A GE Model of Occupation and the Political Economy of Trade

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How does factor mobility determine when occupation-based cleavages emerge over trade?

- In contrast to Stolper-Samuelson and Ricardo-Viner, occupation is a third determinant of preferences over trade (Blonigen and McGrew 2014; Owen and Johnston 2015)
- Also affects preferences over redistribution (Rehm 2009; Rommel and Walter 2014; Walter 2015)
- Factor mobility shapes when different types of cleavages are salient (Hiscox 2002) → what about mobility across occupations?
  - Entry and exit costs – barriers to mobility (e.g. accreditation)
  - Individuals identify deeply with occupation
An occupation is a set of activities or tasks that employees perform. They perform these tasks essentially the same across industries.

(1) Occupation characteristics – distinct from industry or education – explain protectionist sentiment.

(2) Predicts political cleavages over trade liberalization policy that diverge from predictions of the standard HO/RV models

Example: accountant, software developer
## Observed mobility in U.S. across occupation and industry, 1994-2008

<table>
<thead>
<tr>
<th>Industry</th>
<th>Occupation</th>
<th>No change</th>
<th>Change</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Occupation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No change</td>
<td>60.5</td>
<td>17.9</td>
<td>78.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(463,107)</td>
<td>(136,738)</td>
<td>(559,845)</td>
</tr>
<tr>
<td></td>
<td>Change</td>
<td>10.1</td>
<td>11.5</td>
<td>21.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(77,435)</td>
<td>(87,787)</td>
<td>(165,132)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>70.7</td>
<td>29.4</td>
<td>100.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(540,452)</td>
<td>(224,525)</td>
<td>(764,977)</td>
</tr>
</tbody>
</table>

Zero Profit Conditions

We next assume, as is conventional in the literature, that production costs equal the returns from production. Thus, the price of commodity \( X \), \( p_1 \), will be equal to the wages paid to the \( (1 - I) \) laborers in task 1, \( (1 - I) a_{11} w_1 \), plus a weighted average of wages that would be paid (with \( q_1 \)-likelihood) to the \( I \) domestic laborers in task 2, \( I a_{12} w_2 \), and (with \( (1 - q_1) \)-likelihood) laborers abroad, \( I a_{12} w^\ast_2 \). We can state the two zero-profit conditions as such:

\[
p_1 = (1 - I) a_{11} w_1 + I[q_1 a_{12} w_2 + (1 - q_1) \beta_2 ta_{12} w^\ast_2]
\]

Notice that we can now determine the value of \( \beta \) for which a cost minimizing firm would prefer to send jobs abroad. Specifically, for \( X \), when the wages for domestic laborers, \( a_{12} w_2 \), are equal to wages paid after offshoring, \( a_{12} w^\ast_2 \), the firm will indifferent. Solving for \( \beta \), for each commodity, we find:

\[
a_{12} w_2 = a_{12} w^\ast_2
\]

\[
a_{22} w_4 = a_{22} w^\ast_4
\]

When \( \beta_i \neq \beta^\ast_i \), the firm will offshore. Equations (1) - (4) and (7) - (8) represent a set of general equilibrium conditions. To understand attitudes over trade policy, political scientists often focus on how a policy will impact wages. Positive impacts will increase a voter's support while a negative impact will incentivize opposition. Thus, like trade economists, IPE scholars seek to understand how different shifts will affect changes in wages. To do this, we differentiate the six conditions, and solve for our set of six unknowns (the six wages). It is conventional among trade economists to look at percentage changes. We follow that approach here. Thus, let a 'hat' represent the relative change in a variable or parameter: \( \hat{p}_i \) denotes \( \frac{dp_i}{p_i} \) and \( \hat{L}_{ij} \) denotes \( \frac{dL_{ij}}{L_{ij}} \). At this point, economists also treat \( a_{ij} \) as an exogenous parameter. If we do so, however, we must also transform the \( a_{ij} \)'s into fractions consistent with relative changes.

In the four market clearing equations \([1) - (4)]\), we use \( a_{ij} \) to express the fraction of labor used in the production of each commodity. Notice that, for each sector, these fractions must sum to unity:

\[
1 + a_{12} = 1 \quad \text{and} \quad 2 + a_{22} = 1.
\]

Analogously, for the two zero-profit conditions \([equations (7) - (8)]\), we use \( \beta_{ij} \) to express the factor shares in each industry, where \( \beta_{11} + \beta_{12} + \beta_{13} = 1 \) and \( \beta_{21} + \beta_{22} + \beta_{23} = 1 \). Taking the derivative and substituting in the \( a_{ij} \)'s and \( \beta_{ij} \)'s, the six GE conditions...
We next assume, as is conventional in the literature, that production costs equal the returns from production. Thus, the price of commodity $X$, $p_1$, will be equal the wages paid to the $(1 - I)$ laborers in task 1, $(1 - I)a_{11}w_1$, plus a weighted average of wages that would be paid (with $q_1$-likelihood) to the domestic laborers in task 2, $(1 - I)a_{12}w_2$, and (with $(1 - q_1)$-likelihood) laborers abroad, $(1 - I)a_{12}w^*_2$. We can state the two zero-profit conditions as such:

$$p_1 = (1 - I)a_{11}w_1 + I[q_1a_{12}w_2 + (1 - q_1)\beta_2a_{12}w^*_2]$$

Notice that we can now determine the value of $\beta$ for which a cost minimizing firm would prefer to send jobs abroad. Specifically, for $X$, when the wages for domestic laborers, $(1 - I)a_{12}w_2$, are equal to wages paid after offshoring, $(1 - I)a_{12}w^*_2$, the firm will be indifferent. Solving for $\beta$, for each commodity, we find:

$$a_{12}w_2 = a_{12}w^*_2$$

When $i \neq \beta$, the firm will refer to offshore. Equations (1) - (4) and (7) - (8) represent a set of general equilibrium conditions. To understand attitudes over trade policy, political scientists often focus on how a policy will impact wages. Positive impacts will increase a voter's support while a negative impact will incentivize opposition. Thus, like trade economists, IPE scholars seek to understand how different shifts will affect changes in wages. To do this, we differentiate the six conditions, and solve for our set of six unknowns (the six wages). It is conventional among trade economists to look at percentage changes. We follow that approach here. Thus, let a 'hat' represent the relative change in a variable or parameter: $\hat{p}_i$ denotes $\frac{dp_i}{p_i}$ and $\hat{L}_{ij}$ denotes $\frac{dL_{ij}}{L_{ij}}$. At this point, economists also treat $a_{ij}$ as an exogenous parameter. If we do so, however, we must also transform the $a_{ij}$'s into fractions consistent with relative changes.

In the four market clearing equations $(1) - (4)$, we use $a_{ij}$ to express the fraction of labor used in the production of each commodity. Notice that, for each sector, these fractions must sum to unity:

$$1 = a_{11} + a_{12}$$

Analogously, for the two zero-profit conditions $(7) - (8)$, we use $\omega_{ij}$ to express the factor shares in each industry, where $\omega_{11} + \omega_{12} + \omega_{13} = 1$ and $\omega_{21} + \omega_{22} + \omega_{23} = 1$. Taking the derivative and substituting in the $a_{ij}$'s and $\omega_{ij}$'s, the six GE conditions

$$p_1 = (1 - I)a_{11}w_1 + I[q_1a_{12}w_2 + (1 - q_1)\beta_2a_{12}w^*_2]$$

Total wages paid to laborers in occupation 1 (in sector 1)
We next assume, as is conventional in the literature, that production costs equal the returns from production. Thus, the price of commodity $X$, $p_1$, will be equal to the wages paid to the laborers in task 1, $a_{11}w_1$, plus a weighted average of wages that would be paid (with likelihood) to the domestic laborers in task 2, $a_{12}w_2$, and (with likelihood) laborers abroad, $a_{12}w^*_2$. We can state the two zero-profit conditions as such:

$$p_1 = (1 - I)a_{11}w_1 + I[q_1a_{12}w_2 + (1 - q_1)\beta_2ta_{12}w^*_2]$$

$$p_2 = (1 - I)a_{21}w_3 + I[q_2a_{22}w_4 + (1 - q_2)\beta_2ta_{22}w^*_4]$$

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$$a_{12}w_2 = a_{12}w^*_2$$

$$a_{22}w_4 = a_{22}w^*_4$$
Labor Market Clearing Conditions

### Labor Market Clearing Conditions

**total labor** used to produce goods with task 1 (in sector 1)

**inputs** needed to complete one task

**units** produced of commodity 1

\[ L_{11} = (1 - I) a_{11} X \]
Suppose that task $j = 1$, which represents a (1 - $I$) proportion of the labor employed by the firm, is non-shorable, but that task $j = 2$, which represents a fraction $I$, is shorable (i.e. may be supplied by either foreign or domestic labor). We assume that the firm is imperfectly informed about future economic conditions, which affects their assessment of $a_i$. Denote $\bar{\alpha}_i$ as the firm's threshold value of $a_i$ (in sector $i$), which makes the firm indifferent between shoring (and not) the $I$-proportion of jobs. Firms perceive that, with probability $(1 - q_i)$, Nature ($N$) will select such that $I \leq \bar{\alpha}_i$. Likewise, the firm anticipates that, with probability $q_i$, it will be more cost-effective to employ the $I$ jobs domestically.

With these parameters, we can now state the general equilibrium conditions. We first assume full domestic employment; that the domestic factor market will clear. Notice that for the non-shorable tasks, the labor inputs used ($L_{i1}$) will equal the number of goods produced ($X_i$), multiplied by the number of labor inputs necessary to complete each task (i.e. to produce each good) ($a_{11}$):

$$L_{11} = (1 - I)a_{11}X$$

For the shorable tasks, however, the firm only perceives a $q_i$-likelihood of employing the tasks domestically, and thus weights the expected labor required ($I \cdot a_{12} \cdot Y_i$) by $q_i$:

$$L_{12} = q_i I a_{12} X$$

This leads to the following labor market clearing conditions:

$$L_{11} = (1 - I)a_{11}X$$

$$L_{12} = q_i I a_{12} X$$

$$L_{21} = (1 - I)a_{21}Y$$

$$L_{22} = q_2 I a_{22} Y$$

Combining these conditions to identify labor market clearing, by sector, we have:

$$L_{1} = (1 - I)a_{11}X + q_1 I a_{12} X$$

$$L_{2} = (1 - I)a_{21}Y + q_2 I a_{22} Y$$

Notice that $a_i$ may be less than or greater than one, depending on the technology of the foreign factor.

Notice that the $(1 - q_i)$ factors employed abroad are not accounted for in the domestic labor market clearing conditions.
Six General Equilibrium Conditions

\[ p_1 = (1 - I)a_{11}w_1 + I[q_1a_{12}w_2 + (1 - q_1)\beta_2ta_{12}w^*_2] \]
\[ p_2 = (1 - I)a_{21}w_3 + I[q_2a_{22}w_4 + (1 - q_2)\beta_4ta_{22}w^*_4] \]
\[ L_{11} = (1 - I)a_{11}X \]
\[ L_{12} = q_1Ia_{12}X \]
\[ L_{21} = (1 - I)a_{21}Y \]
\[ L_{22} = q_2Ia_{22}Y \]
Derivating

\[
p_1 = (1 - I)a_{11}w_1 + I[q_1a_{12}w_2 + (1 - q_1)\beta ta_{12}w_2^*]
\]
\[
p_2 = (1 - I)a_{21}w_3 + I[q_2a_{22}w_4 + (1 - q_2)\beta ta_{22}w_4^*]
\]
\[
L_{11} = (1 - I)a_{11}X
\]
\[
L_{12} = q_1Ia_{12}X
\]
\[
L_{21} = (1 - I)a_{21}Y
\]
\[
L_{22} = q_2Ia_{22}Y
\]

\[
\begin{align*}
\hat{p}_1 &= \theta_{11}\hat{w}_1 + \theta_{12}\hat{w}_2 + \theta_{13}\hat{w}_2^*
\hat{p}_2 &= \theta_{21}\hat{w}_3 + \theta_{22}\hat{w}_4 + \theta_{23}\hat{w}_4^*
\hat{L}_{11} &= \lambda_{11}\hat{X}
\hat{L}_{12} &= \lambda_{12}\hat{X}
\hat{L}_{21} &= \lambda_{21}\hat{Y}
\hat{L}_{22} &= \lambda_{22}\hat{Y}
\end{align*}
\]
Thus, we can begin by creating a parameter that captures task-specific factor mobility. To construct this parameter, we follow the approach used for sector-specific factor mobility. We treat equation (7), for example, as a function of changes in the composition of the production process, and we introduce the following notation for the change in the composition of input factor $i$ (which is safe from task $s$ to task $t$): 

\[ \sigma_{it} = \frac{d\left(\frac{L_{11}}{L_{12}}\right)}{\frac{L_{11}}{L_{12}}} \]

\[ \frac{d\left(\frac{L_{21}}{L_{11}}\right)}{\frac{L_{21}}{L_{11}}} \]

\[ \frac{d\left(\frac{w_3}{w_1}\right)}{\frac{w_3}{w_1}} \]

Notice that, for calculating the elasticity of substitution for commodity $X$, we can write: 

\[ \sigma_{IS} = \frac{d\left(\frac{L_{21}}{L_{11}}\right)}{\frac{L_{21}}{L_{11}}} \]

\[ \frac{d\left(\frac{w_3}{w_1}\right)}{\frac{w_3}{w_1}} \]

Note that these are within the same sector. Define the elasticity of substitution as:

\[ \frac{d\left(\frac{L_{11}}{L_{12}}\right)}{\frac{L_{11}}{L_{12}}} \]

\[ \frac{d\left(\frac{L_{21}}{L_{11}}\right)}{\frac{L_{21}}{L_{11}}} \]

\[ \frac{d\left(\frac{w_3}{w_1}\right)}{\frac{w_3}{w_1}} \]
Four wage equations

\[
\begin{align*}
\dot{w}_1 &= \frac{\dot{p}_1}{\theta_{11}} \left( L_{12} + \frac{1}{\sigma_{11}} \frac{L_{12} \phi_{12}}{\phi_{12} \phi_{11}} \right) \frac{d\theta_{12}}{dp_1 X_1 \theta_{12}} - \frac{\dot{p}_1}{\theta_{13}} \left( L_{12} + \frac{1}{\sigma_{13}} \frac{L_{12} \phi_{12}}{\phi_{12} \phi_{13}} \right) \frac{d\theta_{12}}{dp_1 Y_1 \theta_{13}} \\
\dot{w}_2 &= \frac{\dot{p}_1}{\theta_{12}} \left( L_{12} + \frac{1}{\sigma_{12}} \frac{L_{12} \phi_{12}}{\phi_{12} \phi_{12}} \right) \frac{d\theta_{12}}{dp_1 X_1 \theta_{12}} - \frac{\dot{p}_1}{\theta_{12}} \left( L_{12} + \frac{1}{\sigma_{12}} \frac{L_{12} \phi_{12}}{\phi_{12} \phi_{12}} \right) \frac{d\theta_{12}}{dp_1 Y_1 \theta_{12}} \\
\dot{w}_3 &= \frac{\dot{p}_2}{\theta_{21}} \left( L_{22} + \frac{1}{\sigma_{21}} \frac{L_{22} \phi_{22}}{\phi_{22} \phi_{21}} \right) \frac{d\theta_{22}}{dp_2 Y_2 \theta_{22}} - \frac{\dot{p}_2}{\theta_{22}} \left( L_{22} + \frac{1}{\sigma_{22}} \frac{L_{22} \phi_{22}}{\phi_{22} \phi_{22}} \right) \frac{d\theta_{22}}{dp_2 Y_2 \theta_{22}} \\
\dot{w}_4 &= \frac{\dot{p}_2}{\theta_{21}} \left( L_{22} + \frac{1}{\sigma_{21}} \frac{L_{22} \phi_{22}}{\phi_{22} \phi_{21}} \right) \frac{d\theta_{22}}{dp_2 Y_2 \theta_{21}} - \frac{\dot{p}_2}{\theta_{22}} \left( L_{22} + \frac{1}{\sigma_{22}} \frac{L_{22} \phi_{22}}{\phi_{22} \phi_{22}} \right) \frac{d\theta_{22}}{dp_2 Y_2 \theta_{22}}
\end{align*}
\]
Implications for Trade Cleavages

What happens to wages if factors are:

• 100% mobile ($\sigma_s \& \sigma_t \rightarrow \infty$)?
• stuck in sectors ($\sigma_t \rightarrow \infty \& \sigma_s \rightarrow 0$)?
• stuck in occupations ($\sigma_s \rightarrow \infty \& \sigma_t \rightarrow 0$)?
• stuck in both sectors and occupations ($\sigma_s \& \sigma_t \rightarrow 0$)?
Next Steps: Theory

0% inter-occupation factor mobility

100% factor mobility

Inter-industry factor mobility

0% inter-industry factor mobility

\[ \sigma_t \]

\[ \sigma_s \]
Next Steps: Theory

wage effects aligning by occupation

wage effects diverging

wage effects aligning by sector

100% factor mobility

(Inter-industry factor mobility)

(Inter-occupation factor mobility)
Implications for Trade Cleavages

Inter-industry factor mobility

0% inter-industry factor mobility

100% factor mobility

Inter-occupation factor mobility

0% inter-occupation factor mobility

I. Factor-based cleavages
II. Sectoral cleavages
III. Occupational cleavages
IV. Sectoral & Occupational cleavages
• We develop a model of trade that includes
  o Offshorable tasks
  o Inter-occupation factor mobility
• Nature of cleavages determined by mobility of factors across occupations and sectors
• Next steps
  o Estimate factor mobility over time in US context using CPS data
  o Examine how determinants of roll call votes on trade shift in response to changes in factor mobility
Additional Slides
\[
\begin{align*}
\dot{p}_1 &= \theta_{11}\dot{w}_1 + \theta_{12}\dot{w}_2 + \theta_{13}\dot{w}^*_2 \\
\dot{p}_2 &= \theta_{21}\dot{w}_3 + \theta_{22}\dot{w}_4 + \theta_{23}\dot{w}^*_4 \\
\dot{L}_{11} &= \lambda_{11}\dot{X} \\
\dot{L}_{12} &= \lambda_{12}\dot{X} \\
\dot{L}_{21} &= \lambda_{21}\dot{Y} \\
\dot{L}_{22} &= \lambda_{22}\dot{Y}
\end{align*}
\]

Where:

\[
\begin{align*}
\theta_{11} &= \frac{a_{11}(1 - I)w_1}{p_1} \\
\theta_{12} &= \frac{a_{12}Iq_1w_2}{p_1} \\
\theta_{13} &= \frac{a_{12}I(1 - q_1)\beta_2tw_2^*}{p_1} \\
\theta_{21} &= \frac{a_{21}(1 - I)w_3}{p_2} \\
\theta_{22} &= \frac{a_{22}Iq_2w_4}{p_2} \\
\theta_{23} &= \frac{a_{22}I(1 - q_2)\beta_4tw_4^*}{p_2}
\end{align*}
\]

and:

\[
\begin{align*}
\lambda_{11} &= \frac{a_{11}(1 - I)}{L_1} \\
\lambda_{12} &= \frac{a_{12}q_1I}{L_1} \\
\lambda_{21} &= \frac{a_{21}(1 - I)}{L_2} \\
\lambda_{22} &= \frac{a_{22}q_2I}{L_1}
\end{align*}
\]
4.4 Analysis of Political Cleavages: A More General Model

If we treat class- and urban/rural- cleavages both as a 'class-cleavage,' there are four possible extreme scenarios in our model: full factor mobility, zero factor mobility, and mobility across either sector or occupation. In this section, we diagram and walk through each scenario, and analyse which cleavages emerges in each. We find that, in this model's extreme cases, trade preferences can fall along factor lines, sector lines, occupation lines, but also along mixed lines. We begin the case of full factor mobility.

4.4.1 Inter-Occupation & Inter-Industry Factor Mobility: Factor-line Cleavage

Suppose that factors can move freely about sectors and occupations. Figure 3 displays this scenario. The Model's of Rogowski and Hiscox predict that trade cleavages will emerge either along class lines (if capital and land are either both abundant or both scarce) or along urban/rural lines (if capital and labor are either both abundant or both scarce), depending on the allocation of abundant factors in a country.

Our model shows fidelity with Rogowski and Hiscox, predicting the same type of cleavage. The logic is straightforward: if factor owners can move between sectors and between occupations, they will fear neither a wage decrease (from being stuck in a non-competitive industry or

Tasks are performed in the occupation to transform the ‘potential’ of the factor into the economic good.

F = factor  
O = occupation  
S = sector
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Our model shows fidelity with Rogowski and Hiscox, predicting the same type of cleavage. The logic is straightforward: if factor owners can move between sectors and between occupations, they will fear neither a wage decrease (from being stuck in a non-competitive industry or occupation) nor a decline in the return to their factor of production.
Factor Mobility: Diagram

\[
\sigma_{t1} \quad \text{Inter-Occupation Factor Mobility}
\]

\[
\sigma_{18} \quad \text{Inter-Sector Factor Mobility}
\]

\[
\frac{d\left(\frac{L_{11}}{L_{12}}\right)}{\frac{L_{11}}{L_{12}}} \quad \frac{d\left(\frac{w_3}{w_1}\right)}{\frac{w_3}{w_1}}
\]

Inter-Occupation Factor Mobility

\[
\text{F} = \text{factor} \\
\text{O} = \text{occupation} \\
\text{S} = \text{sector}
\]
Sector Specific Factor Mobility

\[ \sigma_{1s} = \frac{d\left(\frac{L_{22}}{L_{12}}\right)}{d\left(\frac{L_{21}}{L_{11}}\right)} \times \frac{d\left(\frac{w_3}{w_1}\right)}{d\left(\frac{w_3}{w_1}\right)} \]

\[ \sigma_{2s} = \frac{d\left(\frac{L_{22}}{L_{12}}\right)}{d\left(\frac{L_{21}}{L_{11}}\right)} \times \frac{d\left(\frac{q_2 w_4}{q_1 w_2}\right)}{d\left(\frac{q_2 w_4}{q_1 w_2}\right)} \]

\[ \sigma_{t1} = \frac{d\left(\frac{L_{11}}{L_{12}}\right)}{d\left(\frac{1-I}{1-I}\right)} \times \frac{d\left(\frac{w_1}{w_2}\right)}{d\left(\frac{1-I}{1-I}\right)} \]

\[ \sigma_{t2} = \frac{d\left(\frac{L_{21}}{L_{22}}\right)}{d\left(\frac{1-I}{1-I}\right)} \times \frac{d\left(\frac{q_2 w_4}{q_2 w_4}\right)}{d\left(\frac{1-I}{1-I}\right)} \]
4.4 Analysis of Political Cleavages: A More General Model

If we treat class- and urban/rural- cleavages both as a 'class-cleavage,' there are four possible extreme scenarios in our model: full factor mobility, zero factor mobility, and mobility across either sector or occupation. In this section, we diagram and walk through each scenario, and analyse which cleavages emerges in each. We find that, in this model’s extreme cases, trade preferences can fall along factor lines, sector lines, occupation lines, but also along mixed lines. We begin the case of full factor mobility.

4.4.1 Inter-Occupation & Inter-Industry Factor Mobility: Factor-line Cleavage

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