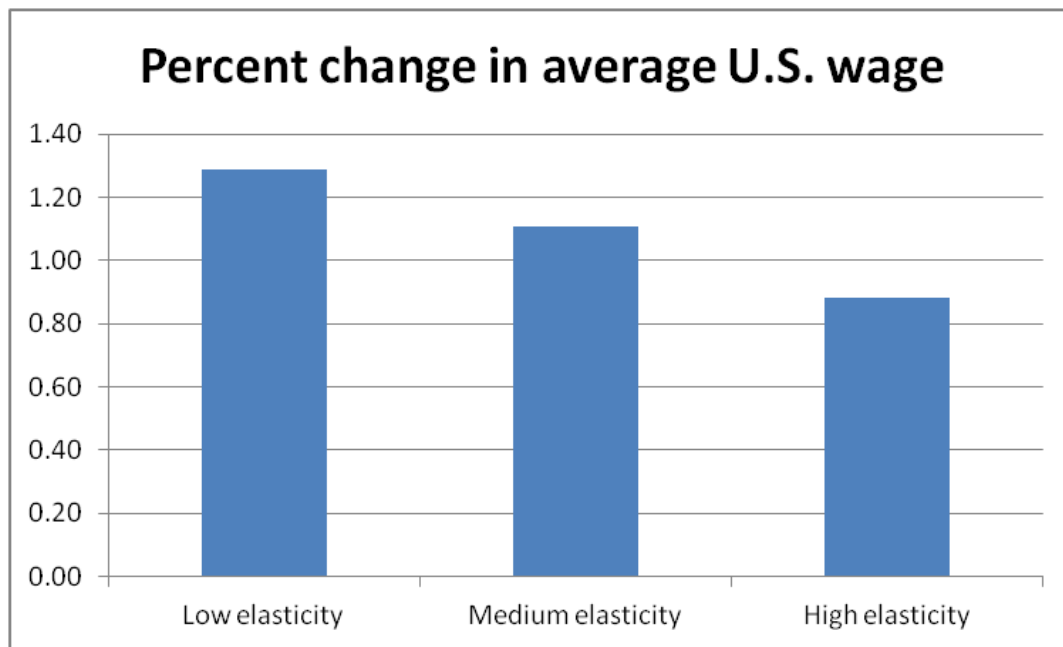


Scenario: Global trade liberalization

Results for U.S. wages

Revised GTAP framework

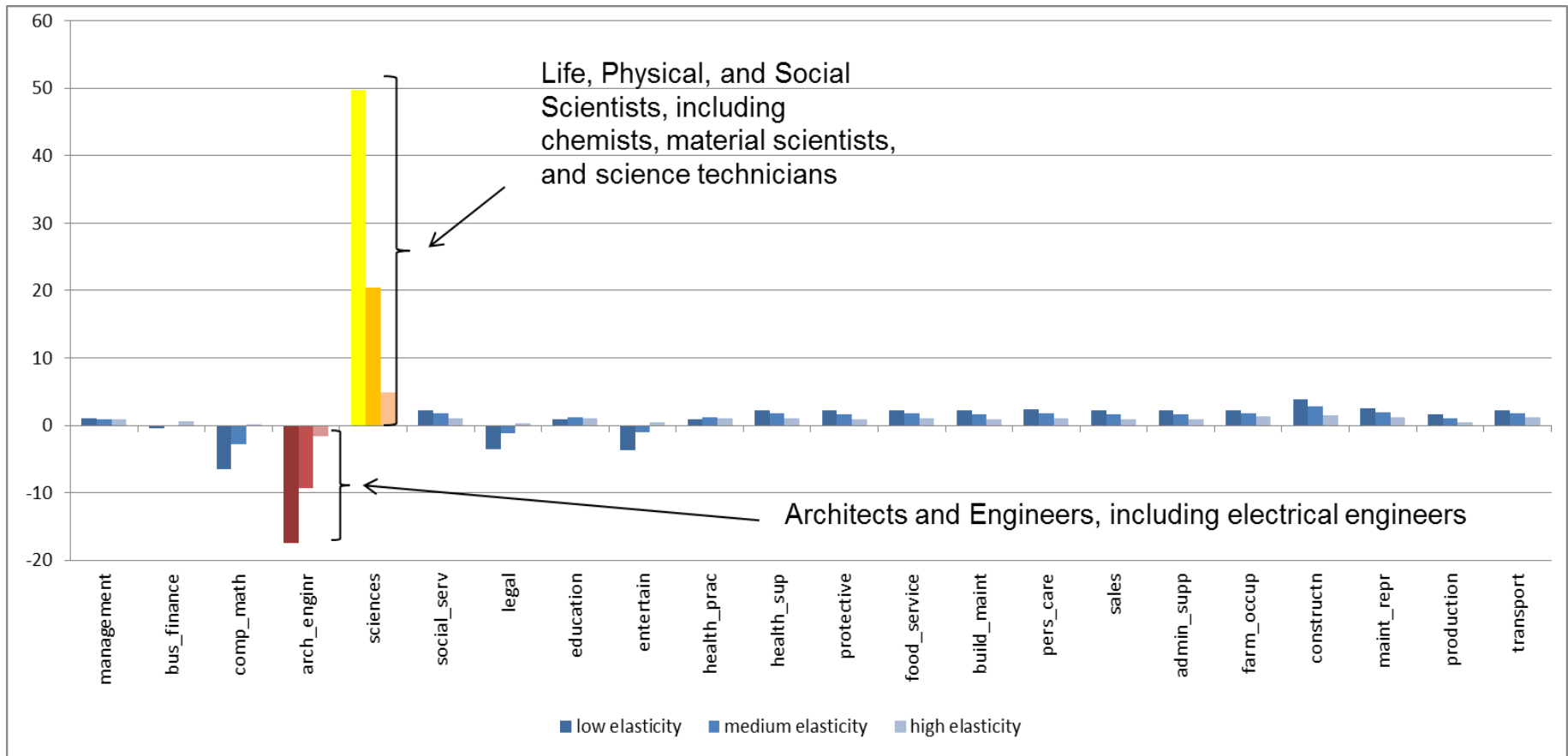
- We simulate the absence of duties levied on imports of goods by all economies in the world



Sensitivity analysis with respect to skilled labor substitutability, σ_{VA_2j}

Scenario: Global trade liberalization

Results for U.S. wages, by occupation, percent change Revised GTAP framework



Sensitivity analysis with respect to skilled labor substitutability, σ_{VA_2j}

Overview of “Labor Statistics for the GTAP Database,” Weingarden and Tsigas, 4/2010

- Objective: contribute labor splits to GTAP using more recent data sources that are disaggregated by occupation
 - Utilized publicly available statistics on employment and wages from the International Labor Office (ILO)
 - To impute missing wage values, we apply a minimization of squared deviations method
- Obtained wage and employment statistics by industry for 5 occupations and 46 countries
- Employment statistics by industry for 5 occupations and a further 47 countries
- For China and India we utilize both national and ILO statistics to obtain wages and employment

The ILO *Annual Yearbook* and the *October Inquiry*

- Combining two ILO databases gives us wages and employment data for more than 40 countries
 - The *ILO Annual Yearbook* gives the number of workers by industry and occupation, $N_{\text{Occ, Ind}}$ and the average wage by industry, w_{Ind}
 - Each country has approx. 15 industries (ISIC 2 or 3 top level codes)
 - Each industry has approx. 9 occupations (one-digit ISCO codes)
 - The *ILO October Inquiry* database gives 161 wages by job, w_{Job}
 - A job is occupation and industry-specific, such as “Mathematics teacher”. The equivalent occupation/industry combination would be “Professional” in “Education”. Therefore, each w_{Job} observation can be mapped to a wage by occupation and industry $w_{\text{Occ, Ind}}$
 - The data we use has been prepared by Freeman & Oostendorp for their 2000 and 2005 working papers

Wages and Employment Data from the *ILO Annual Yearbook*

Labor wages

Occupations	Industries				
	A	B	...	...	C
1	$W_{ij}; i=1, \dots, r; j=1, \dots, c$				
2					
3					
r					
Average	W.1	W.2	W.3	...	W.c

MISSING VALUES:
Wages by Industry & Occupation

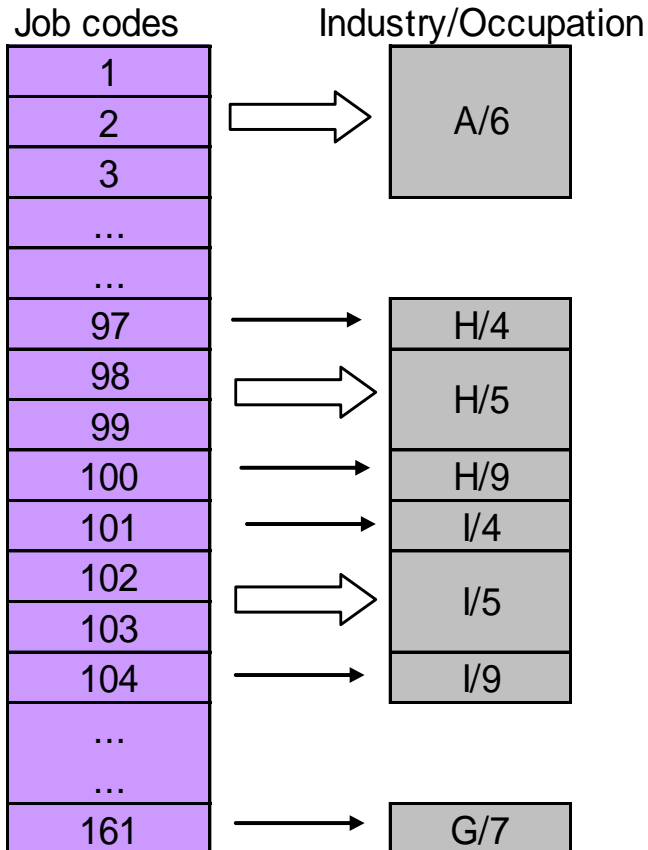
ILO Annual Yearbook:
Average Wages by Industry

Number of workers

Occupations	Industries				
	A	B	...	...	C
1	$L_{ij}; i=1, \dots, r; j=1, \dots, c$				
2					
3					
r					
Total	L.1	L.2	L.3	...	L.c

ILO Annual Yearbook:
Employment by Industry & Occupation

Wages by Job from the *ILO October Inquiry*



- The *October Inquiry* database has wage data for 161 jobs. These jobs map to 35 industry/occupation groups
 - For 23 of these industry/occupation groups, more than one job mapped to the same group. In these cases we used an arithmetic average to find a wage by occupation and industry ($w_{Occ, Ind}$) from multiple wages by job (w_{Job})
 - 35 elements of the $w_{Occ, Ind}$ matrix were estimated from w_{Job} observations but this meant that many elements of the 5×15 $w_{Occ, Ind}$ matrix were still missing

Wages and Employment Data from the ILO Annual Yearbook and the October Inquiry

Labor wages with observed wages by job

Occupations	Industries				
	A	B	...	...	c
1					
2					
3					
6					
Average	W.1	W.2	W.3	...	W.c

ILO October Inquiry: Wages by Job

ILO Annual Data: Average wages by Industry

Labor wages: Final matrix

Occupations	Industries				
	A	B	...	...	c
1					
2					
3					
6					
Average	W.1	W.2	W.3	...	W.c

Method of Imputing Wages

$$\text{minimize } \sum_{i \in \text{Occ}} \sum_{j \in \text{Ind}} \beta_{ij} [w_{ij} - \hat{w}_{ij}]^2 + \sum_{i \in \text{Occ}} \sum_{j \in \text{Ind}} [\hat{w}_{i.} - \hat{w}_{ij}]^2$$

subject to $\hat{w}_{.j} = w_{.j}, \quad j \in \text{Ind}$

where w_{ij} are statistics on wages,

\hat{w}_{ij} are estimated wages, and

β_{ij} are degree of belief parameters

Occupations and Industries

Occupations

- 1: Senior officials and managers
- 2: Professionals
- 3: Technicians & associate professionals
- 4: Clerks
- 5: Service and shop workers
- 6: Skilled agricultural workers
- 7, 8, 9: Machine operators, assemblers, craft workers, etc.

Industries (ISIC Rev 3)

- A : Agriculture, hunting and forestry
- B : Fishing
- C : Mining and quarrying
- D : Manufacturing
- E : Electricity, gas and water supply
- F : Construction
- G : Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
- H : Hotels and restaurants
- I : Transport, storage and communications
- J : Financial intermediation
- K : Real estate, renting and business activities
- L : Public administration and defense; compulsory soc.security
- M : Education
- N : Health and social work
- O : Other community, social and personal service activities
- P : Private households with employed persons
- Q : Extra-territorial organizations and bodies
- X: Not classifiable by economic activity

Results: United States

Input matrix: Observed wages by job and industry averages

	A	C	D	E	F	G	H	I	J	K	L	M	N	O	P
onetwo		\$46	\$27	\$32					\$29		\$38	\$26	\$62		
three		\$30	\$24			\$13		\$55	\$25	\$24			\$25		
four			\$11	\$18		\$12	\$10	\$31	\$15		\$20				
five						\$18	\$10	\$18			\$19				
sixtonine	\$17	\$21	\$16	\$27	\$19	\$15	\$9	\$23					\$11	\$13	
Average	\$9	\$18	\$15	\$24	\$19	\$12	\$12	\$17	\$16	\$16	\$15	\$15	\$15	\$15	\$15

Final matrix: Imputed wages by job

	A	C	D	E	F	G	H	I	J	K	L	M	N	O	P
onetwo	\$12	\$32	\$23	\$28	\$19	\$14	\$16	\$11	\$21	\$17	\$20	\$20	\$24	\$18	\$18
three	\$11	\$23	\$20	\$19	\$16	\$13	\$13	\$36	\$18	\$20	\$9	\$13	\$14	\$15	\$15
four	\$9	\$12	\$10	\$15	\$13	\$9	\$12	\$23	\$10	\$12	\$16	\$11	\$11	\$12	\$12
five	\$7	\$11	\$10	\$14	\$11	\$13	\$9	\$13	\$9	\$10	\$9	\$8		\$11	\$10
sixtonine	\$9	\$10	\$12	\$23	\$19	\$14	\$11	\$10	\$12	\$14	\$11	\$13	\$8	\$12	\$14

Comparison of 2002 data from ILO and Bureau of Labor Statistics (national source)

	Agri	Mining	Manu	Util	Constr	Trade	Hotel	Transp	Finance	Proper	Public	Educat	Health	Commu
ILO	\$ 9	\$ 18	\$ 15	\$ 24	\$ 19	\$ 12	\$ 12	\$ 17	\$ 16	\$ 16	\$ 15	\$ 15	\$ 15	\$ 15
US	\$ 10	\$ 21	\$ 18	\$ 25	\$ 19	\$ 14	\$ 9	\$ 17	\$ 22	\$ 15	\$ 16	\$ 13	\$ 17	\$ 14

Data Availability by Country, wages and employment

Most Recent and Complete Year of ILO Data for Countries with Wage and Employment Data							
Country	N _{Occ, Ind}	W. Ind ^(a)	Industries	Country	N _{Occ, Ind}	W. Ind ^(a)	Industries
	Best year		Number		Best year		Number
Australia	2006	2002	14	Mauritius	2006	2003	15
Austria	2006	2002	16	Mexico	2006	2003	18
Barbados	2003	1995	9	Moldova	2006	2003	15
Bolivia	2000	1999	8	Netherlands	2005	1990	14
Brazil	2004	2001	18	New Zealand	2006	1991	13
Bulgaria	2006	1990	14	Nicaragua	2006	2002	6
Canada	2006	2003	14	Peru	2006	2001	13
Costa Rica	2006	2000	18	Philippines	2006	1999	17
Croatia	2006	1996	15	Poland	2006	2002	15
Cyprus	2006	2002	15	Portugal	2006	2000	12
Czech Republic	2006	2003	15	Romania	2006	2003	14
Estonia	2006	1997	15	Russia	2006	2000	16
Finland	2006	1998	14	San Marino	1999	2003	10
Germany	2006	2003	13	Singapore	2006	2002	7
Hungary	2006	2003	15	Slovakia	2006	2002	14
Iceland	2000	2003	5	Slovenia	2006	1997	15
Japan	2006	1998	11	Sri Lanka	1998	2000	5
Korea	2006	2001	14	Sweden	2006	1991	12
Kyrgyzstan	2006	2002	15	Thailand	1998	1995	9
Latvia	2006	2003	15	Turkey	2006	1992	6
Lithuania	2006	2000	15	U.K.	2006	2003	17
Luxembourg	1991	1995	6	United States	1998	1999	9
Malawi	1998	1995	9	Venezuela	1997	2000	9

Source: Authors' calculations

^(a) The best year of wages refers to the *ILO Yearbook*. For some countries the best year of wages in the Freeman and Oostendorp *October Inquiry* data does not match the best year of wages in the *ILO Yearbook*.

China has incomplete data and all data is missing for India.

Statistics for China and India

- Employment: Labor Statistical Yearbook
 - 2002 employment by sector
 - 2006 statistics on
 - employment by sector and educational attainment, and
 - employment by occupation and educational attainment
- Wages: 2006 ILO October Inquiry wages by job and 2007 ILO Yearbook wages by industry
- Results: employment and wages for 11 sectors
- Employment: IndiaStat
 - Distribution of Main Workers by Industry and Occupation for 1991
- Wages
 - IndiaStat, Industry division-wise average wages for 2006
 - ILO October Inquiry wages by job for 2000
- Results: wage and employment for 6 sectors

Data Availability by Country, employment

Most Recent and Complete Year of ILO Data for Countries with Employment Data Only					
Country	N _{Occ, Ind}	Industries	Country	N _{Occ, Ind}	Industries
	<u>Best year</u>	<u>Number</u>		<u>Best year</u>	<u>Number</u>
Algeria	2004	18	Italy	2006	18
Anguilla	2001	17	Macau, China	2003	18
Argentina	2006	18	Macedonia	1991	7
Bahrain	1991	10	Malaysia	2000	9
Bangladesh	2005	16	Maldives	2006	18
Belgium	2006	18	Malta	2006	18
Belize	2005	18	Morocco	2006	9
Bermuda	2006	18	Namibia	1991	10
Botswana	2001	18	Nepal	1991	10
Cape Verde	1990	10	Nethl. Antilles	1992	9
Chile	2006	9	Norway	2006	17
Colombia	1994	10	Oman	2000	18
Denmark	2002	18	Pakistan	2006	10
Ecuador	2006	18	Panama	2006	18
Egypt	2003	17	Paraguay	1994	9
El Salvador	2006	13	Qatar	2006	18
Ethiopia	2005	16	Réunion	1999	18
France	2005	18	Serbia	2006	18
Greece	2006	18	South Africa	2003	12
Guatemala	1991	10	Spain	2006	17
Honduras	1999	9	Suriname	1996	10
Hong Kong	2006	8	Trinidad and Tobago	2002	10
Indonesia	2006	9	Tunisia	1997	6
Iran	2005	18	Uruguay	1998	9
Ireland	2006	18	West Bank and Gaza Strip	2006	18
Israel	2006	15			

Source: Authors' calculations

Thank you!