

Measuring vehicle parts content

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U.S.-Mexico Chamber of Commerce - Mid-America Chapter
Breakfast roundtable

June 19, 2019

Chicago, IL

Disclaimer

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

Motivation

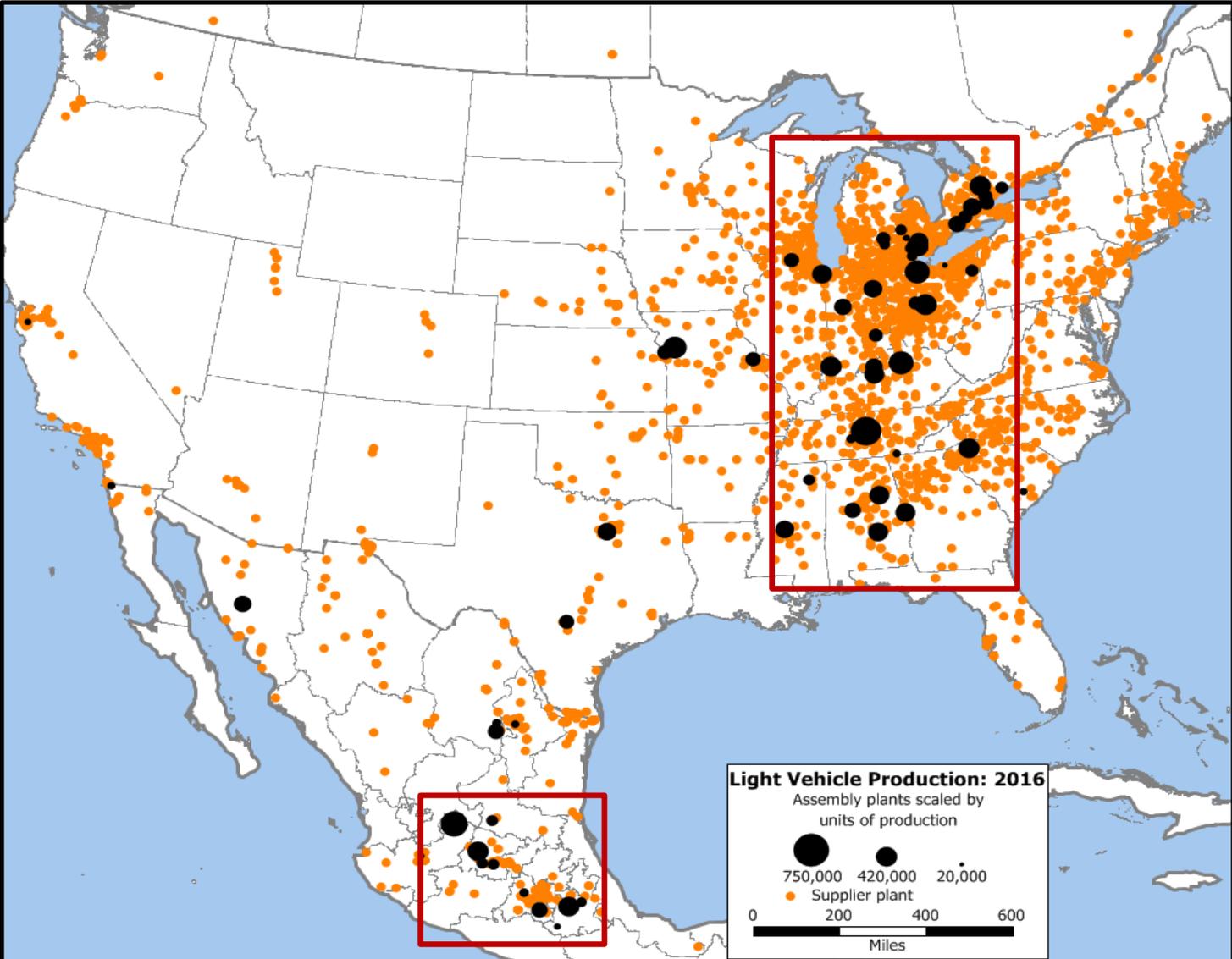


The Economist, 10/04/2018

Outline

- Light vehicle production
- Vehicle parts sourcing
 - Measurement issues
 - Two microdata-based measures

Parts and vehicle assembly co-locate



Vehicles typically sold where produced

Light vehicle sales in North America, by origin, %

Vehicles sold in North America by country:						
Vehicles produced in:	Mexico		U.S.		Canada	
	1995	2018	1995	2018	1995	2018
NAFTA	98	50	87	77	88	74
Elsewhere	2	50	13	23	12	26
All	100	100	100	100	100	100

Source: Author's calculations based on data from Wards AutoInfobank

52% of U.S. sales produced in the U.S., 15% in Mexico, 10% in Canada

Parts sourcing



Motor vehicle parts typically represent 75% of the value added of a finished vehicle

Try to measure this!



Example: journey of a seatbelt

1. Produce nylon fibers



2. Dye and weave fibers



3. Cut and sew finished cloth



4. Fit finished seat belt into car



Macro data

- **Trade data**
 - Comprehensive, yet much “double counting” for parts
- **Input output table (Global Value Chain)**
 - Tends to be aggregated
 - **De Gortari (2017)**: combines input-output data w firm-level detail; his approach allows more intensive use of U.S. inputs in production of MEX exports to the U.S. (typically input distribution is assumed fixed).
 - **Finding: U.S. value-added in cars produced in Mexico and sold to U.S. consumers: 38% [2014 data]**

Micro-data

- Two approaches using micro-data to get a look at supply chain integration
 - AALA “domestic content”
 - Detailed engine and transmission sourcing
 - See: **Chicago Fed Midwest Economy blog May 2019**

American Automobile Labeling Act (AALA)

- AALA passed in U.S. in 1992, requires data to be displayed next to vehicle price to inform purchase decision. Data collection starts in 1997
- Data provided, by model year, on:
 - Percent of U.S./Canada parts content
 - Names and % of any other country with >15% parts content
 - Country of final assembly
 - Country of origin of engine and transmission
- <https://www.nhtsa.gov/part-583-american-automobile-labeling-act-reports>

Starts
in
2011

American Automobile Labeling Act (AALA)



2011 CHEVROLET VOLT

EXTERIOR: VIRIDIAN JOULE TRICOAT ENGINE, RANGE EXTENDER, 1.4L
 INTERIOR: JET BLACK/CERAMIC WHITE ELECTRIC DRIVE UNIT, VOLTEC



Visit us at www.chevy.com

STANDARD EQUIPMENT
 ITEMS FEATURED BELOW ARE INCLUDED AT NO EXTRA CHARGE IN THE STANDARD VEHICLE PRICE SHOWN

- 8 YEAR / 100,000 MILE BATTERY AND VOLTEC COMPONENT LIMITED WARRANTY SEE DEALER FOR DETAILS
- 5 YEAR / 100,000 MILE POWERTRAIN LIMITED WARRANTY SEE DEALER FOR DETAILS

MECHANICAL

- BATTERY, PROPULSION, LITHIUM ION
- ELECTRIC DRIVE UNIT, VOLTEC
- ENGINE, RANGE EXTENDER, 1.4L INTERNAL COMBUSTION ENGINE
- TIRE SEALANT & INFLATOR KIT IN PLACE OF SPARE TIRE

SAFETY AND SECURITY

- AIRBAGS, DUAL-STAGE FRONTAL, SIDE-IMPACT, & KNEE FOR DRIVER AND FRONT PASSENGER
- AIRBAGS, ROOF RAIL SIDE-IMPACT

FOR FRONT AND REAR OUTBOARD SEATING POSITIONS

- ANTILOCK BRAKE SYSTEM, 4 WHEEL DISC
- REAR CHILD SEAT LATCH ANCHORS
- THEFT DETERRENT SYSTEM, CONTENT THEFT ALARM
- DAYTIME RUNNING LAMPS
- STABILITRAK-STABILITY CONTROL
- REMOTE KEYLESS ENTRY WITH REMOTE START
- PEDESTRIAN FRIENDLY ALERT
- POWER DOOR LOCKS WITH LOCKOUT PROTECTION
- HEADLAMPS, AUTO ON/OFF
- TIRE PRESSURE MONITOR
- 5 YEARS ONSTAR DIRECTIONS AND CONNECTIONS WITH AUTOMATIC CRASH RESPONSE

EXTERIOR

- MIRRORS, OUTSIDE HEATED, POWER ADJUSTABLE, BODY COLOR
- REAR WINDOW DEFROSTER

WINDSHIELD WIPERS VARIABLE & INTERMITTENT

- WINDSHIELD, SOLAR ABSORBING
- CHILD LOCKS, REAR DOORS & WINDOWS
- WHEELS, 17" FORGED PAINTED ALUMINUM

INTERIOR

- 30 GB AUDIO HARD DRIVE
- AUDIO SYSTEM W/ NAVIGATION, DVD ROM
- AIR CONDITIONING, AUTOMATIC
- AUXILIARY AUDIO INPUT JACK
- FLOOR MATS, CARPET FRONT/REAR
- INSIDE REARVIEW MIRROR, AUTO DIMMING
- STEERING COLUMN, TILT & TELESCOPING
- VISORS, ILLUMINATED VANITY MIRRORS
- EFFICIENCY DISPLAY SCREENS W/ PROGRAMMABLE CHARGE TIMES
- STEERING WHEEL RADIO CONTROLS

CRUISE CONTROL

- FRONT BUCKET SEATS, MANUAL DRIVER & PASS ADJUST
- REAR SEAT, 40/40 SPLIT FOLDING SEATBACK
- POWER WINDOWS EXPRESS DOWN, DRIVER EXPRESS UP
- USB PORT
- XM RADIO INCL XM NAV/TRAFFIC/LOCAL FORECAST - SERVICE SUBSCRIPTION SOLD SEPARATELY BY SIRIUS/XM AFTER 3 MTHS
- UNIVERSAL HOME REMOTE
- BLUETOOTH FOR PHONE
- BOSE PREMIUM AUDIO

OTHER

- CHARGE CORD, 120 V PORTABLE

OPTIONS & PRICING

MANUFACTURER'S SUGGESTED RETAIL PRICE

STANDARD VEHICLE PRICE \$40,280.00

OPTIONS INSTALLED BY THE MANUFACTURER (MAY REPLACE STANDARD EQUIPMENT SHOWN)

PREMIUM TRIM PKG INCLUDES: 1,395.00

- LEATHER APPOINTED SEATING,
- PREMIUM DOOR TRIM
- HEATED FRONT SEATS, DRIVER & PASSENGER
- LEATHER WRAP STEERING WHEEL

VIRIDIAN JOULE TRICOAT 995.00
 REAR CAMERA & PARK ASSIST 695.00

PACKAGE INCLUDES:

- ULTRASONIC FRONT & REAR PARK ASSIST
- REAR VISION CAMERA SYSTEM

WHEELS, 17" FORGED POLISHED ALLOY 595.00

TOTAL OPTIONS \$3,680.00
TOTAL VEHICLE & OPTIONS \$43,960.00
DESTINATION CHARGE 720.00

TOTAL VEHICLE PRICE* \$44,680.00



EPA Fuel Economy and Environmental Comparisons

Charge Time
 4 hours @ 240V

All Electric
 When battery is fully charged, first 35 miles only.

93 MPG equivalent
 36 kWh/100 miles combined city/hwy

Gas Only
 When electricity is used up, runs on gas for another 344 miles.

37 MPG
 2.7 gallons per 100 miles combined city/hwy

Cost per year if always used in All Electric \$601
 Cost per year if always used in Gas Only mode \$1,302

Range (Miles)
 All Electric Range (battery) 35 miles
 Extended Range (gas) 344 miles
TOTAL 379 miles

How This Vehicle Compares (combined composite)
 Among all vehicles and within compact cars

Greenhouse Gases (CO2 g/mi, tailpipe only)	60	84
Other Air Pollutants	6	10

Examples: Charging Routines

Miles driven between full charge	Fuel Economy MPG	Electricity Consumed	Electricity + Fuel Energy Cost
50	N/A	10.9 kWh	\$6/mi
45	118	12.9 kWh	\$6/mi
69	69	12.9 kWh	\$6/mi
75	69	12.9 kWh	\$6/mi
Never Charge	37	36 city / 48 hwy	N/A

Your actual mileage and costs will vary with fuel cost, temperature, driving conditions, and how you drive and maintain your vehicle. Cost estimates are based on \$0.09/mile per year at \$3.29 per gallon and \$1.10 cents per kWh. MPG equivalent is 33.7 kWh = 1 gallon gasoline energy. Visit www.fueleconomy.gov to download the Fuel Economy Guide (also available at dealers).

GOVERNMENT SAFETY RATINGS

This vehicle has not been rated by the government for frontal crash, side crash or rollover risk.

Source: National Highway Traffic Safety Administration (NHTSA).

www.safercar.gov or 1-888-327-4236

PARTS CONTENT INFORMATION

FOR VEHICLES IN THIS CARLINE:
 U.S./CANADIAN PARTS CONTENT: 40%
 MAJOR SOURCES OF FOREIGN PARTS CONTENT: KOREA 20%

NOTE: PARTS CONTENT DOES NOT INCLUDE FINAL ASSEMBLY, DISTRIBUTION, OR OTHER NON-PARTS COSTS.

FOR THIS VEHICLE:
 FINAL ASSEMBLY POINT: DETROIT, MI U.S.A.
 COUNTRY OF ORIGIN: AUSTRIA
 ENGINE: AUSTRIA
 TRANSMISSION (ELECTRIC DRIVE UNIT): JAPAN

2011 General Motors LLC
 MLR_7902_2011 - 10/21/2010

SALES MODEL CODE 1P0C6
 DEALER NO 91006
 FINAL ASSEMBLY
 DETROIT, MI U.S.A.

VIN 1G1RD6E41B0100445

REISSUE

DEALER TO WHOM DELIVERED
 GENERAL MOTORS LLC
 PO BOX 100 482-462-036
 DETROIT, MI 48265-1000

What is measured?
 Transaction value of parts only; reported as percentage by carmaker

AALA data limitations

- available only for vehicle models sold in U.S.
- does not account for origin of 100% of parts.
- U.S./Canadian content is reported jointly
- 15% content minimum for reporting countries other than U.S./Canada
- Vehicle models assembled in multiple countries do not have to be reported separately

Our approach

- Match domestic content data from AALA to vehicle model production data
- If a vehicle model is sold in the U.S. market, we can observe the “domestic” (U.S. and Canadian) content for production in any of the three North American countries
- We capture nearly all production: avg. 85% (MEX), 98% (U.S.), 99% (Canada)

Regional re-allocation of parts content

	<u>U.S./Canadian</u> parts content in vehicles produced in (and sold in the U.S.):		
	Mexico (%)	U.S. (%)	Canada (%)
2016	27	59	64
2010	31	67	66
2005	46	76	78
2000	53	81	83
1997	63	79	82

Source: Authors' calculations based on data provided by the AALA

Note: data reported are production-weighted averages by vehicle model years

North American parts content stable

	Source of parts content for light vehicles produced in (and sold in the U.S.):					
Country of origin for parts:	Mexico (%)		U.S. (%)		Canada (%)	
	2011	2016	2011	2016	2011	2016
Mexico	43 →	48	12 →	14	12 →	14
U.S./CDN	28	27	64	59	66	64
NAFTA	71	75	76	73	78	78

Source: Author's calculations based on data provided by AALA

Powertrain sourcing

- Engine (14%) and transmission (7%) represent 21% of the cost of car (Menk et al, 2012).
- We observe comprehensive data on engine and transmission sourcing for vehicles produced in North America, by country and vehicle model.
- We don't know where engine and transmission components are sourced.

North America dominates in powertrains

Origin of powertrains used in vehicles assembled in North America

		Engines		Transmissions	
Sourced from:		<u>2000</u>	<u>2016</u>	<u>2000</u>	<u>2016</u>
<i>Sourced from within NAFTA</i>	same country that builds vehicle	57.6	55.1	49.4	49.0
	within NAFTA	30.8	30.6	25.6	27.5
		<i>88.4</i>	<i>85.7</i>	<i>75.0</i>	<i>76.5</i>
	elsewhere	11.6	14.3	25.0	23.5
	<i>All</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>
	<i>All (units)</i>	<i>17.1 mio</i>	<i>17.8 mio</i>	<i>17.1 mio</i>	<i>17.8 mio</i>

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

Note: percentages reported are production-weighted averages

70% of light vehicles assembled in North America have both engine and transmission sourced from within North America.

Within North America: Mexico grows

Origin of powertrains used in vehicles assembled in North America

	Engines		Transmissions	
Sourced from:	<u>2000</u>	<u>2016</u>	<u>2000</u>	<u>2016</u>
Canada	12.5	5.0	5.4	1.0
Mexico	9.8 →	22.8	1.6 →	19.0
U.S.	66.1	57.9	68.0	56.4
elsewhere	11.6	14.3	25.0	23.5
<i>All</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>
<i>All (units)</i>	<i>17.1 mio</i>	<i>17.8 mio</i>	<i>17.1 mio</i>	<i>17.8 mio</i>

Source: Author's calculations based on data from IHS Markit as of October 2017

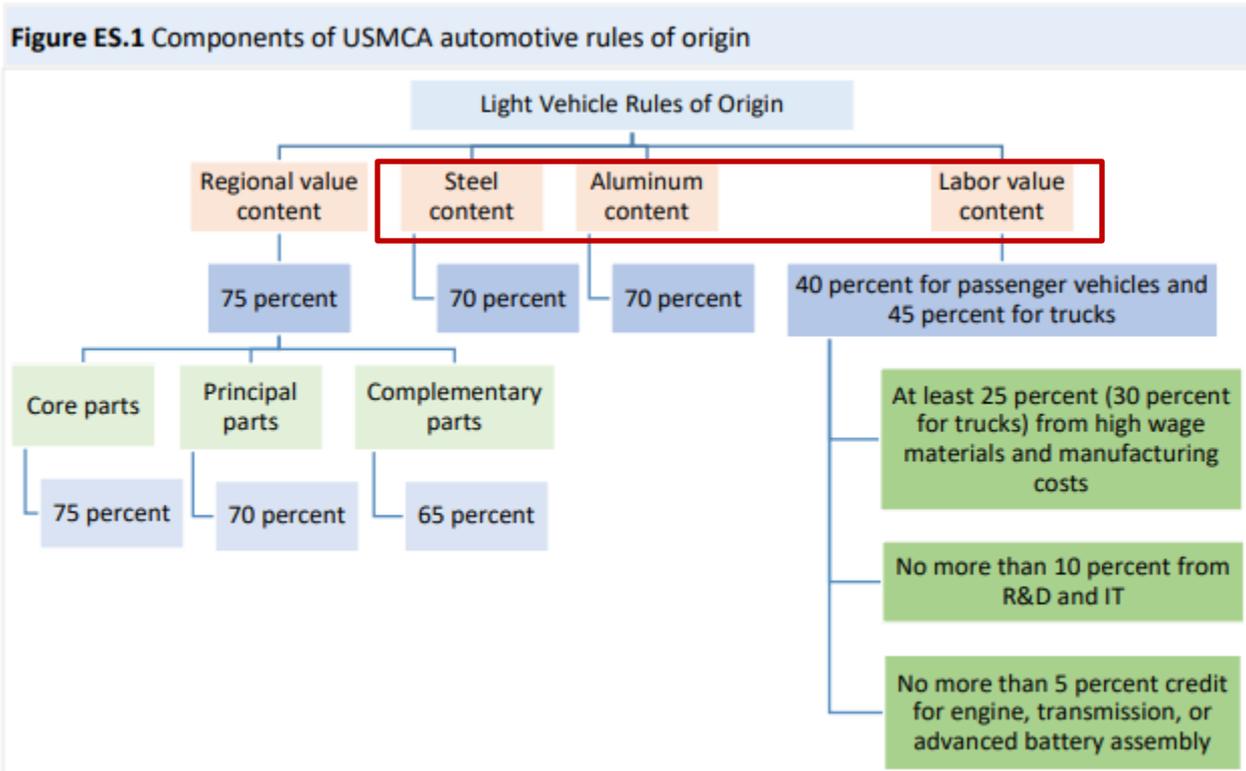
Few vehicles have final assembly and powertrain production in only 1 country

Location of final assembly, engine, and transmission plants

All in U.S.	27%
All in Mexico	4%
In 2 or 3 North American countries	38%
Engine and/or transmission imported from Europe or Asia	30%

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

USMCA – higher content req.'s



NAFTA: 62.5%

NAFTA: 60%

Source: USITC produced based on USMCA text.
 Note: "High-wage material" is defined as parts produced in a plant paying its workers an average of \$16/hr or higher. Research and Development (R&D) and Information Technology (IT) expenditures are similarly high-wage limited.

Summary

- Automotive supply chains are highly integrated within North America.
- Powertrain sourcing plays an important role in the integration of supply chains.

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