Incorporating Unemployment into the GTAP Model

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Outline

- Motivation
- Introducing frictional unemployment into GTAP
- Example simulation using new model
  - 25% increase in U.S. tariff on steel and aluminum
  - Comparison to standard GTAP model
- Summary and future considerations

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Motivation

- AGE models designed for medium to long-run analysis
  - Labor markets have enough time to return to full employment after policy shock
- Recent concerns about impacts of FTAs on employment
  - Does economy go back to original “full” employment?
  - Length of adjustment?

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Incorporating Frictional Unemployment

Matching Function

- To hire new workers, firms must use labor to match unemployed workers with job openings

- Matching function: $m_j = \mu_j \left(1-\bar{n}\right)^{\gamma_j} R_j \left(\sum_k R_k\right)^{-\gamma_j}$

- Properties:
  - Increasing in unemployment and own recruitment effort
  - Decreasing in recruitment effort in other industries
  - CRTS in all arguments
  - Decreasing returns to own recruitment effort

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Labor Classes

- For both skilled and unskilled labor:
  - Existing
  - Matched (newly hired)
  - Recruiters
  - Unmatched labor

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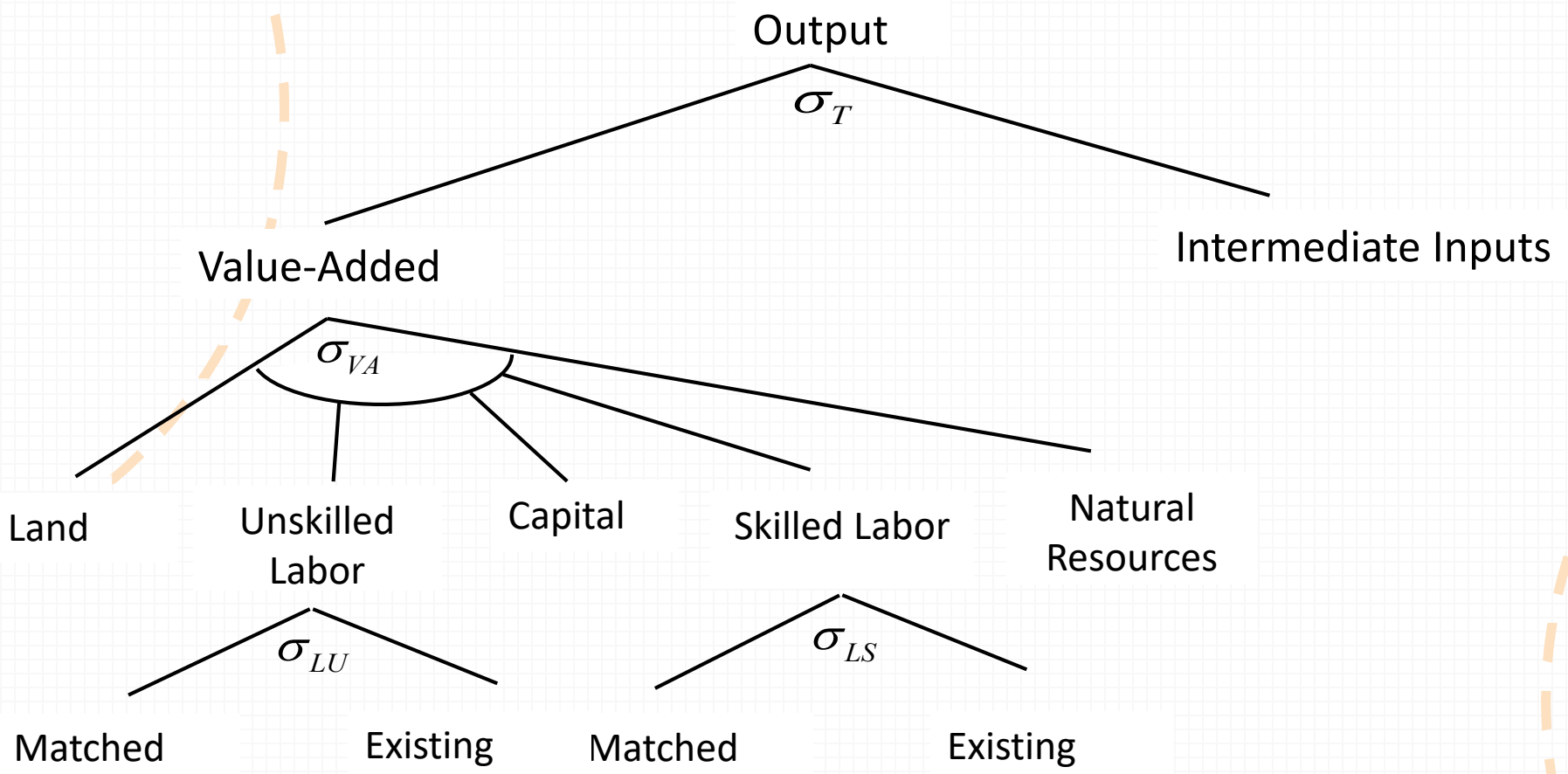
Production Structure



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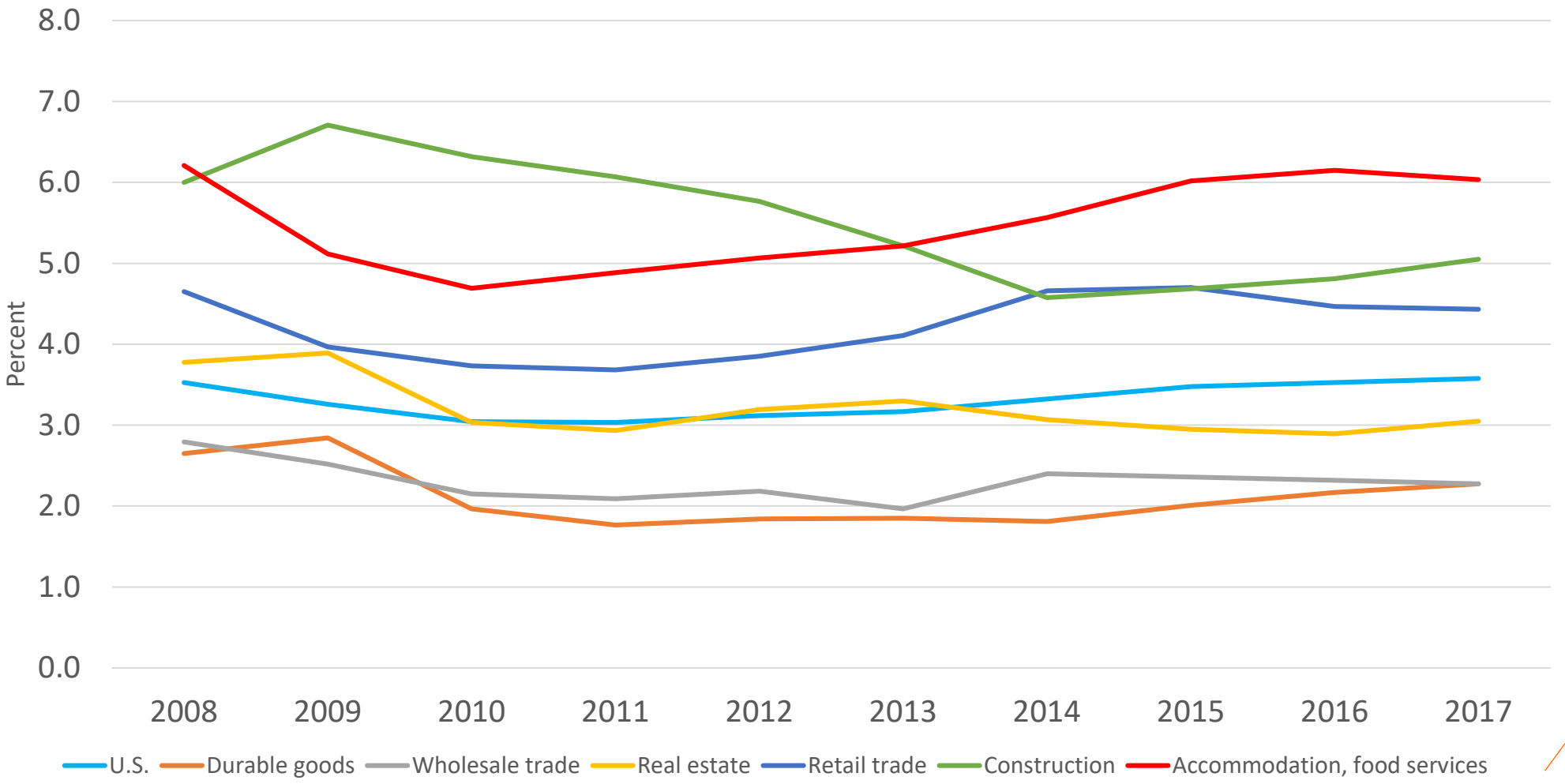
Average Monthly Separation Rates by Select Industries



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Separation/Turnover Rates in Simulation

Industry	Unskilled Labor	Skilled Labor
Food and agriculture	0.3	0.3
Extraction	0.31	0.31
Metals	0.21	0.21
Manufacturing	0.2418	0.2418
Trade and transportation	0.375	0.375
Services	0.4199	0.3815
Total	0.365	0.365

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Labor Supply

- Goal: incorporate labor supply in manner that minimizes changes to existing GTAP preference structure

- Assume consumption is separable from labor supplied
  - Use an additive function
  - Constant elasticity of supply

$$U(c,h) = \log c - \psi_u \frac{h_u^{1+\rho_u}}{1+\rho_u} - \psi_s \frac{h_s^{1+\rho_s}}{1+\rho_s}$$

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Level of Unemployment by Labor Type

- Use unemployment rates by education level
  - Not a perfect match – future work could consider alternatives

Education Level	Unemployment Rate	Labor Class	Unemployment Rate
Without high school diploma	14.1	Unskilled	11.8
High school graduate	9.4	Skilled	7.0
Associate's degree or some college	8.0		
B.S. or higher	4.3		
Total U.S.	9.0		

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Calibrating the Matching Function

- Empirical estimates of γ vary 0.3 to 0.75
  - Hafstead and Williams (2018) use 0.5
- Assume that 1% of initial labor is used for recruitment
  - Hafstead and Williams assume 0.5%
- Initial number of matches: turnover rate * initial units of labor
- Given level of unemployment, only unknown is μ
  - Implication for assuming constant percentage of recruiters

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25% Increase in U.S. Tariff on Metals

Aggregations and Parameter Values

- 6 sectors/industries:
  - Food and agriculture, extraction industries, metals, manufacturing, trade and transport, services
- 3 regions: USA, EU, and ROW
- 5 primary factors
- Parameters
  - All common parameters se to default values
  - Labor supply elasticities: 1.0
  - Elasticity of substitution between matched and existing labor: 2.5

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Overview of Tariff Impact

- Imported metal products more expensive relative to domestic metal products
- Metal products are primarily intermediate inputs
  - U.S. firms substitute domestic for imported metal products
- Increase in demand lead to increase in price of U.S. metals
  - Increases the cost of production for U.S. industries - manufacturing
- Price of U.S. manufactured products increases relative to other regions
  - Reduction in domestic demand as U.S. firms substitute to imports
  - Reduction in U.S. exports of manufactured products

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Overview of Tariff Impact Continued

- Impacts on labor markets
  - Increase labor demand by U.S. metals
  - Decrease in labor demand by U.S. manufacturing
  - Manufacturing is much larger employer, so overall demand decreases
  - Wage rates fall to return to full employment

- In GTAP Labor, existing labor is sector specific:
  - Wages increase in metals
  - Wage decrease in manufacturing is amplified
  - Unmatched labor is mobile across industries – small wage decrease

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U.S. Metals and Manufacturing

Sector	Standard GTAP	GTAP Labor
Output price	Percent change	
Metals	2.25	4.25
Manufacturing	0.30	0.20
Output		
Metals	11.83	7.83
Manufacturing	-0.65	-0.46

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Impact on U.S. Unskilled Labor

Sector	Standard GTAP	GTAP Labor
Composite labor use - qfe	Percent change	
Metals	11.82	5.54
Manufacturing	-0.66	-0.37
Composite wage rate - pfe		
Metals	-0.10	7.21
Manufacturing	-0.10	-0.59
Wage rate existing labor		
Metals		9.55
Manufacturing		-0.74
Wage rate matched labor		-0.11

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Changes in U.S. Employment by Sector

Sector	Unskilled Labor	Skilled Labor
Matched labor	Units (millions)	
Metals	2,531.1	1,594.4
Manufacturing	-2,768.0	-1,663.0
Services	-2,635.8	-4,585.4
Total	-3,588.5	-5,119.0
Recruiters		
Metals	114.6	69.6
Manufacturing	-193.7	-153.1
Services	-255.5	-817.5
Total	-449.8	-1,054.1
	Percent change	
Unemployment level	0.83	1.53

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Summary

- Incorporate job-search frictions into standard GTAP model
  - Firms must use real resources (recruiters) to fill vacancies
  - Matching function based on level of unemployment and recruitment effort
- Illustrate how tariff on intermediate input can reduce employment
- Key limitation: data availability
  - Labor turnover rate in different regions?
  - Unemployment rates by skilled and unskilled labor?

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Questions?

Impacts on U.S. Income and EV

	Standard GTAP	GTAP Labor
	Percent change	
Income	-0.0051	-0.21
Utility		
Consumption	-0.0015	-0.10
Skilled labor		0.24
Unskilled labor		0.23
Total	-0.0015	-0.036
	$millions	
EV	-202.4	-4,888.7

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Sensitivity Analysis – U.S. Metals

Variable	Base	Mean	Standard Deviation
Market price	4.25	4.30	0.32
Output	7.83	7.75	0.60
Unskilled labor			
Composite labor use	5.54	5.41	0.93
Matched labor	26.11	25.52	4.26
Composite wage rate	7.21	7.38	1.18
Existing labor wage rate	9.55	9.76	1.51
Unemployment level			
Unskilled	0.83	0.83	0.15
Skilled	1.53	1.52	0.29

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