Powertrain Sourcing in North America: Example of Regional Integration

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The analysis and conclusions set forth are those of the author and do not indicate concurrence by members of the research staff of the Federal Reserve Bank of Chicago.
Motivation

Powertrain = Engine + Transmission

1. USMCA [if ratified] would require 75% North America content for powertrains
2. Little written about the powertrain
3. Engine is 14% of vehicle value and transmission 7% [Final assembly = 29%]

(Source: CAR Group, 2012)
Principal data source

• Data from IHS Markit.
• We start with production by vehicle models for every assembly plant in North America from 2000 to 2016.
• Data identify the specific plants and number of units where the various types of engines and transmissions were manufactured for each vehicle model.
• We focus on vehicles with internal combustion engines.
• 1 vehicle = 1 engine = 1 transmission
1. Powertrain production has larger economies of scale than final assembly production

<table>
<thead>
<tr>
<th>[2016 data]</th>
<th>Assembly</th>
<th>Engine</th>
<th>Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td># Plants in N. America</td>
<td>63</td>
<td>35</td>
<td>23</td>
</tr>
<tr>
<td>Mean plant production</td>
<td>281,000</td>
<td>434,000</td>
<td>589,000</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations based on data from IHS Markit as of October 2017.
Carmakers share powertrains among vehicle models

- **140 different vehicle models** assembled at North America assembly plants, 2016
- **100 different engine models** installed at North America assembly plants, 2016
- **46 different transmissions** installed at North America assembly plants, 2016

Source: Authors’ calculations based on data from IHS Markit as of October 2017.
Powertrain sharing example: FCA 3.6L V6

Jeep Grand Cherokee is offered with 5 engines:
- 3.0L V6
- 3.6L V6
- 5.7L V8
- 6.2L V8
- 6.4L V8

Same 3.6L V6 also goes into:
- Other Jeeps
- Trucks
- Cars
- Minivans
2. Most engines and transmissions installed at North America final assembly plants are made in North America

- North American final assembly plants import from the outside North America only 14% of engines and 24% of transmissions.

Source: Authors’ calculations based on data from IHS Markit as of October 2017.
Source: Authors’ calculations based on data from IHS Markit as of October 2017.
Changing powertrain sourcing for North American final assembly plants

Source: Authors’ calculations based on data from IHS Markit as of October 2017.
Engine plants are located near vehicle final assembly plants.

Source: Maptitude, Authors’ calculations based on data from IHS Markit as of October 2017.
Transmission plants are located near vehicle final assembly plants.

Source: Maptitude, Authors’ calculations based on data from IHS Markit as of October 2017.
3. Less than 1/3 of vehicles have final assembly, engine, and transmission from only one country

70% All North America

27% U.S. only

4% Mexico only

39% Multiple countries

30% Imports from Asia or Europe

23% Engine or transmission

7% Engine and transmission

Source: Authors’ calculations based on data from IHS Markit as of October 2017.
Detroit 3 carmakers import fewer powertrains than do the other carmakers

<table>
<thead>
<tr>
<th>Assembly &amp; powertrain</th>
<th>Det 3</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>All North America</td>
<td>82%</td>
<td>56%</td>
</tr>
<tr>
<td>U.S. only</td>
<td>27%</td>
<td>27%</td>
</tr>
<tr>
<td>Mexico only</td>
<td>2%</td>
<td>6%</td>
</tr>
<tr>
<td>Multiple countries</td>
<td>53%</td>
<td>23%</td>
</tr>
<tr>
<td>Imports from Asia or Europe</td>
<td>18%</td>
<td>45%</td>
</tr>
<tr>
<td>Engine or transmission</td>
<td>16%</td>
<td>32%</td>
</tr>
<tr>
<td>Engine and transmission</td>
<td>2%</td>
<td>13%</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations based on data from IHS Markit as of October 2017.
Engine sourcing for assembly plants

Source: Authors’ calculations based on data from IHS Markit as of October 2017.
Transmission sourcing for assembly plants

Source: Authors’ calculations based on data from IHS Markit as of October 2017.
4. Powertrain sourcing can result in complex geographies

<table>
<thead>
<tr>
<th>% sourced from the carmaker’s nearest plant</th>
<th>Engine</th>
<th>Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>All carmakers</td>
<td>56%</td>
<td>52%</td>
</tr>
<tr>
<td>Detroit 3</td>
<td>52%</td>
<td>66%</td>
</tr>
<tr>
<td>Asian 3</td>
<td>68%</td>
<td>40%</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations based on data from IHS Markit as of October 2017.
Example: 2016 Silverado/Sierra Co-location – in principle

★ Assembly
● Engine
▲ Transmission

Scaled by 2016 production

Source: Authors’ calculations based on data from IHS Markit as of October 2017.
Silverado/Sierra
In reality – complex sourcing

★ Assembly
○ Engine
▲ Transmission

Scaled by 2016 production

Source: Authors’ calculations based on data from IHS Markit as of October 2017.
## Silverado/Sierra assembly & powertrain sourcing

<table>
<thead>
<tr>
<th>Vehicle assembly</th>
<th>Engine source</th>
<th>Transmission source</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>U.S.</td>
<td>U.S.</td>
<td>24%</td>
</tr>
<tr>
<td>U.S.</td>
<td>Mexico</td>
<td>U.S.</td>
<td>27%</td>
</tr>
<tr>
<td>U.S.</td>
<td>U.S.</td>
<td>Mexico</td>
<td>7%</td>
</tr>
<tr>
<td>Mexico</td>
<td>Mexico</td>
<td>Mexico</td>
<td>20%</td>
</tr>
<tr>
<td>Mexico</td>
<td>Canada</td>
<td>Mexico</td>
<td>12%</td>
</tr>
<tr>
<td>Mexico</td>
<td>U.S.</td>
<td>Mexico</td>
<td>1%</td>
</tr>
<tr>
<td>Mexico</td>
<td>Mexico</td>
<td>U.S.</td>
<td>9%</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations based on data from IHS Markit as of October 2017.
Summary

• Most North America assembly plants get their engines and transmissions from North America powertrain plants.

• Within North America, cross-border shipments of powertrains are common.

• Economies of scale differ for powertrain and vehicle production.

• Differences in economies of scale lead to complex geographies in powertrain sourcing.