

Understanding U.S. Worker Exposure to Trade by Gender, Education Level, and Occupation

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- Policy makers are interested in distributional impacts of trade policy changes on workers
 - President Biden's 2021 Trade Policy Agenda describes "worker-centric trade policy"
- Standard GTAP labor specification not detailed enough to understand winners and losers of specific trade policies
- Contribution of this paper:
 - Details a methodology to disaggregate U.S. labor in GTAP into 20 types, by gender, educational attainment, and occupation category
 - Provides heterogeneous wage bill shares for each type by GTAP sector
 - Runs several illustrative simulations on manufacturing, agriculture, and services sectors to understand differential impact on workers

Other Literature with GTAP Labor Modifications

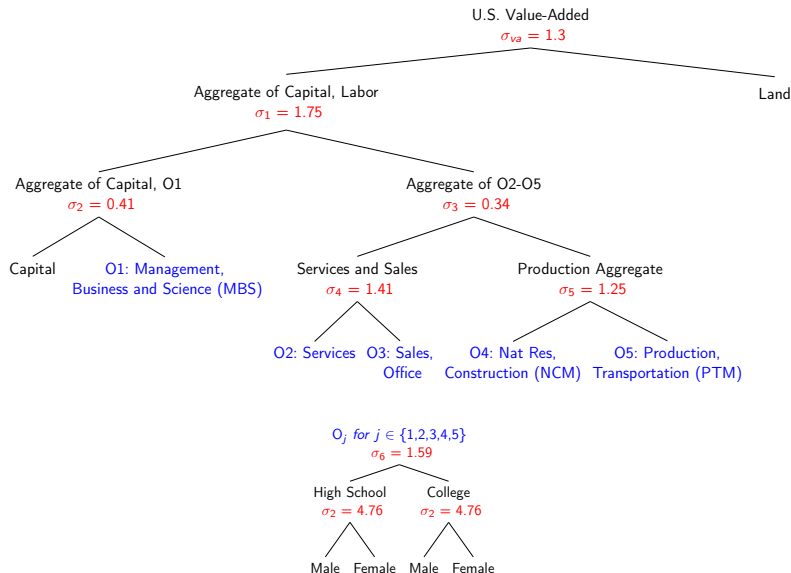
- By skill level:
 - Dimaranan and Narayanan (2008) split the labor factor in GTAP into skilled and unskilled labor
 - Bohringer et al (2005); Boccanfuso and Savard (2008)
- By occupation:
 - Carneiro and Arbach (2003); Colombo (2008); Giesecke et al (2011)
- By gender:
 - Fontana and Wood (2000); Colombo (2008); Gurevich et al (2020)
 - World Bank gender disaggregated labor database for large number of countries
- Others:
 - Flaig et al (2011) disaggregate labor by skill type and ethnicity, nationality
 - Dixon et al (2011) models occupation, legal status, and place of birth
 - Global Affairs Canada labor effects by gender, age, and occupation

Modifying the U.S. Labor Factor Demand in GTAP

- Two obstacles: (1) how to find estimated labor demand elasticities, and (2) how to choose demand hierarchy/nesting
- Matched structure of Johnson & Keane (2013) to use their estimated substitution and labor supply elasticities
- Disaggregated the labor factor into 20 types: 2 genders, 2 educational attainments, and 5 occupation types
- Only modified U.S. labor factor to take advantage of rich U.S.-level CPS data

	Female, High School	Female, College	Male, High School	Male, College
Management, Business, and Science (MBS)	F-H-1	F-C-1	M-H-1	M-C-1
Services	F-H-2	F-C-2	M-H-2	M-C-2
Sales and Office	F-H-3	F-C-3	M-H-3	M-C-3
Natural Resources, Construction, Maintenance (NCM)	F-H-4	F-C-4	M-H-4	M-C-4
Production, Transportation, Materials Moving (PTM)	F-H-5	F-C-5	M-H-5	M-C-5

GTAP Production Nesting Structure



Construction of Wage Bill Share Matrix

- The model requires wage bill shares by labor type and GTAP sector to share out labor payments
- Shares for each GTAP sector are calculated using the Current Population Survey (CPS) Annual Social and Economic Supplement (ASEC)
 - Representative survey of U.S. households with about 90,000 people surveyed; includes many demographic and economic variables
 - CPS industry codes concorded to GTAP sectors with customized concordance
 - CPS occupation codes grouped into 5 categories

GTAP	F-C-1	F-C-2	F-C-3	F-C-4	F-C-5	F-H-1	F-H-2	F-H-3	F-H-4	F-H-5	M-C-1	M-C-2	M-C-3	M-C-4	M-C-5	M-H-1	M-H-2	M-H-3	M-H-4	M-H-5	Total
bph	0.265	0.029	0.052	.	0.056	0.004	.	0.007	0.001	0.004	0.402	0.020	0.022	0.007	0.071	0.005	0.009	0.003	0.008	0.038	1.00
eeq	0.079	.	0.027	.	0.035	.	0.002	0.005	.	0.046	0.375	0.054	0.092	0.016	0.093	0.034	0.016	0.011	0.011	0.105	1.00
ele	0.159	0.004	0.027	0.002	0.022	0.024	0.003	0.003	0.001	0.021	0.539	0.039	0.041	0.012	0.042	0.013	0.006	0.006	0.004	0.030	1.00

U.S. Labor Supply Modifications

- We relax the standard GTAP assumption that labor supply is fixed, introduce upward sloping labor supply curve so that workers can respond to changes in the real wage
- Perfectly competitive labor market where wage equals the marginal product of labor, no wage rigidities or frictions on worker movements
- Labor supply elasticities estimated in Johnson and Keane (2013)

	Elasticity Estimate
High school male	0.74
College male	0.74
High school female	0.94
College female	1.13

Illustrative Simulations

- We run hypothetical experiments on different sector groups to understand U.S. worker exposure to trade policy changes:

Simulation	Sectors
Increase U.S. tariffs by 5% on all agricultural imports	Rice, wheat, other grains, vegetables and fruit, oil seeds, cane and beet, fibres crops, other crops, cattle, other animal products, raw milk, wool, cattle meat, other meat, vegetable oils, milk, processed rice, sugar, other foods, beverages and tobacco products
Reduction in services imports	Electricity, gas manufacture, water supply, construction, wholesale and retail trade, accommodation, food and services, land transport, water transport, air transport, warehousing, information and communication, other financial intermediation, insurance, real estate, other business services, recreation, other services, government, education, health and social work, and ownership of dwellings
Increase U.S. tariffs by 5% on heavy manufacturing imports	Petroleum, coal, chemical products, rubber, plastic, pharmaceutical, minerals, ferrous metals, computer, electronics, electrical equipment, and machinery

Simulations: Agriculture Sectors

Simulated employment effects after U.S. tariff increases on agriculture imports

	Nominal Wage (% Change)	Real Wage (% Change)	Labor Supply (% Change)
Female, high-school, NCM (F-H-4)	0.165	0.025	0.023
Female, college, NCM (F-C-4)	0.141	0.001	0.001
Male, high-school, NCM (M-H-4)	0.139	-0.001	-0.001
Male, college, NCM (M-C-4)	0.125	-0.015	-0.011
Male, high-school, MBS (M-H-1)	0.115	-0.025	-0.019
Male, college, services (M-C-2)	0.111	-0.03	-0.022
Female, high-school, MBS (F-H-1)	0.115	-0.025	-0.024
Male, high-school, services (M-H-2)	0.107	-0.033	-0.024
Male, high-school, sales (M-H-3)	0.107	-0.033	-0.024
Male, college, MBS (M-C-1)	0.106	-0.034	-0.025
Male, college, sales (M-C-3)	0.106	-0.034	-0.025
Female, college, services (F-C-2)	0.117	-0.024	-0.027
Female, high-school, services (F-H-2)	0.11	-0.03	-0.028
Female, high-school, sales (F-H-3)	0.111	-0.03	-0.028
Female, college, MBS (F-C-1)	0.11	-0.03	-0.034
Female, college, sales (F-C-3)	0.11	-0.03	-0.034
Male, high-school, PTM (M-H-5)	0.08	-0.06	-0.045
Male, college, PTM (M-C-5)	0.076	-0.065	-0.048
Female, high-school, PTM (F-H-5)	0.083	-0.057	-0.054
Female, college, PTM (F-C-5)	0.084	-0.056	-0.063

NCM = natural resources (farm workers), construction, and maintenance; PTM = production, transportation, and materials moving; MBS = management, business and science

Simulations: Services Sectors

Simulated employment effects after a reduction in U.S. services imports

	Nominal Wage (% Change)	Real Wage (% Change)	Labor Supply (% Change)
Female, college, services (F-C-2)	0.276	-0.013	-0.014
Male, college, services (M-C-2)	0.265	-0.024	-0.018
Male, high-school, services (M-H-2)	0.26	-0.029	-0.021
Female, college, MBS (F-C-1)	0.268	-0.021	-0.024
Female, high-school, services (F-H-2)	0.262	-0.027	-0.025
Male, college, MBS (M-C-1)	0.256	-0.034	-0.025
Male, college, sales (M-C-3)	0.252	-0.037	-0.027
Female, college, sales (F-C-3)	0.262	-0.027	-0.03
Female, high-school, sales (F-H-3)	0.256	-0.033	-0.031
Female, high-school, MBS (F-H-1)	0.254	-0.035	-0.033
Male, high-school, sales (M-H-3)	0.243	-0.046	-0.034
Male, high-school, MBS (M-H-1)	0.229	-0.06	-0.045
Male, high-school, NCM (M-H-4)	0.185	-0.104	-0.077
Male, college, NCM (M-C-4)	0.184	-0.105	-0.078
Female, high-school, NCM (F-H-4)	0.18	-0.109	-0.103
Female, college, NCM (F-C-4)	0.19	-0.099	-0.112
Male, college, PTM (M-C-5)	0.122	-0.167	-0.123
Male, high-school, PTM (M-H-5)	0.103	-0.187	-0.138
Female, college, PTM (F-C-5)	0.13	-0.159	-0.18
Female, high-school, PTM (F-H-5)	0.096	-0.193	-0.182

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Simulations: Heavy Manufacturing Sectors

Simulated employment effects after U.S. tariff increases on all heavy manufacturing imports

	Nominal Wage (% Change)	Real Wage (% Change)	Labor Supply (% Change)
Male, high-school, services (M-H-2)	0.544	-0.030	-0.022
Male, college, services (M-C-2)	0.542	-0.032	-0.023
Female, high-school, services (F-H-2)	0.548	-0.026	-0.025
Female, college, services (F-C-2)	0.548	-0.026	-0.029
Male, college, sales (M-C-3)	0.509	-0.065	-0.048
Male, high-school, sales (M-H-3)	0.49	-0.084	-0.062
Female, college, sales (F-C-3)	0.511	-0.063	-0.071
Female, high-school, sales (F-H-3)	0.497	-0.077	-0.072
Male, college, MBS (M-C-1)	0.474	-0.1	-0.074
Female, college, MBS (F-C-1)	0.494	-0.08	-0.091
Female, high-school, MBS (F-H-1)	0.449	-0.125	-0.117
Male, high-school, MBS (M-H-1)	0.388	-0.186	-0.138
Male, college, PTM (M-C-5)	0.377	-0.197	-0.146
Male, high-school, PTM (M-H-5)	0.373	-0.201	-0.149
Female, high-school, PTM (F-H-5)	0.395	-0.179	-0.168
Female, college, PTM (F-C-5)	0.409	-0.165	-0.186
Female, college, NCM (M-C-4)	0.239	-0.335	-0.248
Male, high-school, NCM (M-H-4)	0.186	-0.388	-0.287
Female, high-school, NCM (F-H-4)	0.217	-0.357	-0.336
Female, college, NCM (F-C-4)	0.264	-0.31	-0.35

NCM = natural resources, construction, and maintenance; PTM = production, transportation, and materials moving; MBS = management, business and science

Conclusions and Future Research

- In this paper, we propose a methodology to disaggregate U.S. labor factor demands by gender, educational attainment, and occupation
- Illustrative simulations show differential effects on workers
 - Sectors that expand as a result of the policy change have positive employment effects for workers employed in those sectors, but wage and labor effects are partly/wholly mitigated by sectors that contract
- Future research:
 - Explore changes to the wage structure, more disaggregated types, household factor ownership
 - Update base year data to be more recent than 2017
 - Re-estimate the substitution and labor supply elasticities with more recent data