

# Powertrain Sourcing in North America: Example of Regional Integration

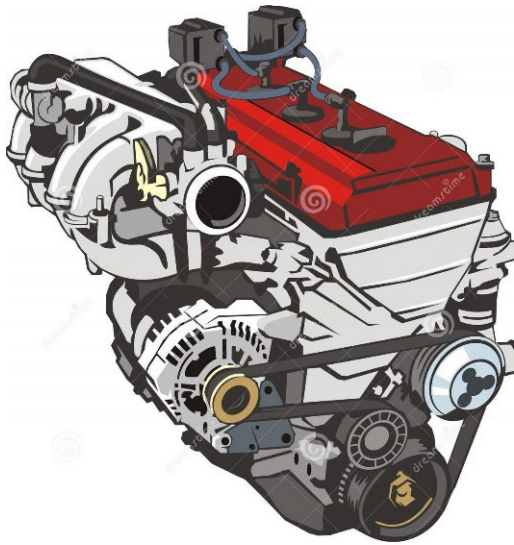
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with **Thomas Klier**, Federal Reserve Bank of Chicago

Forging a New Path for North American Trade:  
The Auto Sector  
Federal Reserve Bank of Chicago, Detroit Branch  
September 4, 2019

*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

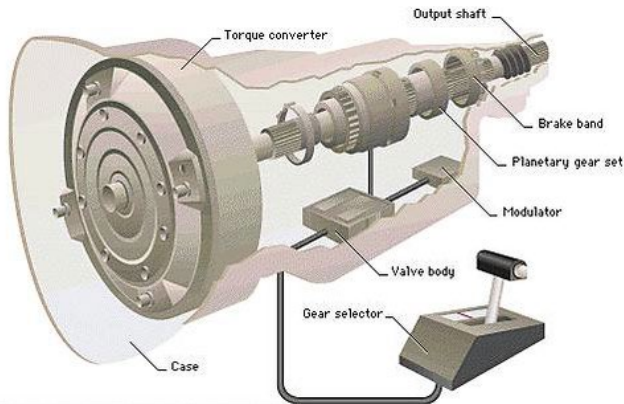
## Powertrain = Engine + Transmission



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

<b><i>[2016 data]</i></b>	<b>Assembly</b>	<b>Engine</b>	<b>Transmission</b>
<b># Plants in N. America</b>	<b>63</b>	<b>35</b>	<b>23</b>
<b>Mean plant production</b>	<b>281,000</b>	<b>434,000</b>	<b>589,000</b>

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

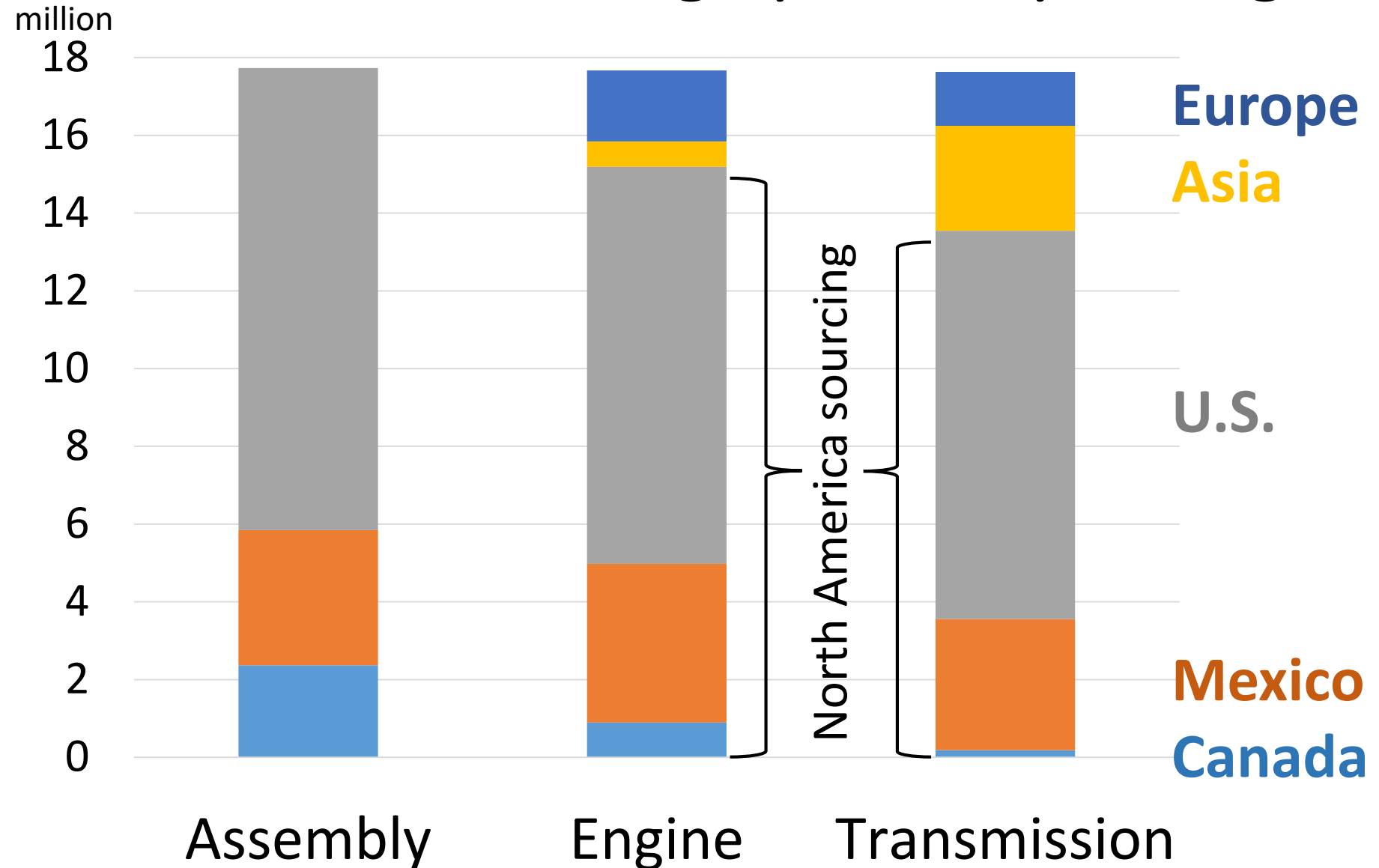


## 2. Most engines and transmissions installed at North America final assembly plants are made in North America

- 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.

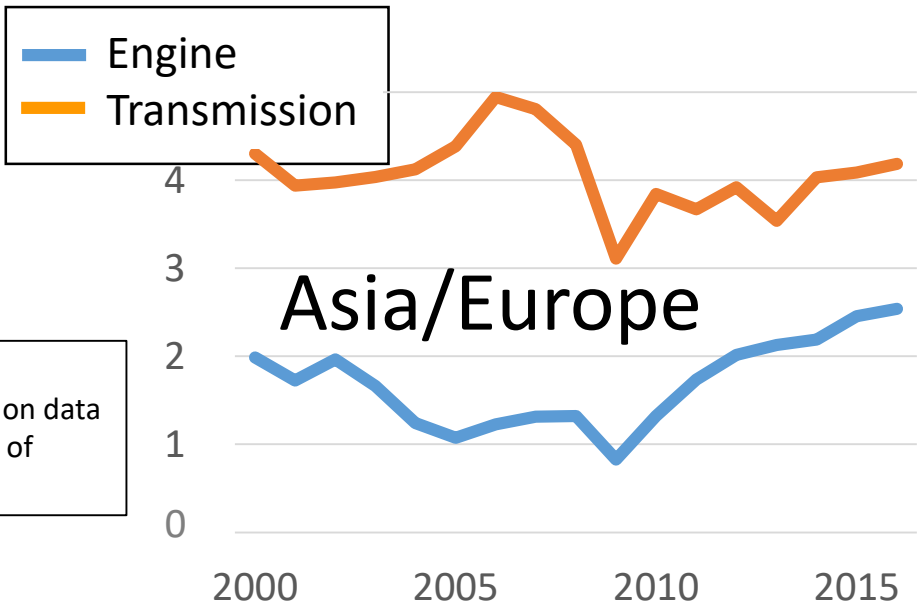
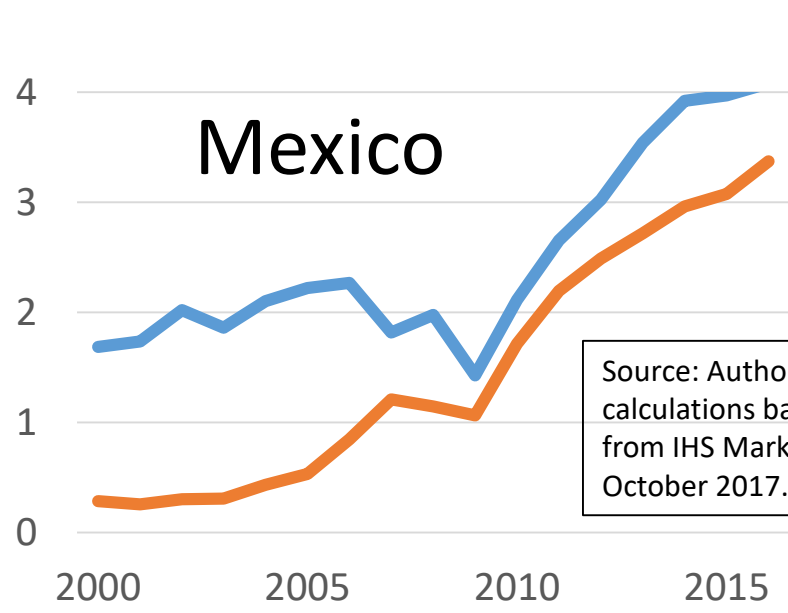
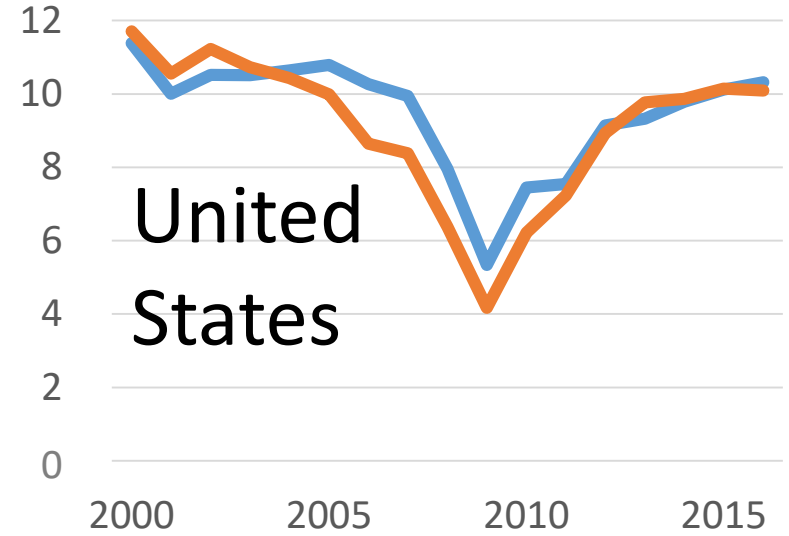
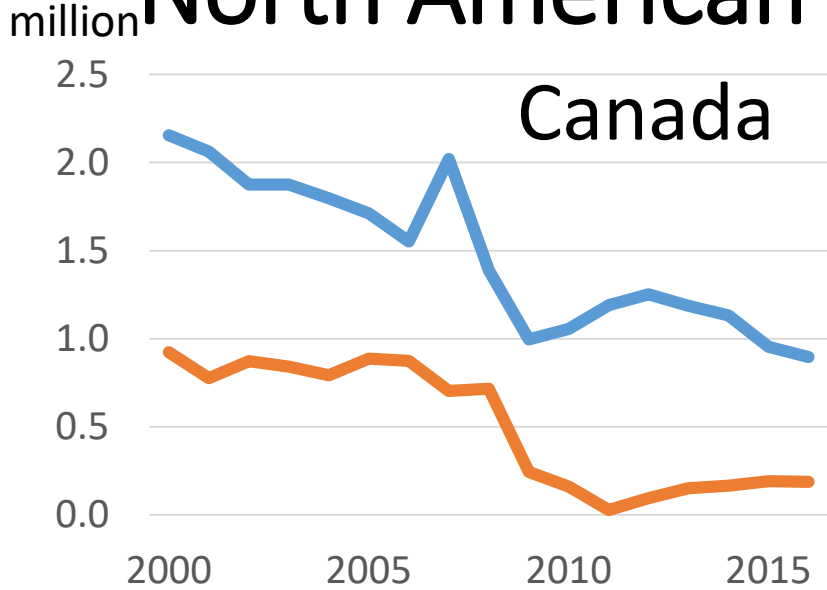
# Powertrain sourcing by country of origin



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



# Changing powertrain sourcing for North American final assembly plants

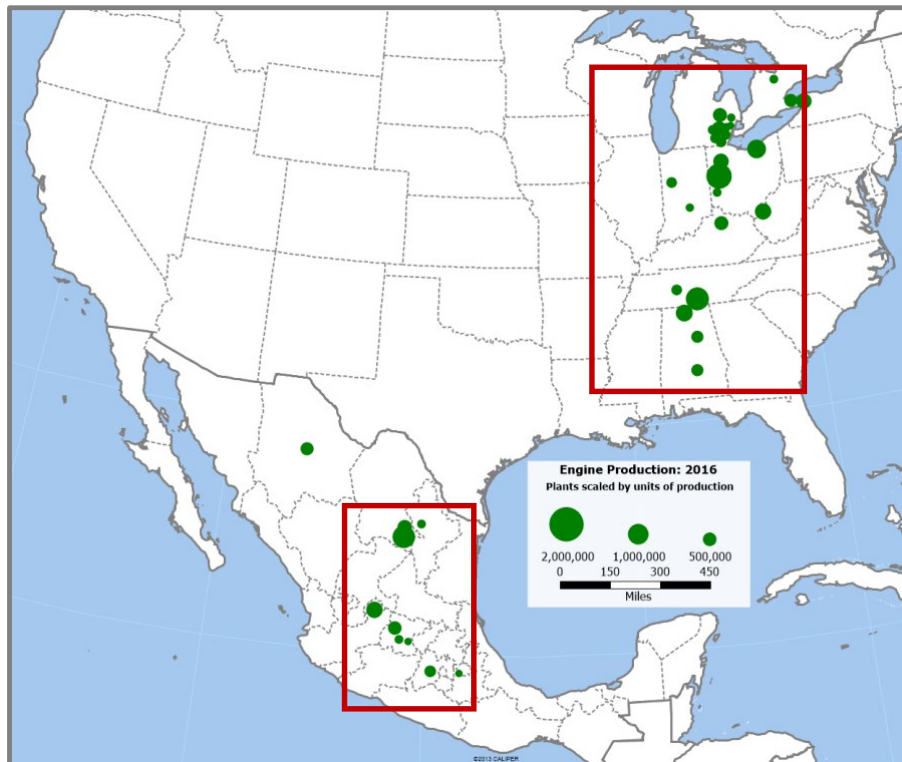


— Engine  
— Transmission

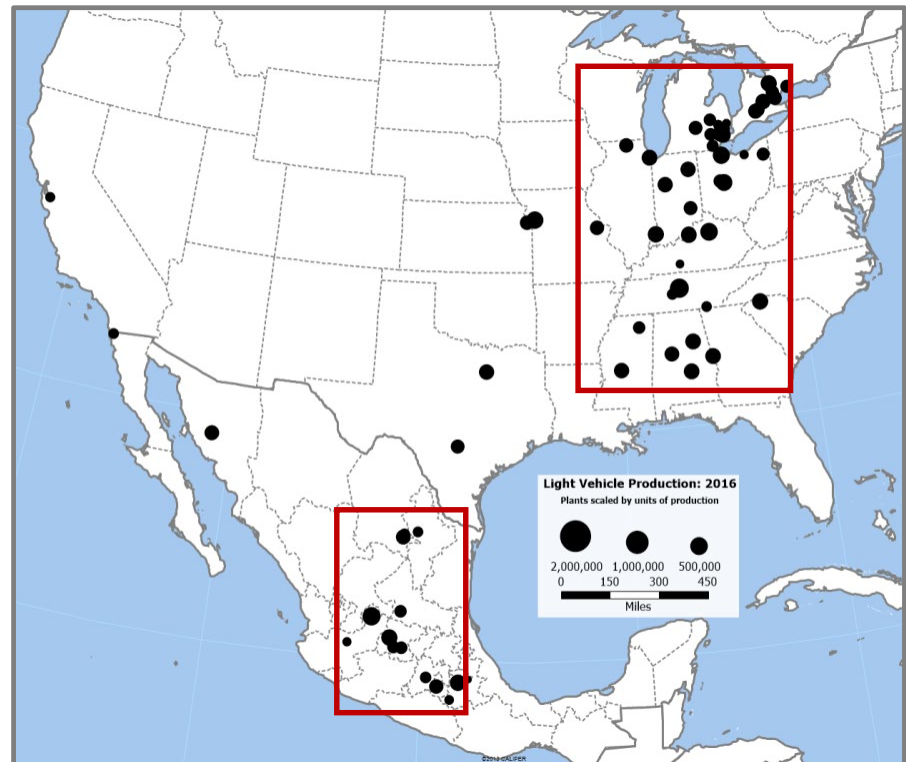
Source: Authors' calculations based on data from IHS Markit as of October 2017.

# Engine plants are located near vehicle final assembly plants

## Engine plants



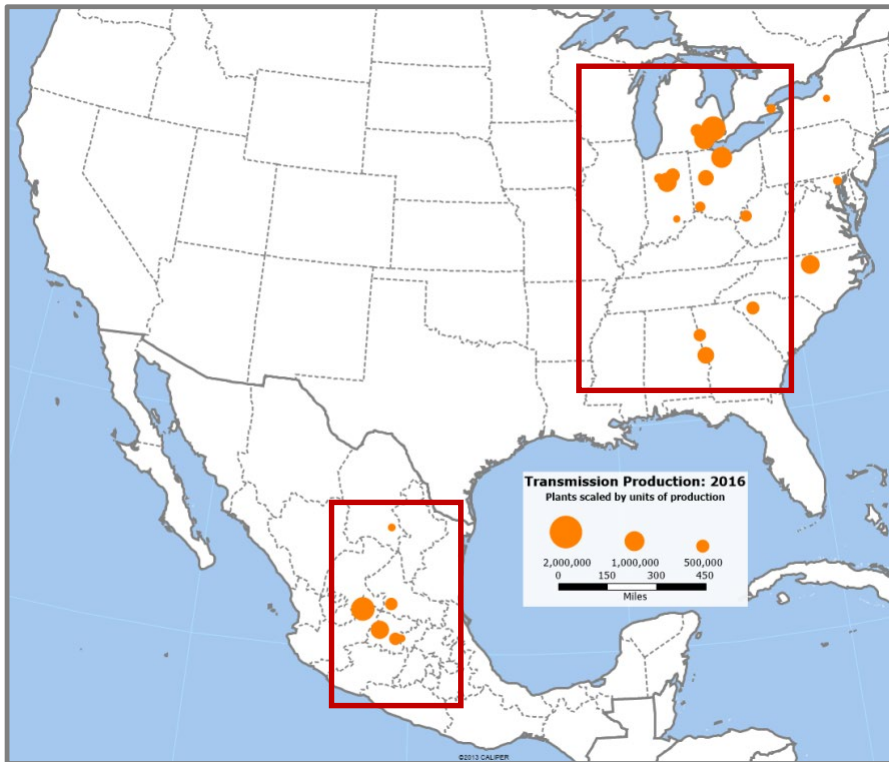
## Final assembly plants



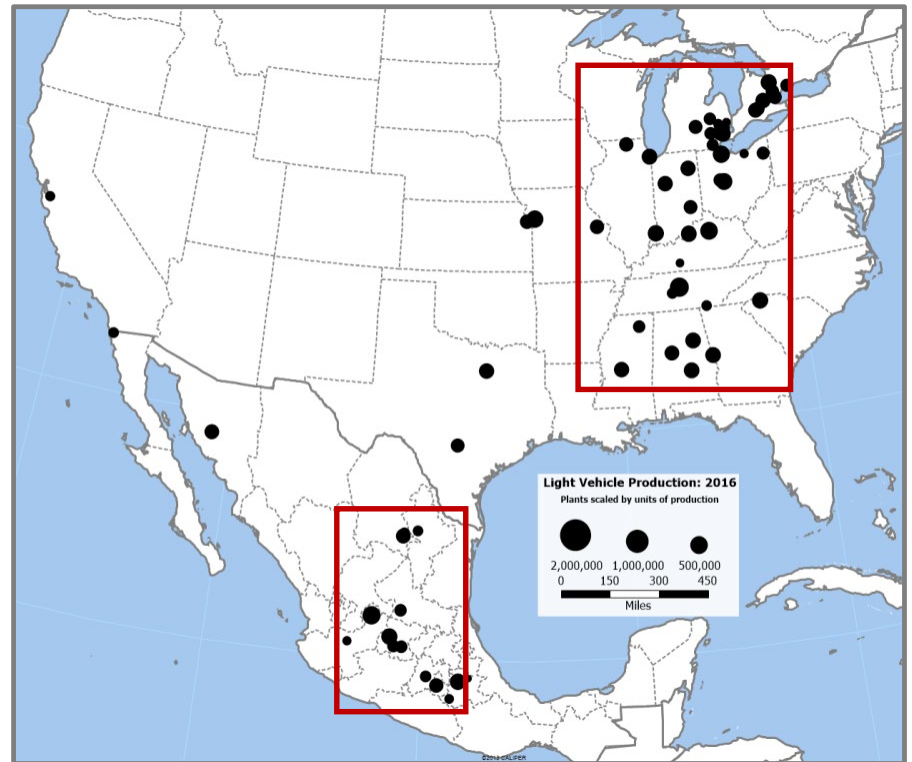
Scaled by 2016 production

# Transmission plants are located near vehicle final assembly plants

## Transmission plants



## Final assembly plants



Scaled by 2016 production

### 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

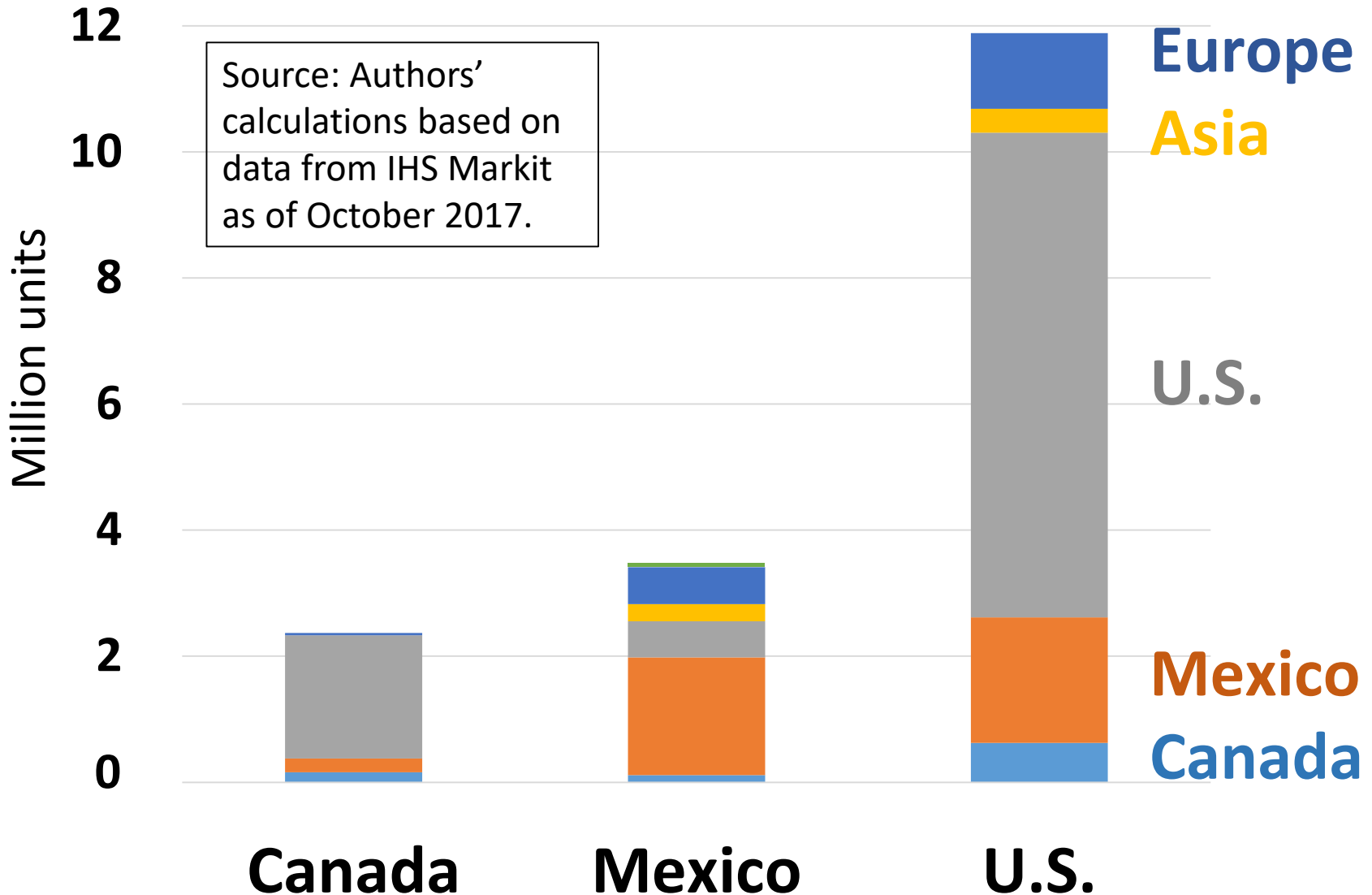
7% Engine and transmission

# Detroit 3 carmakers import fewer powertrains than do the other carmakers

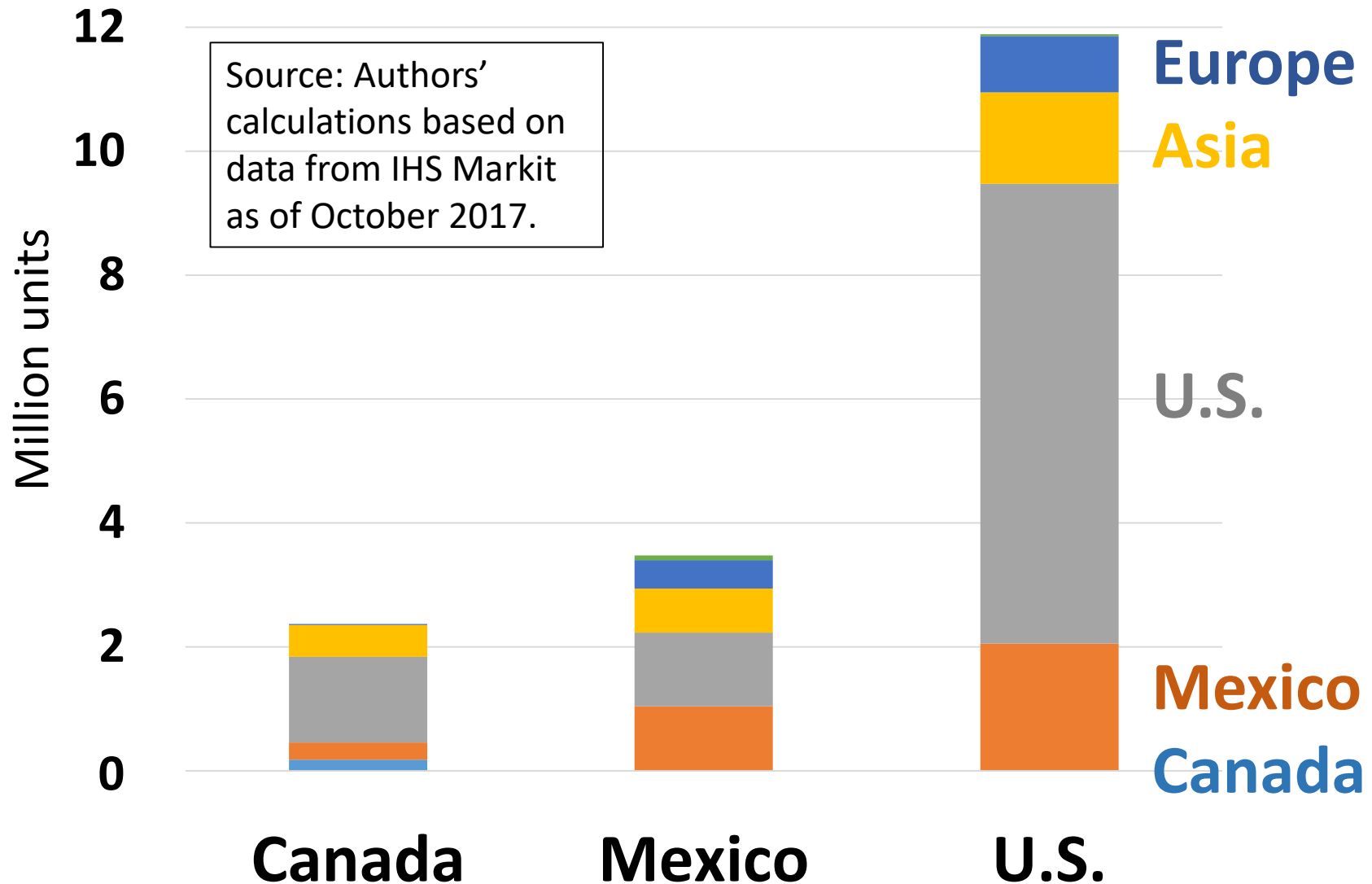
<u>Assembly &amp; powertrain</u>	<u>Det 3</u>	<u>Other</u>
All North America	82%	56%
U.S. only	27%	27%
Mexico only	2%	6%
Multiple countries	53%	23%
Imports from Asia or Europe	18%	45%
Engine <u>or</u> transmission	16%	32%
Engine <u>and</u> transmission	2%	13%

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

# Engine sourcing for assembly plants



# Transmission sourcing for assembly plants



## 4. Powertrain sourcing can result in complex geographies

% sourced from the carmaker's nearest plant		
	Engine	Transmission
<b>All carmakers</b>	<b>56%</b>	<b>52%</b>
Detroit 3	52%	66%
Asian 3	68%	40%

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



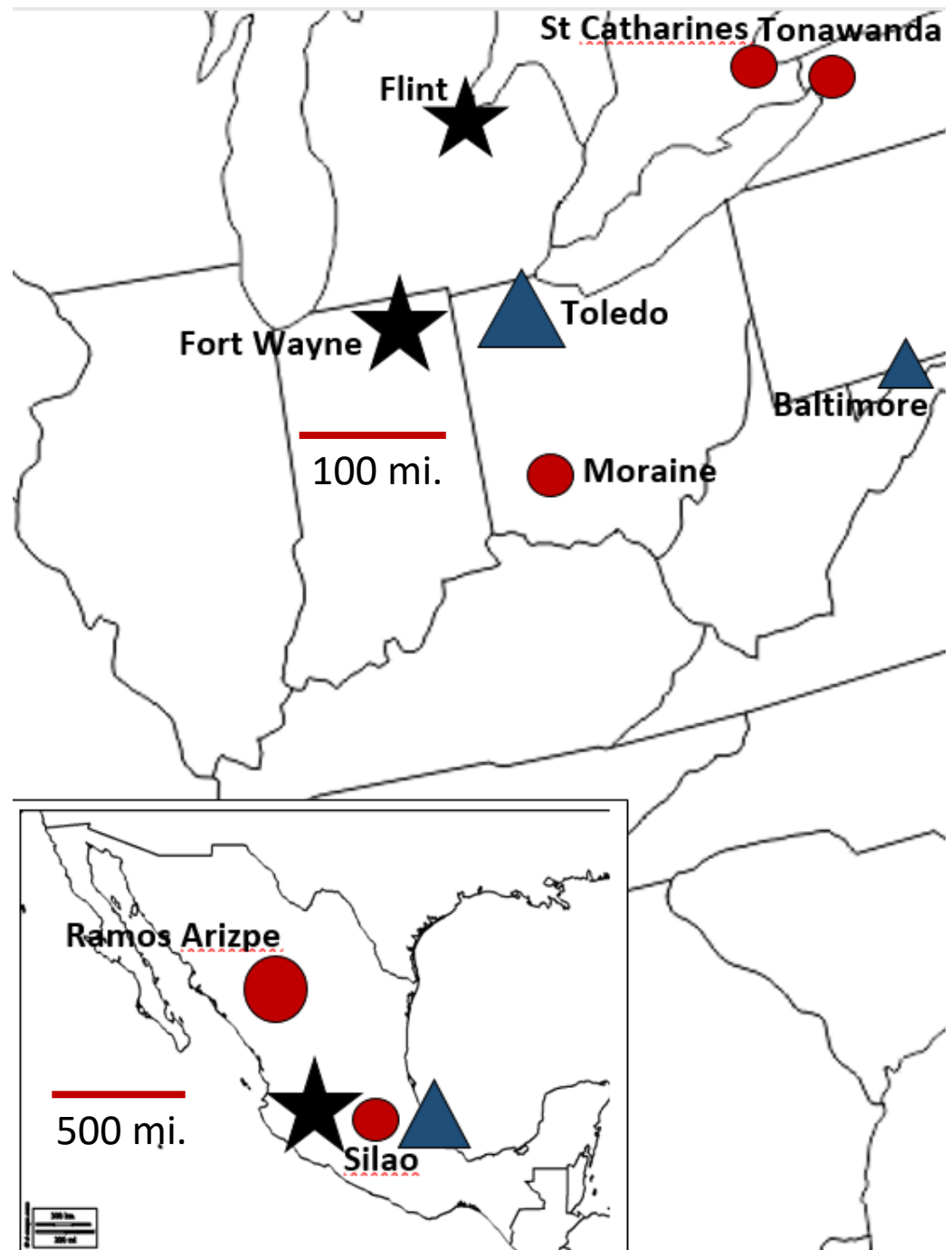
# Example: 2016 Silverado/Sierra

Co-location –  
in principle

- ★ Assembly
- Engine
- ▲ Transmission

Scaled by 2016 production

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



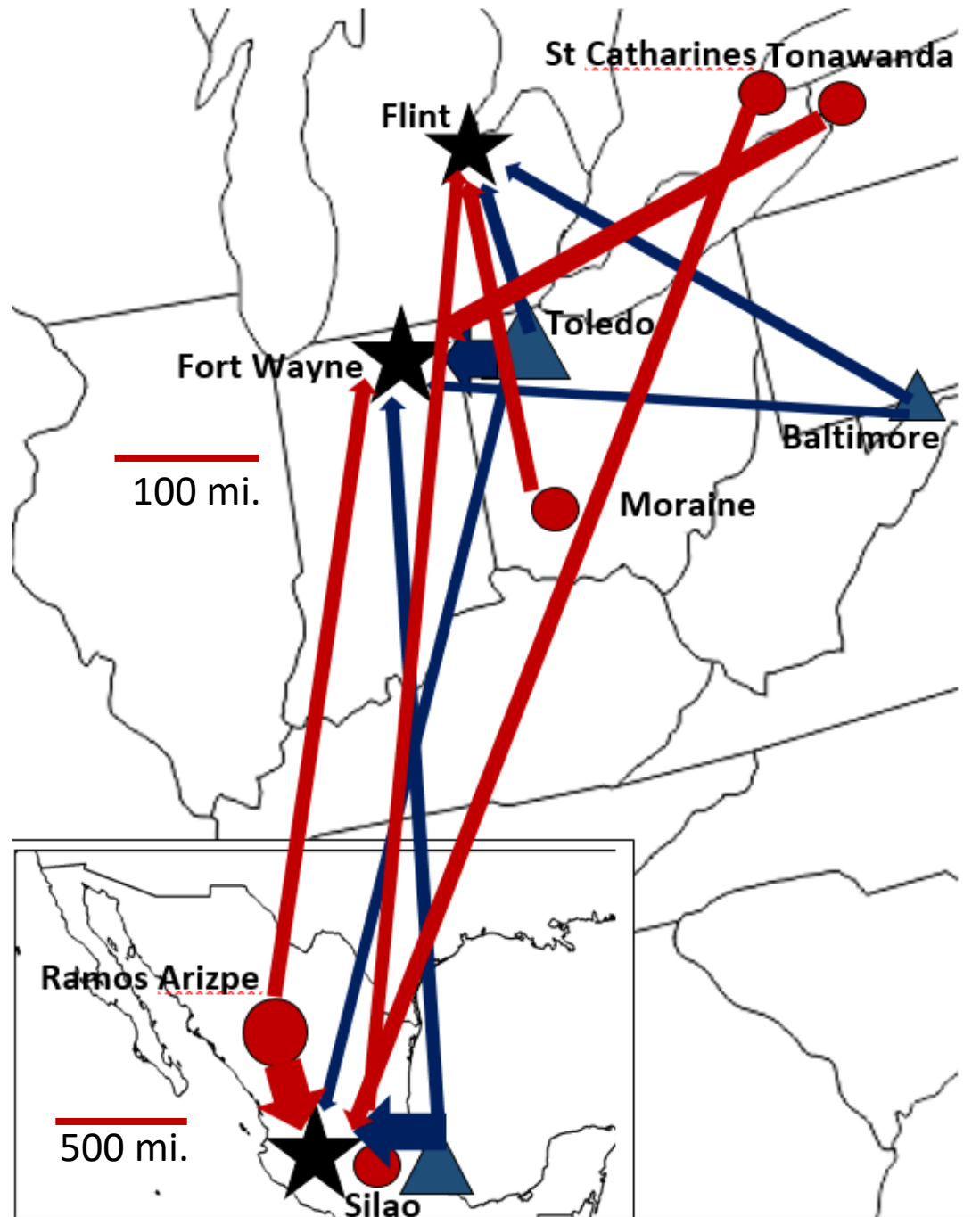
# Silverado/Sierra

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

<u>Vehicle assembly</u>	<u>Engine source</u>	<u>Transmission source</u>	<u>Share</u>
U.S.	U.S.	U.S.	24%
U.S.	Mexico	U.S.	27%
U.S.	U.S.	Mexico	7%
Mexico	Mexico	Mexico	20%
Mexico	Canada	Mexico	12%
Mexico	U.S.	Mexico	1%
Mexico	Mexico	U.S.	9%

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.