Intermediate inputs are increasingly important in trade

1. Two-thirds of world trade
2. Value-added trade and global supply chains
3. Can significantly amplify the gains from trade

Energy is a particularly important intermediate input. Changes in energy costs (and therefore changes in policy) have direct and indirect effects.
Intermediate inputs are increasingly important in trade

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Importance of Trade and I/O for Energy is Clear in the Data

1. Significant energy is embedded in traded goods and services
2. Most energy use is along the supply chain
Significant Energy Embedded in Traded Goods/Services

**Figure 1:** Trade in Energy Use, Production vs Final Demand (2015)

Source: Own calculations from UNCTAD-EORA database, following Aslam et al. (2017) for GVCs.
Most Energy Use is Along the Supply Chain

**Figure 2:** Energy Use in Canada, by Stage of Production (2015)

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The importance of intersectoral and international energy linkages

1. **Empirical:** Properly accounting for indirect energy use
2. **Policy/Model:** Properly quantifying economic implications of energy development and policies that affect energy prices
The Plan for this Book Chapter

The importance of intersectoral and international energy linkages

1. **Empirical**: Properly accounting for indirect energy use
2. **Policy/Model**: Properly quantifying economic implications of energy development and policies that affect energy prices

**Specific Contributions of the Book Chapter:**

1. **Data**: Accounting for indirect energy use, sectoral linkages
2. **Empirics**: Energy as a source of comparative advantage
3. **Model**: The effect of resource exports on Canada’s aggregate economy, and that of provincial GDP, employment, fiscal transfers

Existing literature: *Lan et al. (2016)* for energy trade; little overlap.
Data: Accounting for Sectoral Energy Linkages and International Trade
Input-Output Data is Useful

Multi-Region Input-Output Table: UNCTAD-EORA Database

- 190 countries, 15,909 sectors (I’ll use 26 aggregates)
- Covers 1990-2015 (in some cases back to 1970)
- Full multi-region input-output linkages
- Energy use by sector, 9 fuel types
- (I won’t use, but you might like) 2,720 ag/enviro indicators
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Input-Output tables have many uses. Though often abused.

Useful for: Accounting exercises.

Not useful for: Counterfactuals.

Instead, use I/O data to calibrate trade models (Albrecht and Tombe, 2016; Tombe and Winter, 2018)
Figure 3: Import Share of Final Energy Demand in Canada

Source: Own calculations from UNCTAD-EORA Resource Footprints database.
Energy as Source of Comparative Advantage

**Estimating the Sources of Comparative Advantage:**

Exports $x_{jn}$, country and sector characteristics $c_n$ and $s^j$, estimate:

$$\ln(x_{jn}) = \delta_n + \delta^j + \beta (s^j \times c_n) + \epsilon_{jn}$$

If $\beta \neq 0$ then $c_n$ matters for trade and this is evidence of that as a source of comparative advantage.
Estimating the Sources of Comparative Advantage:
Exports $x_n^j$, country and sector characteristics $c_n$ and $s^j$, estimate:

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If $\beta \neq 0$ then $c_n$ matters for trade and this is evidence of that as a source of comparative advantage.

A large and growing literature takes this approach:

- Importance of contracts $\times$ judicial system (Nunn, 2007 QJE)
- Industry complexity $\times$ judicial system (Levchenko, 2007 ReStud)
- Financing needs $\times$ financial depth (Manova, 2008 ReStud)
- Job complexity $\times$ human capital stock (Costinot, 2009 JIE)
- Volatility $\times$ labour market rules (Cunat and Melitz, 2010 JEEA)
### Table 1: Regression of Exports on Energy Intensity x Energy Production

<table>
<thead>
<tr>
<th></th>
<th>Dep. Var.: log(exports)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>2-3</td>
<td></td>
</tr>
<tr>
<td>(Direct Intensity)$_j$ x Endowment$_n$</td>
<td>0.095***</td>
</tr>
<tr>
<td></td>
<td>[0.026]</td>
</tr>
<tr>
<td>(Total Intensity)$_j$ x Endowment$_n$</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Country FEs</td>
<td>Yes</td>
</tr>
<tr>
<td>Sector FEs</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>3,524</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.737</td>
</tr>
</tbody>
</table>

Source: Own calculations from UNCTAD-EORA database. Regression follows Nunn (2007), who finds estimates for human capital (0.085) and physical capital (0.105).
Proper Counterfactuals and “Economic Impacts”
In 2014, resource exports (mostly energy) totalled $150 billion

**Question:** What is the value of these exports on Canada’s economy?
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Quantifying The Value of Energy Exports

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**Question:** What is the value of these exports on Canada’s economy?

Don’t focus too much on the dollars.

**Energy infrastructure is a reduction in trade costs.**

**Proper Counterfactuals: The Effect of Trade Cost Changes**

- Increase export costs modestly.
- Increase export costs to prohibitive levels.
- Carefully map out all the resulting reallocations/adjustments.
Modest Export Costs Have Large Effects

**Figure 4:** Change in Real GDP due to Various Export Costs

Source: Own calculations from an Eaton-Kortum model based on Caliendo and Parro (2015) and the World Input-Output Database.
The Effect of Blocking the $150B in Resource Exports

**Figure 5:** Change in Real GDP from Blocking Canada’s Resource Exports

Source: Own calculations from an Eaton-Kortum model based on Caliendo and Parro (2015) and the World Input-Output Database. Resource exports include mining, oil and gas.
Reconciling the Model with Input-Output Estimates

**Figure 5:** Change in Real GDP from Blocking Canada’s Resource Exports

Source: Own calculations from an Eaton-Kortum model based on Caliendo and Parro (2015) and the World Input-Output Database. Resource exports include mining, oil and gas.
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Quantifying The Value of Energy Exports

In 2014, resource exports (mostly energy) totalled $150 billion

**Counterfactual:** No resource exports (infinite export cost)

**Selection of Aggregate Results**

- **Real GDP:** Declines 0.6% or $13 billion
- **Employment:** Resources drops two-thirds. Half to services (mainly transport, wholesale/retail), half to manuf. activities (metals, refining, pulp & paper)
- **Trade:** Refining exports rise significantly, as do metals. All other sectors also increase (exchange rate effect)

**Substitution matters:** mining, oil and gas, and refined products exports total $170 billion. Blocking both decreases real GDP 0.9% or $20 billion.
Within-Canada Effects of Resource Exports

Employment and economic activity can reallocate across regions as well as sectors.
Employment and economic activity can reallocate across regions as well as sectors.

Propagating Economic Shocks Across Provinces

- **Real GDP Effects**: trade linkages
- **Real Income Effects**: fiscal transfers
- **Migration Effects**: employment, worker mobility

Tombe and Winter (2018) provides a tractable, quantitative model to conduct such an analysis. Includes endogenous inter-provincial trade, migration, and fiscal transfers!
### Table 2: Effect of Blocking Resource* Exports, by Province

<table>
<thead>
<tr>
<th>Province</th>
<th>Per Cent Change in Real GDP</th>
<th>Emp.</th>
<th>Real Income</th>
<th>Transfers (% of GDP) Before</th>
<th>Transfers (% of GDP) After</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC</td>
<td>-0.81</td>
<td>0.16</td>
<td>-0.64</td>
<td>1.8</td>
<td>1.9</td>
</tr>
<tr>
<td>AB</td>
<td>-1.88</td>
<td>-0.11</td>
<td>-0.82</td>
<td>8.8</td>
<td>7.4</td>
</tr>
<tr>
<td>SK</td>
<td>-3.86</td>
<td>-1.02</td>
<td>-1.43</td>
<td>0.7</td>
<td>-2.7</td>
</tr>
<tr>
<td>MB</td>
<td>-0.53</td>
<td>0.46</td>
<td>-0.44</td>
<td>-7.0</td>
<td>-7.0</td>
</tr>
<tr>
<td>ON</td>
<td>-0.08</td>
<td>0.07</td>
<td>-0.7</td>
<td>0.8</td>
<td>1.4</td>
</tr>
<tr>
<td>QC</td>
<td>-0.22</td>
<td>-0.05</td>
<td>-0.78</td>
<td>-3.3</td>
<td>-2.7</td>
</tr>
<tr>
<td>NB</td>
<td><strong>0.09</strong></td>
<td>0.43</td>
<td>-0.47</td>
<td><strong>-13.4</strong></td>
<td><strong>-12.9</strong></td>
</tr>
<tr>
<td>NS</td>
<td>-0.35</td>
<td>0.44</td>
<td>-0.46</td>
<td><strong>-15.7</strong></td>
<td><strong>-15.5</strong></td>
</tr>
<tr>
<td>PE</td>
<td>-0.59</td>
<td>0.12</td>
<td>-0.67</td>
<td>-22.0</td>
<td>-22.0</td>
</tr>
<tr>
<td>NL</td>
<td>-3.1</td>
<td>-2.32</td>
<td>-2.29</td>
<td>-7.0</td>
<td>-9.6</td>
</tr>
</tbody>
</table>

* And agricultural exports. Future work will disaggregate if possible. This is for 2010. Work updating to 2014 is ongoing.
Concluding Thoughts
Conclusion and Next Steps

- **Sharpen the Contribution:** Measuring the size and consequences of energy trade, between sectors and countries

- **Potential IV for the Empirics:** Country endowments (oil and gas reserves, for example) affect prices → trade

- **Add Model Detail:** Further disaggregate sectors for the inter-provincial analysis