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RSCAS 2015/59
Robert Schuman Centre for Advanced Studies
Global Governance Programme-182

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EUI Working Paper **RSCAS** 2015/59

ISSN 1028-3625

Printed in Italy, September 2015
European University Institute
Badia Fiesolana
I – 50014 San Domenico di Fiesole (FI)
Italy
www.eui.eu/RSCAS/Publications/
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Abstract

Regulatory standards protect consumers from defective products, but they impede trade when they differ across countries. The Transatlantic Trade and Investment Partnership (TTIP) seeks to reduce distortions in the automobile and other industries. This paper evaluates the equivalence of automobile regulations in the United States and the European Union in terms of catastrophe avoidance and estimates the trade gains from improved regulatory coherence. The UN 1958 Agreement on automobiles, which offers a framework for harmonizing regulations among signatories, is used to quantify the trade effect of regulatory convergence. The removal of regulatory differences in autos is estimated to increase trade by 20 percent or more. The effect on trade from harmonizing standards is only slightly smaller than the effect of EU accession on auto trade. The large economic gains from regulatory harmonization imply that TTIP has the potential to improve productivity while lowering prices and enhancing variety for consumers.

Keywords:

Regulatory harmonization, difference-in-differences, trade agreement

1. Introduction*

The Transatlantic Trade and Investment Partnership (TTIP) aims at harmonizing regulations across the European Union and the United States. The European Commission states TTIP's objective as achieving "greater regulatory compatibility between the EU and the US, and paving the way for setting global standards." The US Trade Representative says "T-TIP can set high standards and pioneer new rules for the global trading system."[1]

This Paper focuses on the gains that both partners could reap from regulatory coherence in the automobile industry, using the trade effects of the 1958 Agreement—the most comprehensive agreement on technical prescriptions for automobiles to date—as an event study. The 1958 Agreement establishes a set of uniform standards for vehicles and their components relating to safety, environment, energy, and antitheft requirements. The European Union, as well as Japan and Korea among others, are parties to the agreement. The United States, however, has its own safety standards and is not a contracting party to the 1958 Agreement.

Given the feasibility of regulatory harmonization (as evidenced by the 1958 Agreement), the auto industry stands out as a critical test case in the TTIP for improving regulatory coherence between the United States and the European Union. Both maintain vastly different regulations as well as different ways of administering them. Despite disparities in regulations and hence production requirements, we show that these regulatory regimes are not significantly different in terms of the safety outcomes they deliver.

The regulatory divergence distorts the market, raising production costs, encouraging price discrimination across markets, and limiting the available import varieties. To measure the trade loss from having two sets of regulations, the Paper examines how the 1958 Agreement affects trade, using a difference-in-differences approach. The advantage of our methodology is that it uses an actual case of regulatory harmonization (accession to the 1958 Agreement) in the same industry to estimate the effect of regulatory convergence. Because of variation in dates of members' accession, we can control for exporter-year specific effects, importer-year effects, country-pair effects, as well as other bilateral time-varying events such as EU accession or voluntary export restraints. In contrast, other studies have estimated trade gains from regulatory harmonization using an ad valorem tariff equivalent of regulatory differences. Regulatory convergence could have very different effects from tariffs because adhering to two distinct regulatory frameworks affects a company's production structure, lowering both variable and fixed costs.

We find that joining the 1958 Agreement boosts auto trade by more than 20 percent. This effect is significantly higher than effects estimated using tariff equivalents and almost as large as the additional increase from joining the European Union. The results are robust to different periods, different samples, and controlling for EU accession, high market share exporters, and for voluntary export restraints that were in effect over the period, as well as potential endogeneity of the agreement. We further show that foreign direct investment has not already segmented markets to such a degree that it would limit the medium-run trade gains from regulatory convergence.

Achieving regulatory harmonization or mutual recognition of regulations now would help US and EU producers benefit from scale economies and compete in the global marketplace, while providing

* We are grateful to Lucian Cernat, Bill Cline, Bernard Hoekman, Gary Hufbauer, Brad Jensen, Robert Lawrence, Jeff Schott, Jennifer Thomas, Charles Ulthus, and participants at the Standards, Regulation and Trans-Atlantic Trade conference at EUI for helpful comments. Partial support for this study was provided by the Italian Trade Commission.

1 "Member States Endorse EU-US Trade and Investment Negotiations," European Commission Memo, June 14, 2013; Dan Mullaney, "Five Things You Should Know about the Transatlantic Trade and Investment Partnership," USTR Tradewinds Blog, November 2013.

consumers with more varieties within a market and equivalent safety at lower prices. More broadly, the TTIP agreement is about both market integration and first-mover advantage. Simply put, by harmonizing regulations in some industries or agreeing to recognize each other's regulations, replication in production could be avoided, generating real productivity gains. Moreover, as the largest combined market for many products, the rest of the world will be very likely to follow similar rules.

2. The Equivalence of Regulations

Regulatory standards ensure that products are safe for consumers and do not excessively damage the environment. The EU and US safety and environmental regulations are both relatively high and well enforced, but have different requirements. This section focuses on safety regulations because although environmental standards also differ, they are less distortionary from an economic perspective. While there are barriers to harmonizing environmental regulations, notably in the driving pattern required during testing (including distance, speed, and whether the car is allowed to warm up before testing begins), there is also room from a manufacturing perspective to create one model for both markets that adheres to the most stringent emissions regulation. For example, the European Union is moving toward a greenhouse gas emissions standard of 95 grams/kilometer (60.6 miles per gallon equivalent) for 95 percent of vehicles by 2020 and the United States is moving toward an average level of 163 grams/mile (54.5 miles per gallon equivalent) by 2025. It may be in the producer's interest to make one car for both markets that meets the 60.6 miles per gallon threshold.[2] A clear hierarchy in these regulations favors low emissions. As a result, environmental regulations can create a race to the top, where an automobile that meets the highest standard on various emissions tests is marketable in both economies. In contrast, safety requirements are more complex and often incompatible in the sense that one car cannot meet both regulations simultaneously.

The US and EU models of the 2014 Ford Fusion have 80 percent of the same parts, which is higher than the industry average for overlapping parts,[3] yet a fifth of the Fusion's parts need to be manufactured separately for the two markets. Some of the parts are different because of testing regulations, while other differences lie in specific parts. For example, both markets require crash testing but the tests are distinct, in both speed of the car and rigidness of the barrier. US standards are tougher because cars must satisfy certain criteria even accounting for passengers not wearing seatbelts. Other parts that are different are individually small, such as the color of the tail light or the presence of side lights (only the United States requires them)—but these add up.

To demonstrate the technical differences in a single part, table 1 shows the differences in regulatory standards between US and EU lighting systems for automobiles, in particular side turn signal lamps. The first column lists the technical regulation in the European Union, column 2 is the corresponding US regulation, and column 3 explains the differences, if any, between the two regulations. In many cases, an EU manufacturer can clearly comply with US regulations, such as the height of the front lights, which has a lower minimum in the European Union. In other cases, there is no overlap, such as the front light color. This extensive table only addresses one specific light system.

Ultimately, what matters is the outcome of the requirements: Are passengers safe in vehicles meeting European or US regulations? To answer this question, we compare auto fatality data across countries. Figure 1a shows fatalities per 100,000 vehicles across EU countries. Figure 1b shows the same across US states. The EU rates are very similar to US rates, with 15.8 fatalities per 100,000 vehicles in the European Union versus 13.6 fatalities in the United States. Figure 1c shows fatality rates and GDP per capita of the individual EU countries and US states, indicating that rates vary far

[2] See Canis and Lattanzio (2014) for a detailed analysis of the differences between US and EU emissions standards.

[3] Justin Berkowitz, "Free Trade Cars: Why a U.S.-Europe Free-Trade Agreement is a Good Idea," *Car and Driver,* August 2013.

more with stage of development than with auto regulations, which are largely the same within Europe and the United States. This suggests that country-specific variables, such as age of the fleet on the road, quality of roads, terrain, weather, and enforcement of laws are far more important in safety than regulation of the vehicles.

To test whether fatalities per motor vehicle are fewer in the United States or the European Union, we regress the fatality rate on an indicator variable for the European Union—this variable takes the value 1 for EU members and zero otherwise. If the United States and the European Union have different safety regulations, the EU dummy should be negative and significant if the European Union is safer, and positive and significant if the European Union is more dangerous. The results, reported in table 2, show no significant difference across EU countries and US states. Next, we control for GDP per capita. The point estimate on lnGDP is negative and highly significant; suggesting that a 10 percent increase in GDP per capita saves 2 to 3 lives per 100,000 vehicles. The third column measures fatalities in logs and results remain similar, though in this case the interpretation is slightly different. The results show that a 1 percent increase in per capita income reduces fatalities by more than 1 percent. In both specifications, per capita income explains more than 50 percent of the variation in fatality rates across countries. The coefficient on the EU variable remains insignificant in all specifications, and is very small when income is included in the regression, suggesting that auto safety in EU countries is not statistically different from US states.

3. Economic Benefits: Evidence from the 1958 Agreement

The economic argument against different regulations is that instead of making one model for both markets, car producers make two separate models. Returns to scale are underutilized, some processes are duplicated, producers can price discriminate, and inventory cannot be reallocated across markets. As a result, consumers face higher average prices and less variety.

Regulatory barriers are especially burdensome for small producers or in small markets. Some models are not sold in markets where there is demand because sunk costs of adjusting the models to those markets are too high. For example, while the Canadian market adheres to US regulations, demand for subcompact and compact cars is higher in Canada than in the United States (representing 65 and 41 percent of market share, respectively). European manufacturers are unable to take advantage of this demand for smaller cars in Canada, because as Canadian car sales were less than 5 percent of US auto sales in 2014, the sunk cost of adjusting a subcompact European car to US regulations (in order to sell in the Canadian market) is higher than the relative gains in the Canadian market.[4]

Regulatory differences also affect consumers: When there is demand for the same car in both markets, consumers may not be able to take advantage of price differentials across markets due to the cost of recertification in the new market. This allows producers to price discriminate, selling a Mercedes for the profit-maximizing price in each market, which leads to higher average prices.[5]

Regulatory differences also impede market integration, preventing companies from selling new products in both markets. For example, if a specific new technology is approved under European regulations, such as Mercedes-Benz LED Intelligent Light System, but not under US regulations, the

[4] Canadian light vehicle sales in 2014 were 0.55 million units (0.23 million passenger cars and 0.32 million light trucks); US light vehicle sales in 2014 were 16.8 million units (7.7 million passenger cars and 9.1 million light trucks). *Sources:* Desrosiers Automotive Reports, www.desrosiers.ca/pdfs/sales.pdf; and WardsAuto Reports, http://wardsauto.com/public-data.

[5] The welfare consequences of price discrimination can be positive if poor consumers receive a lower price, which may be socially optimal. See Bradford and Lawrence (2004) for a detailed analysis of the welfare effects from removing price differentials across markets.

new technology is not available for sale in the United States. US consumers thus cannot enjoy the new technology because markets are not integrated.

Increased integration of markets promotes rapid innovation. Previous work on auto emissions regulations shows that convergence of regulation leads to increased technology transfer and motivates export-oriented car industries in smaller countries to adopt higher emissions regulations to converge with the US and EU markets, creating a race to the top. Using data on automobile emissions regulations between 1992 and 2007, Antoine Dechezleprêtre, Eric Neumayer, and Richard Perkins (2015) find that technological developments, measured as cross-border patents, are more likely to flow between countries where regulatory standards are similar, rather than the level of regulations themselves. Perkins and Neumayer (2012) find that small and developing countries with export-oriented auto industries are more likely to have stricter auto emissions regulations and their auto sectors receive higher levels of inward foreign direct investment (FDI). The authors argue that export-oriented firms whose main target markets include countries with higher emissions standards have an incentive to raise standards in their home markets since these firms already have the infrastructure in place to produce higher-standard vehicles and therefore would be more competitive than strictly domestic producers. Better regulatory coherence will also promote research and development because instead of spending on adapting models to different regulatory regimes, companies will channel resources toward finding safer and more fuel efficient technologies.

While an increasing number of countries have adopted the UN Regulations associated with the 1958 Agreement, some such as Chile (and some small countries) follow US regulations. Regulatory convergence will not only help the US and EU markets but also may draw smaller countries into their standardized framework, thus spreading the high standards.

Quantifying the Gains from Integration of Regulations

To estimate the gains from having a single market, we use data on trade to evaluate the effect of becoming a contracting party to the 1958 Agreement. Along with its subsequent revisions in 1967 and 1995, the 1958 Agreement has gone a long way towards completely harmonizing regulatory standards. [6] Individual governments and governing bodies (such as the European Union) that are parties to the agreement verify that automobiles meet the regulations before they are certified for sale to consumers. The agreement was made under the United Nations Economic Commission for Europe (UNECE) and originally allowed participation only by UNECE members, but since 1995 has accepted non-European members, such as Japan (1998) and South Korea (2004). Table 3 lists the countries that are currently contracting parties to the 1958 agreement, by order of accession date.

The variation in accession dates helps to isolate the effect on auto trade of signing the 1958 Agreement. Figure 2 shows the average and median of the log of real exports versus time relative to accession year. Year 0 is the year a country joined the agreement, year 1 is the year after, year –1 is the year before and so forth. The figure shows that after joining the agreement countries tend to increase exports with members, from a similar starting level. The graph is in logs indicating that member exports doubled around accession and exports of non-members remained unchanged. Figure 3 shows that joining the agreement leads to a shift in exports to other agreement members. Both show a clear effect of the agreement on trade flows between contracting parties.

[6] There is also a 1998 Agreement, which is more limited in scope than the 1958 Agreement and calls for the establishment of global technical regulations (GTR) but does not include legally binding global regulations or provide for mutual recognition, as the 1958 Agreement does. The United States is a contracting member of the 1998 Agreement, along with the European Union, Japan, Canada and a host of other countries.

Estimating the Magnitude of the UN58 Effect

To estimate the size of the effect, controlling for supply and demand shocks to trade, we use a difference-in-differences approach. The difference-in-differences approach allows for a near experimental research design. While ideally we would like to randomly assign some countries the same regulatory standards and then observe what happens to auto trade, this type of experimental research design is obviously not feasible. This methodology is as close as you can get to experimental design using data. It compares trade growth between a new member and an existing member to trade growth between the new member and an otherwise similar country that is not a member.

In particular, we use the following regression equation on exports from country *i* to country *j* in year *t* (*exports*$_{ijt}$):

$$(1)\ \ln(exports)_{ijt} = \gamma_{it} + \gamma_{jt} + +\gamma_{ij} + UN58_{ijt} + \varepsilon_{ijt},$$

where US58 is a dummy for two countries being members of the 1958 agreement, γit is an exporter-year fixed effect, γjt is an importer-year fixed effect, and γij is an country-pair fixed effect, and the final term is the error. When Greece joined the agreement in 1992 the *UN58* variable switched from 0 to 1, on bilateral trade flows with another agreement member. The variable remains 1 when trade is between Greece and other agreement members for all subsequent years that Greece is a member of the agreement.

We also include a dummy for the European Union to ensure that *UN58* does not pick up EU effects, as a number of countries that joined the 1958 Agreement also joined the European Union over the period. The EU dummy is one for the year of accession and all years after for trade between the new member and other EU members, and zero otherwise.[7]

Data are from UN Comtrade for trade in passenger cars (SITC 7321) and include total value of bilateral exports for all country pairs. Data are drawn as mirror import data, which is better reported, and range from 1970 to 2013, over which period 41 countries acceded to the agreement. Because of the large number of fixed effects, we cannot estimate the regression on the full sample. We include all exporters that exported an aggregate of $1 million in automobiles in at least one year of the sample, and all importers that imported at least $1 million in one year. These countries account for on average 97 percent of total auto trade over the period.[8] Errors are clustered at the country-pair level, consistent with our variable of interest.[9]

The advantage of this approach is that importer-year fixed effects control for demand shocks, for example, because of a rise in income or a change in most-favored nation (MFN) tariffs. Exporter-year fixed effects pick up supply shocks, such as a productivity boost. The country-pair fixed effect controls for average trade between two countries and picks up non-time-varying factors, such as distance, common language, and other static linkages, such as the pair's membership in the European Union over the whole period. The variable of interest, *UN58*, picks up the long-run effect on annual bilateral trade flows between members from signing the agreement.

The results are reported in table 4. The first column reports results with only the *UN58* variable, the coefficient of 0.21 implies a trade effect of the agreement of 23 percent (exp(.21)-1). The next column repeats the exercise including the EU dummy in the regression and the result remains unchanged.

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[7] During the sample period, the following countries became EU members: United Kingdom and Ireland in 1973, Greece in 1981, Portugal and Spain in 1986, Austria, Finland, and Sweden in 1995, a group of 10 mainly Eastern European countries in 2004, and Bulgaria and Romania in 2007.

[8] This yields 35 exporters, listed in appendix table A.1, and 69 importers. In the robustness section we also split the period and drop countries with less than $100,000 exports or imports in any year, which yields 77 exporters and 142 importers.

[9] In the robustness section, we also cluster errors at the reporter (importer) level, and results remain robust.

The effect on auto trade of joining the 1958 Agreement is large and significant but smaller than the effect of EU accession. The EU membership effect is more important in this sector because the auto sector relies on distribution and service, and over our sample period relatively high tariffs and other regulations were limiting cross-border auto trade. The EU coefficient found here is comparable to estimates of the gains to trade associated with EU membership in manufacturing sectors.[10]

A potential concern about our methodology is that joining the 1958 Agreement might be endogenous. Countries that have increasing auto trade with agreement members might be more likely to join the agreement. This could overestimate the effect of the agreement on trade. To some extent the exporter-year and importer-year effects should pick this up, as they control for countries that become increasingly involved in auto trade over time. But if the effect is group-specific they may not.

In the absence of a good instrument for joining the agreement, we exploit an additional feature of the data to control for potential endogeneity. In ten countries in the 1958 Agreement, people drive on the left side of the road.[11] For trade between these countries and the rest, the agreement should be less effective because inventory cannot be redeployed across markets and two separate models still need to be created. It is impossible for regulations to be the same when an important feature such as the steering side of the car is different, which results in differences in dashboards, mirrors, pedals, stick shift, etc. We thus create a dummy for trade between a left-hand driving country and a right-hand driving country. We interact this dummy with the *UN58* variable and include the interaction in the regression (country-pair fixed effects eliminate the need to include the dummy itself). If the effect of the agreement is about trends among members, we expect the interaction effect to be insignificant. If it is about regulatory convergence, we expect the variable to be negative and significant, indicating that these country pairs do not experience the full effect of the agreement. The result is shown in the third column of table 4. The negative and significant effect of the interaction shows that the agreement has no effect on trade between left-hand and right-hand driving countries. In addition, controlling for the mixed pairs, the overall effect of the agreement is larger and closer to the EU effect. This strongly suggests that we are picking up the effect of the agreement and not general trends in the group.

The results suggest that the boost in trade from joining the 1958 Agreement has been at least 20 percent. But using the effects of the agreement to predict what would happen to the United States may be problematic because the United States is a relatively large exporter, accounting for 8 percent of auto exports on average to the sample group over the period. If small exporters are affected differently from large exporters then the results might not transfer. Indeed, a standard trade model would suggest larger effects on small exporters if the agreement is largely about fixed costs, as these producers can now access more markets. We next interact average market share over the period with the *UN58* effect. Average market share is defined as a country's total exports of autos in a given year relative to the world total, averaged over the whole period. We use average market share because market share in any year is endogenous to the agreement. If the effect is larger for small exporters we expect the coefficient to be negative. Interacting market share with the *UN58* dummy variable also enables us to estimate the effect on trade for a relatively large exporter like the United States.

The results are reported in column 4. Larger exporters experience a smaller boost to exports from regulatory convergence, but the overall effect is still positive for all exporters. Figure 4 shows how the effect varies with average market share over the period. Exports of a country with a market share of 8 percent like the United States would increase by about 35 percent with other countries that drive on

[10] Freund and Portugal-Perez (2013) find a 52 percent increase in imports associated with EU membership, while Baldwin and Taglioni (2006) find a smaller effect (27 percent) over the period 1980–2004. Using auto data over the same period (1980–2004), we find no significant effect of EU membership on auto exports, but this is not surprising considering new EU members over this period were not major auto producers. The *UN58* effect remains robust and highly significant in this period with a coefficient of 0.34.

[11] These are United Kingdom, Ireland, Japan, Australia, South Africa, New Zealand, Cyprus, Malta, Thailand, and Malaysia.

the right side of the road. The largest exporters, Germany and Japan, still receive a 7 percent boost from membership.

The results above offer strong evidence that regulatory harmonization has strong positive effects on trade. We subject the results to further robustness tests, including more conservative treatment of errors, alternative time periods, controlling for trade policies, and a placebo test. All results remain robust.[12]

Comparison with Other Estimates

Using the 1958 Agreement as an example produces larger effects on trade than results based on tariff equivalents. Ecorys (2009) estimates trade gains associated with EU and US auto regulatory convergence of about 10 percent. After designing and collecting data from a business survey of 5,500 NAFTA and EU member firms, Ecorys constructed an index ranking restrictiveness of nontariff regulations for bilateral trade between countries, ranging from 0 (completely open) to 100 (completely closed), for 23 sectors. The individual responses are aggregated by sector country-pair, and added to a gravity model, which predicts trade after controlling for GDP of trading partners and the distance between them, using data from 2008. The gravity model was run individually for each of the sectors to generate a set of tariff equivalents. In the auto sector, Ecorys finds a 25.5 percent increase in costs of US exports to the European Union, and a 26.8 increase in costs of EU exports to the United States. That is, they estimate that regulations affect trade in the same way as an ad valorem tariff of about 25 percent.

Using this tariff equivalent, Ecorys then uses computable general equilibrium (CGE) analysis to predict the medium-run increase in exports between the United States and European Union following a reduction in nontariff measures between the two countries through 2018. In an ambitious scenario, where all automotive regulations are eliminated, EU exports increase by 10.7 percent a year, while US exports increase 9.1 percent. A limited scenario, which sees only half of nontariff regulations eliminated, still has a positive impact on EU exports (4.3 percent increase per year) and US exports (5.3 percent per year). [13] Following the model, this export increase corresponds to an increase in sector output of 0.7 percent per year for the United States and a 2.2 percent increase for the European Union, which translates into an increase in national income of $2.1 billion and $15.6 billion for the two markets, respectively. In comparison, our model cannot be used like a CGE model to predict changes in output or income, but given the much larger export boost we estimate from regulatory convergence, the Ecorys' predictions likely represent the minimum increases in output and income. Our estimates, which are based on an actual harmonization event, may be larger than theirs for a number of reasons. The most important are that (1) the restrictiveness index from survey evidence is likely to be very noisy and not necessarily linked to the production costs associated with regulatory differences. Perceived regulations may not affect trade in a monotonic way as their model assumes. For example, a small regulatory difference in one sector may affect production costs more than a large regulatory difference in another sector because of the production process. (2) Using a gravity equation to turn the survey into a tariff equivalent forces regulatory barriers to affect trade in a very restrictive way, as an iceberg cost that affects trade in the same way across sectors, when regulatory differences affect production structure, returns to scale, and variable and fixed costs.

In contrast, our estimate is the long-run trade effect of harmonization, as estimated from an actual agreement. As these are historical effects, the actual effect could still differ if modern supply chains have reduced the importance of trade restrictions. The short- to medium-run effects might be significantly smaller if foreign investment has already adjusted to segment the US and EU markets. To

[12] See Freund and Oliver 2015, Peterson Institute for International Economics, Policy Brief 15-10 for details.

[13] For the entire economy, Ecorys predicts a 6.1 percent increase in US exports versus a 2.1 percent increase for the European Union following elimination of nontariff barriers.

the extent these investments are irreversible in the short run, production will take some time to adjust to changes in the regulatory system. In light of this, the next section looks at production chains across markets and the trends in FDI in the auto sector between the United States and European Union.

4. Foreign Direct Investment and Industry Trends

FDI in both directions is substantial. FDI stocks between the United States and European Union in the transportation sector have steadily increased over time in both directions, with an increase in both US direct investment in the European Union and EU investment in the United States. In particular, European investment has increased in recent years, while US FDI stock in the European Union has declined since 2007 (figure 5). For European carmakers, particularly German firms Volkswagen and BMW, revenue from US sales has also steadily increased over the past 10 years (figure 6).

US and European manufacturers use different supply chains for cars produced for the US consumer. The 1992 American Automotive Labeling Act (AALA) requires all automobiles sold in the United States to be labeled with the percent of US and Canadian content that makes up each type of automobile sold in the United States, in order to encourage US consumers to buy cars with high levels of US content. Figure 7 shows the average share of US and Canadian content of the "big three" US automakers (Chrysler, GM and Ford). In 2007, the big three produced car models that contained 70 percent US or Canadian content on average. By 2015 models, that share had declined in all three companies, as production shifted to Mexico. So, while US carmakers' production for US consumption has shifted away from the United States, there has been little movement outside NAFTA.

The AALA data shows that compared with US or Japanese automobile manufacturers, European firms still tend to produce the majority of their parts in the European Union for cars sold in the United States. Table 5 compares the US content of the top 5 models sold in the United States in 2014, separated into US, EU, and other non-US manufacturers. Of the top 5 European cars sold, only Volkswagen has a significant share of its content from outside of Germany and produces cars for the US market in both Germany and Mexico.

The high share of US content among Japanese firms relative to European carmakers is related to historical restrictions on Japanese car imports and a volatile yen. As trade tensions between Japan and the United States flared, the Japanese government agreed to VERs on the number of Japanese cars that could be exported to the United States, while European carmakers had no similar legislation in place. VERs were in effect from 1981 to 1994. Additionally, in 1985, the United States and Japan realigned exchange rates in the Plaza Accord. The significant appreciation of the yen removed the cost advantage of producing in Japan for export to the United States and led to a less stable yen/dollar exchange rate. The three biggest Japanese carmakers opened factories in the United States to get around VERs, (Honda in 1980, Nissan in 1983, and Toyota in 1986) and continued producing in the United States to some extent because of the exchange rate adjustment. In contrast, VW closed its only US plant in the United States in 1988 and did not open another US plant until 2011.[14]

Although the differences in regulations require separate car models for the US markets, European firms still choose to produce cars bound for the US market through EU supply chains perhaps because of fewer historical restrictions on trade (and indeed Korean-made cars also tend to have lower levels of US content than Japanese-made ones). If regulations were mutually recognized, preexisting supply chains, which currently produce two versions of the same model of cars sold in both markets, would become more efficient as they would be able to halve the number of different models they produce along these supply chains.

[14] Schaede (2010); James Healy, "'Transplant' Auto Factories in USA Turn 30 This Year," *USA Today*, April 3, 2012; Andrew Pollack, "Japan to End Restraints on Auto Exports to US," *New York Times*, March 29, 1994.

While European cars sold in the United States are largely European-made, what about US cars sold in Europe? The European Union does not have similar content-reporting regulations in place, making it difficult to determine precisely the European content of US branded cars sold in Europe. However, one way of determining if US auto firms are any more reliant on production in Europe than EU auto firms are on production in the United States is to compare sales of multinationals outside of their home countries, which is likely to move with foreign production, and exports. The higher the ratio of exports to sales, the more foreign affiliates rely on imports from the parent company for sales, rather than producing cars in the market they sell in.

Table 6 uses US Bureau of Economic Analysis data on multinationals operating in the United States and US companies abroad to calculate the ratio of exports to sales in 2012, the most recent year for which data are available. These BEA data are for both US affiliates operating abroad and foreign affiliates operating in the United States and report total sales in transport equipment for both groups (NAICS 366). For European parents and their US affiliates, exports are of all transport equipment and wholesale trade in motor vehicles and motor vehicle parts and supplies. This matches closely data from Comtrade on transportation exports from the European Union to the United States. However, these data are not available for US parents and their European affiliates. To calculate the ratio of exports to sales in this case, we instead use Comtrade data on total EU-27 exports of transport equipment to the United States (SITC 73).

Despite exports to total sales of just one-third of European sales, local content data reveal that European cars are still made of largely EU content. This may be because final assembly is often the most cost-effective stage of production to move. As a result these ratios may offer a good sense of relative differences across markets but may be less useful as an indication of home-country content.

The ratio of exports to total sales is higher in Europe than in the United States. This suggests that US car sales in Europe have relatively higher levels of foreign content than European cars have non-European content in the United States. The estimates from the model of large long-run trade gains from regulatory harmonization, significantly larger than from tariff reductions, therefore may be more delayed in the United States than Europe, because the United States produces vehicles in Europe with less US content compared with the EU content of European vehicles for the US market. European producers are therefore likely to adjust more rapidly to a new integrated terrain than US producers, where production is separated.

Beyond the firms with production abroad, firms that do not currently export to the United States, such as French motor company Renault, could increase variety in the US market without incurring the costs associated with building cars to US specification. As noted earlier, the market for compact and subcompact cars in the United States is very small, but if firms that produce such vehicles following EU regulations can sell in North America, they will be able to reach the US and Canadian consumers who prefer smaller cars without incurring the high costs of modifying the car models. Since regulations provide similar levels of safety, and harmonized regulations bring trade gains, the United States and European Union should work towards making US and European cars available in both markets without having to make separate versions of each model.

5. Policy Proposal

Considering the large gains from harmonization, one proposal for the US and EU automotive sector is for the United States to join the 1958 Agreement. However, this approach has high logistic and legal costs. In addition to the technical differences in regulations, such as the turn signal light example in table 1, EU and US regulations on vehicle safety certification also differ in implementation. The United States operates under a self-certification system for vehicle regulations. The National Highway and Traffic Safety Administration (NHTSA) issues safety regulations for US vehicles, but calls on automakers to certify that their new vehicles conform to these safety regulations. Firms are responsible

for both testing of new vehicles and liable for any penalties associated with vehicles that are found not in compliance with NHTSA regulations. On the other hand, under the 1958 Agreement, the European Union operates under a type-approval system, where firms submit samples of new cars to government testing facilities, which formally approve these new models. Once approved by any government in the European Union, that car model is considered to have met the safety regulations of all EU members and can be sold in all EU countries (Canis and Lattanzio 2014).

As demand for vehicles shifts away from the US market, there is less of an incentive to produce models specifically designed to meet US safety regulations and approval systems. However, logistically, it would likely be infeasible to switch from a self-certification to a type-approval system, as the United States would need to establish a new government entity to handle auto safety regulations, rewrite laws to regulate changes in liability for faulty vehicles and parts , and build new infrastructure for safety testing.

An alternative approach would be to leave established regulatory systems in place in both the United States and the European Union but have both countries accept the other's regulations as valid in their own market. Such a policy could be adopted either for all vehicle regulations or for a range of particular components. Currently, few cases of such mutual recognition are in place, but it is not without precedent, and this approach is gaining ground. New Zealand, which signed on to the 1958 Agreement in 2002, also imports vehicles certified under US regulations.[15] Mexico allows sales of vehicles with either Mexican or European certification.[16] Additionally, free trade agreements have facilitated some of this mutual recognition. The Korea-US Free Trade Agreement allows Korea to import 25,000 vehicles per automaker that meet US regulations, without having to also meet Korean regulations (Schott 2010). Canada is moving toward mutual recognition of EU and US regulations. While Canadian regulations generally mirror US regulations, the Canada-European Union Comprehensive Economic and Trade Agreement, signed in October 2014, lists 17 UNECE safety regulations that are considered an allowable alternative to current Canadian regulations (Foreign Affairs, Trade and Development Canada 2013).

There is evidence that both the United States and the European Union would accept such of agreement. In September 2009, the European Communities brought a proposal to the World Trade Organization (WTO) to supplement the existing text of the December 2008 Negotiating Group on Market Access, in order to reconcile type-approval (1958 Agreement) and self-certification (US regulations) frameworks in the auto industry.[17] The proposal recognized both systems as valid auto regulatory frameworks and allows for three paths for potential signatories: (1) members with type-approval systems already in place must sign the 1958 Agreement, (2) members with self-certification systems may join the 1958 Agreement, then nominate a national regulatory body to deliver type-approval of automobiles produced in that member state, and (3) members with self-certification systems may maintain them while recognizing UN Regulations as equally valid as their own regulations in their market (Negotiating Group on Market Access 2009a).

The proposal also presents a method for documenting member country adoptions of mutually recognized equivalent regulations for EU and US technical requirements. Each member is required to certify that it will accept a particular EU regulation as equivalent to a US regulation. For each requirement, the United States must document each safety requirement that is considered equivalent to the EU requirement in order for a car that meets either regulation to be sold. At the same time, the European Union must recognize that the same US regulation is equivalent to the EU regulation to sell a car that meets either requirement in the market.

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15 New Zealand Transport Agency, "Guide to importing a vehicle," www.nzta.govt.nz/vehicle/importing.

16 Jeremy Cato, "Mexico accepts European vehicle standards, why doesn't Canada?" *Globe and Mail,* November 5, 2014.

17 The 2008 negotiations provide a framework for proposing and adopting regulatory harmonization in the automotive sector but does not itself propose steps for convergence.

For example, the United States requires that the colors of the front and rear end-outline marker lamps be amber and red, respectively.[18] The corresponding EU requirement is white and red, respectively. If both the United States and the European Union recognized each other's regulations, firms from both countries would be able to sell cars with either type of lights in both markets and not have to change the colors.

The US response to the WTO framework was positive. The United States circulated a response outlining a procedure for transparently reporting changes in regulation and conformity assessment procedures, noting transparency was particularly necessary when countries were adopting another member's regulations. This communication also added that when members propose to adopt a technical regulation, they should also consider the costs of complying with this regulation and consider any already available alternatives that fulfil the same objective. A revised version of the proposal, circulated in December 2009, incorporated these US proposed changes (Negotiating Group on Market Access 2009b).

While this proposal has not moved forward in the WTO, there is potential for a similar bilateral proposal of mutual recognition either within the TTIP framework or in an auto sector-specific agreement.

From an economic perspective, assuming the safety and environmental outcomes of the regulations are the same, harmonization and mutual recognition have similar economic results. In both cases, inventory can be redeployed. In both cases, only one model needs to be created for both markets. In both cases, models with low demand in a foreign market can still be exported without costly adjustments. Mutual recognition will be much easier to achieve in this case, especially with respect to the approval system, because shifting from government to self-approval or vice versa would require the trade agreement to impinge on legal systems, which are part of national sovereignty. For members the main economic concern with mutual recognition is that if one system is significantly cheaper to use than the other, it could draw investment away from the region with the more costly regulation.

Mutual recognition also has important implications for outside producers. If the agreement extends only to the European Union and the United States, outside producers will still be required to produce for two different systems. For example, if Korea-manufactured automobiles that meet EU regulations are not eligible for the mutual recognition agreement, then Korean producers will still be required to produce separate models for each market. This will put them at a cost disadvantage relative to US and EU producers. Not extending mutual recognition will also prevent the "global standard setting" that US and EU governments have used to motivate the agreement. It is therefore important that a mutual recognition agreement is extended to outside producers as well. Of course, they would not be permitted to follow their own unique regulations and be granted recognition privileges, but provided they adhere to either US or EU regulations, automobiles produced outside the TTIP area should be subject to the same restrictions as US- or EU-produced vehicles.

Mutual recognition, particularly with enhanced technical harmonization, would require time to achieve. Kenneth Feith, Daniel Malone, and John Creamer (2014) offer a starting point of trust and cooperation, where US and EU regulators considering new technologies keep each other informed and work together on the rulemaking process and commit to bridging the type-approval and self-certification systems, and build in steps towards mutual recognition.

[18] Outline marker lamps are placed on the front and rear of the vehicle to indicate the overall width of the vehicle.

6. Conclusion

Regulatory convergence or mutual recognition of regulations between the European Union and the United States would bring larger welfare gains than tariff reduction. The gains are in efficiency, variety, and innovation. We estimate that harmonization of auto regulations would increase US-EU auto trade by at least 20 percent. These gains can be achieved through the TTIP, which also aims at setting rules for global trade. To maximize auto market integration, greater harmonization would be preferable, with the United States becoming a contracting member of the 1958 Agreement. However, recognizing differences in legal systems and approval systems implies that the greatest benefit at the least cost is likely to come from the harmonization of technical regulations, where overlap already exists, and the mutual recognition of regulations and approval methods across countries. This approach allows firms to streamline production and offers increased variety for consumers without implicitly favoring either the existing EU or US systems. We also recommend that outside producers are extended the same treatment, provided they adhere to the US or EU system.

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Tables and Figures

Table 1 Differences in regulations between EU and US side turn-signal lamps

Current EU regulations and US end-outline marker lamps [clearance lamps] (R48: UN Regulation No. 48; F108: FMVSS Standard No. 108; R7: UN Regulation No. 7; SAE Standard No. J2042)			
Property	EU (UN Regulations)*	US (FMVSS/SAE Standards)§	Comparison
Applicability	Optional, option of AM/RM1/RM2 category lamps	Optional	Identical for applicability The EU permits the use of variable intensity rear end outline marker lamps, while the US prohibits their use
Number	4–8	2x Front 2x Rear	Number of side marker lamps can range from 4–8 in the EU, but must be 4 (2x rear and 2x front) in the US
Color	Front: White Rear: Red	Front: Amber Rear: Red	Color must be white at the front and red at the rear in the EU, while the color must be amber at the front and red at the rear in the US
Position			
Height	Front: Upper edge not lower than upper edge of wind-screen Rear: At maximum height possible	As near the top as practicable	Minimum height at front is lower in the EU Identical for the rear
Width	Outer: ≤400 mm and as close as possible to the extreme outer edge of the vehicle	Indicate the overall width of the vehicle and symmetric about the vertical center line	Widths are more prescriptive in the EU, while the US is more subjective
Length	—	Front: On the front Rear: On the rear Other: Any other location to ensure that overall width of vehicle is indicated	Lengths are not defined in the EU, while the US provides subjective length definitions
Other	Distances must be ≥200 mm vertically from position lamps	—	Minimum vertical distance from position lamps are prescribed in the EU, while the US does not define these minimum distances
Geometric visibility	H: O80° V: D20° to U5°	—	Geometric visibility ranges are prescribed in the EU, while the US does not define geometric visibility ranges
Photometric	H: 0° to O20° V: D10° to	H: I45° to O45°† V:	Smaller horizontal and upward

visibility	U5°	D10°$ to U10°	photometric visibility angles required in the EU
Photometric MinimaΔ	≥4 cd @ H: 0°, V: 0° ≥0.4 cd @ H: O20°, V: D/U 5°	Front: ≥0.62 cd Rear: ≥0.25 cd	Photometric minima are greater in the reference axis for all lamps in the EU Absolute photometric minima for all lamps in the EU are smaller than photometric minima for front end-outline marker lamps and greater than photometric minima for rear end-outline marker lamps
Photometric MaximaΔ	AM: ≥140 cd @ H: 0°, V: 0° ≥14 cd @ H: O20°, V: D/U 5° RM1: ≥17 cd @ H: 0°, V: 0° ≥1.7 cd @ H: O20°, V: D/U 5° RM2: ≥42 cd @ H: 0°, V: 0° ≥4.2 cd @ H: O20°, V: D/U 5°	Front: - Rear: ≥15 cd	Front photometric maxima are prescribed in the EU, while the US does not define front photometric maxima Rear photometric maxima are greater in the reference axis for all lamps in the EU Absolute rear photometric minima for all lamps in the EU are smaller than photometric minima for rear end-outline marker lamps

* Applicable for vehicles that are between 1.8–2.1 m in length
§ Applicable for vehicles that are ≤2302 mm in width
† May be reduced to D0° when lamp is mounted at locations other than the front or rear
$ May be reduced to D5° when lamp is mounted below 750 mm
Δ UN: for single function lamps tested at voltage supplies of 6.75v, 13.5v and 28v; US: for non-reflecting single function lamps with photometric measurements made at ≥1.2m

Directional nomenclature: I, inboard; O, outboard; D, downward; U, upward; B, backward; F, forward; L, left; R, right. Applicable for right hand traffic lamps only, reverse left and right directions for left hand traffic lamps. H, horizontal (longitudinal) plane about a polar axis in a spherical coordinate system centered on the illuminating surface of the lamp; V, vertical (latitudinal) plane perpendicular to a polar axis in a spherical coordinate system centered on the illuminating surface of the lamp

Source: European Commission (2015, table 33).

Table 2 Fatalities US versus EU regression results

	(1)	(2)	(3)
	Fatality rate per 100,000 vehicles	Fatality rate per 100,000 vehicles	ln fatality rate
EU dummy	2.192 [2.393]	–0.190 [1.609]	–0.156 [0.102]
ln GDP per capita		–22.673*** [4.020]	–1.373*** [0.217]
Observations	78	78	78
R-squared	0.017	0.554	0.544

Notes: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Sources: World Health Organization Global Health Observatory Data Repository, 2010, http://apps.who.int/gho/data/node.main.A997; authors' calculations using data from US National Highway and Traffic Safety Administration, 2012 FARS database, www.nhtsa.gov/FARS, and US Census Bureau, 2012, www.census.gov/popest/data/historical/2010s/index.html.

Table 3 Members of the 1958 Agreement (as of February2014)

Country	Date of accession	Country	Date of accession
Belgium	1959	Estonia	1995
France	1959	Belarus	1995
Sweden	1959	Turkey	1996
Hungary	1960	Ireland	1998
Netherlands	1960	European Union	1998
Spain	1961	Japan	1998
United Kingdom	1963	Latvia	1999
Italy	1963	Bulgaria	2000
Germany	1966	Australia	2000
Austria	1971	Ukraine	2000
Luxembourg	1971	Serbia	2001
Switzerland	1973	South Africa	2001
Norway	1975	Azerbaijan	2002
Finland	1976	New Zealand	2002
Denmark	1976	Lithuania	2002
Romania	1977	Cyprus	2004
Poland	1979	Malta	2004
Portugal	1980	South Korea	2004
Russia	1987	Thailand	2006
Croatia	1991	Montenegro	2006
Macedonia	1991	Malaysia	2006
Slovenia	1991	Tunisia	2008
Greece	1992	Albania	2011
Bosnia and Herzegovina	1992	Kazakhstan	2011
Czech Republic	1993	Egypt	2013
Slovakia	1993		

Source: UN Economic Commission for Europe, www.unece.org/fileadmin/DAM/trans/main/wp29/wp29regs/updates/ECE-TRANS-WP.29-343-Rev.22.pdf.

Table 4 Effect of the 1958 Agreement on auto trade

Variable	(1)	(2)	(3)	(4)	(5)
Dependent variable: $ln(exports_{ij})$					
UN58	0.205* [0.118]	0.197* [0.118]	0.388*** [0.138]	0.456*** [0.148]	0.448*** [0.148]
EU		0.662*** [0.134]	0.626*** [0.134]	0.613*** [0.134]	0.691*** [0.154]
Left-Right*UN58			–0.393** [0.156]	–0.368** [0.156]	–0.368** [0.156]
Share*UN58				–1.737* [0.977]	–1.663* [0.982]
Share*EU					–2.238* [1.296]
Observations	50,467	50,467	50,467	50,467	50,467
R-squared	0.85	0.85	0.85	0.85	0.85
Trade effect (percent)	23	22	47	58	57

Notes: Standard errors in brackets clustered at the exporter-importer level. *** p<0.01, ** p<0.05, * p<0.1.

Table 5 US content of top-selling US, EU, and other non-US car models, 2014

Model	Models sold	Percent US/Canadian content	Percent other content[a]	Final assembly location(s)	Engine source(s)	Transmission source(s)
United States						
Ford F-Series	753,851	75		USA	USA	USA
Chevrolet Silverado	529,755	40	51, Mexico	USA, Mexico	USA	USA
Dodge Ram 1500-3500	439,789	66	23, Mexico	USA, Mexico	Mexico, Italy	USA
Ford Fusion	306,860	75	15, Mexico	Mexico	Romania, UK, Spain, Mexico	USA, UK
Ford Escape	306,212	60		USA	Mexico, Spain, UK	USA
Europe						
Volkswagen Jetta	141,354	6–12	37-41, Mexico, up to 26, Germany	Mexico	Mexico	Japan, Argentina, Germany
BMW 3 Series	100,902	5	60-65, Germany	Germany	Germany	Germany
Passat Volkswagen	96,649	40–45	21, Mexico; 26-41, Germany	USA	Germany, Mexico	Germany, Argentina, Japan
Mercedes-Benz "C" Class	75,066	0	73, Germany	Germany	Germany	Germany
Mercedes-Benz "E" Class	66,403	0	73, Germany	Germany	Germany	Germany
Other non-US						
Toyota Camry	428,606	75	20, Japan	USA	USA, Japan	USA, Japan
Honda Accord	388,374	70	15, Japan	USA	USA, Japan	USA, Japan
Toyota Corolla	339,498	60	30, Japan	China, USA	USA	Japan
Nissan Altima	335,644	60	15, Japan	USA	USA	Japan
Honda Cr-V	335,019	70	15, Japan	USA, China, Mexico	USA	USA, Japan

a. To be included in the other content category, an individual country must produce at least 15 percent of the parts included in the car model.

Sources: 1992 American Automotive Labeling Act, National Highway Traffic Safety Administration, http://www.nhtsa.gov/Laws+&+Regulations/Part+583+American+Automobile+Labeling+Act+(AALA)+Reports; Bloomberg, www.bloomberg.com/graphics/2015-auto-sales.

Table 6 Ratio of exports to total sales, 2012

	Exports by parent to affiliate company (millions of US dollars)	Total sales by affiliate (millions of US dollars)	Exports/total sales
All transportation equipment			
European parent, US affiliate	56,860	165,066	0.34
US parent, European affiliate	28,837[a]	166,788	0.17

a. Total EU imports of transportation equipment from the United States (SITC code 73).

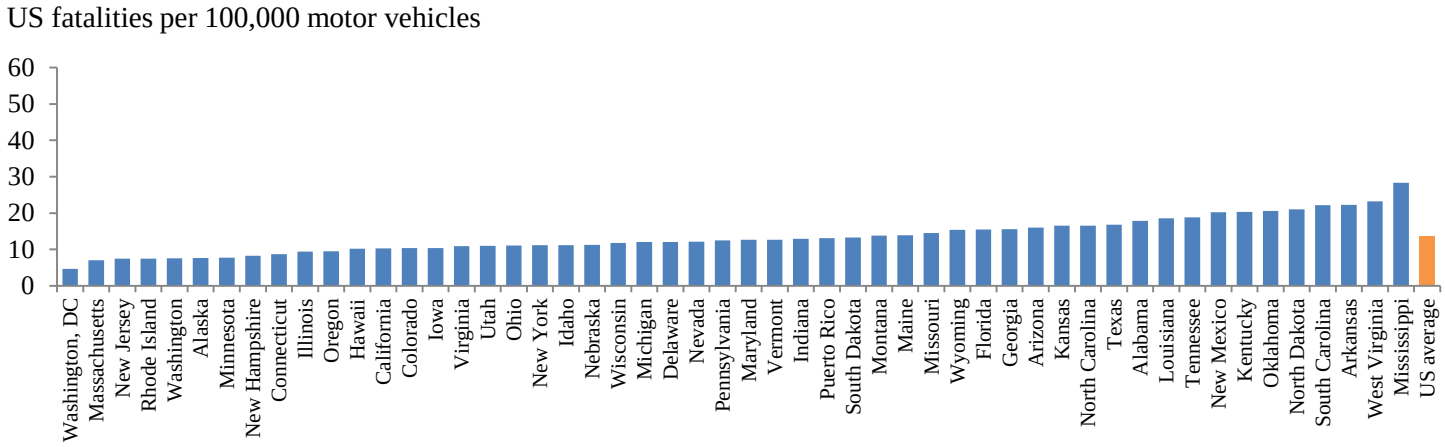
Source: Authors' calculations using data from Bureau of Economic Analysis and UN Comtrade Database.

Appendix table A.1 List of exporters

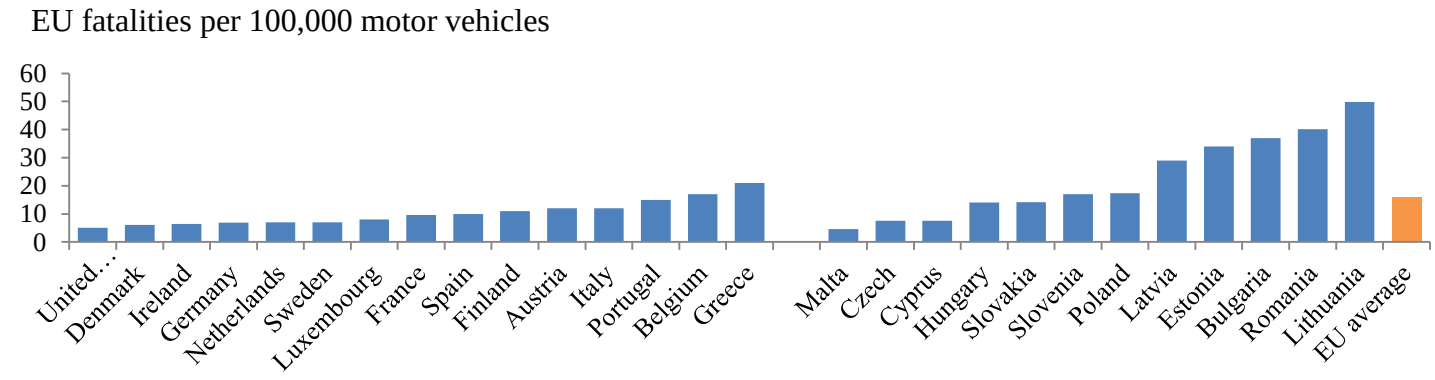
Argentina	United Kingdom
Belgium	India
Belgium-Luxembourg	Italy
Brazil	Japan
Canada	South Korea
China	Mexico
Germany	Netherlands
Spain	Portugal
France	Thailand
United States	Finland
Australia	Hungary
Romania	Morocco
Austria	Poland
Sweden	Russia
South Africa	Serbia/Montenegro
Indonesia	Slovak Republic
Turkey	Slovenia
Czech Republic	

Figure 1 Auto fatalities per 100,000 vehicles, United States and European Union, 2013

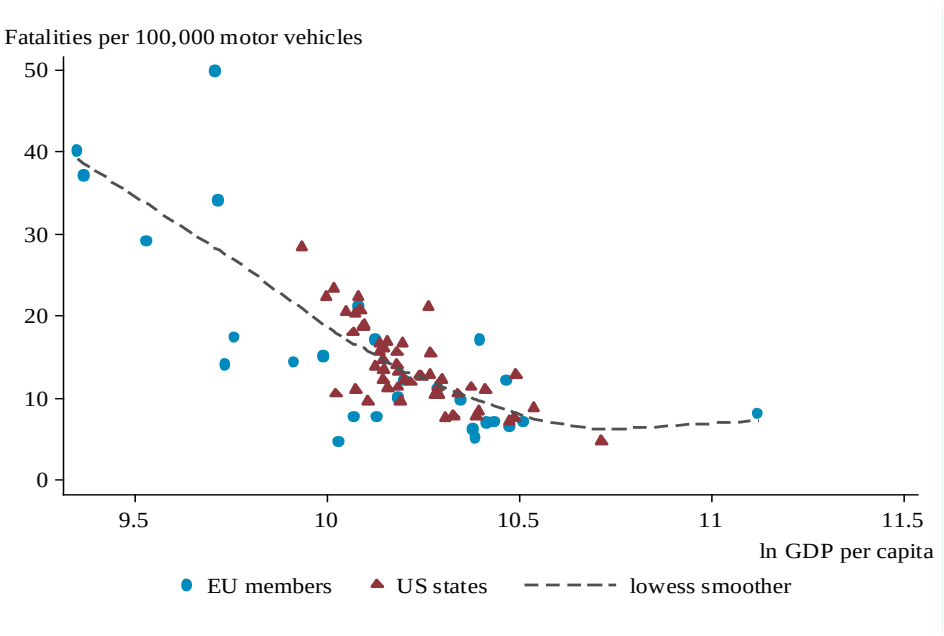
a. Fatalities in the United States



b. Fatalities in the European Union

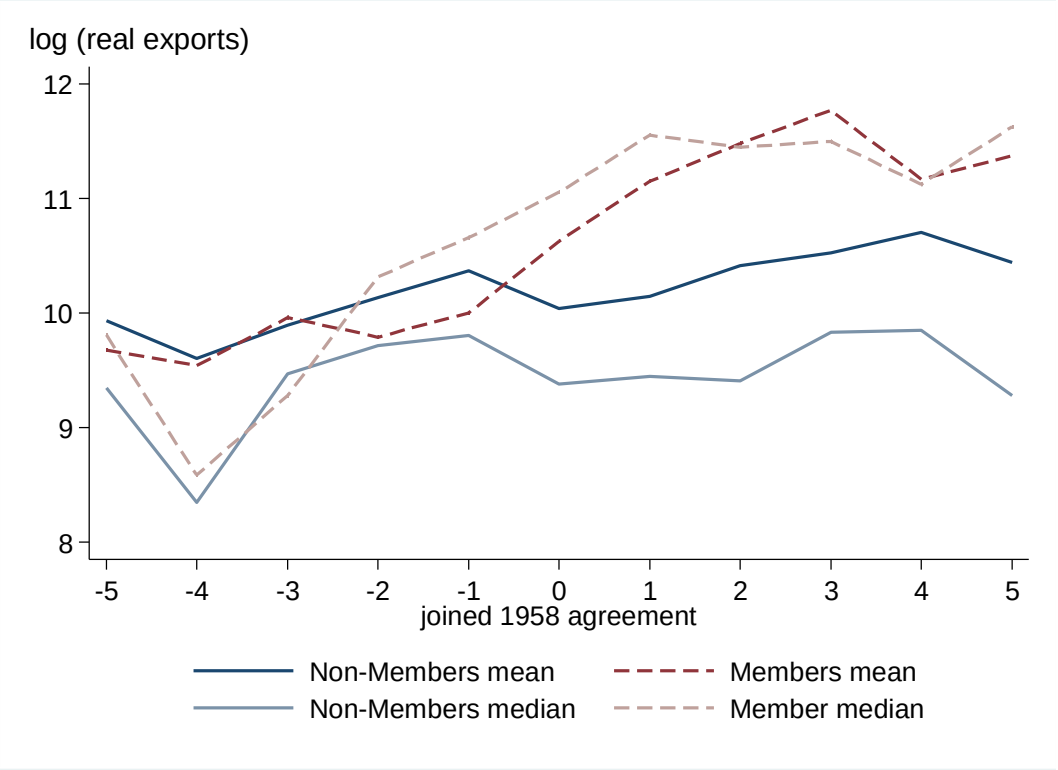


c. Fatality rates and GDP per capita in individual EU countries and US states



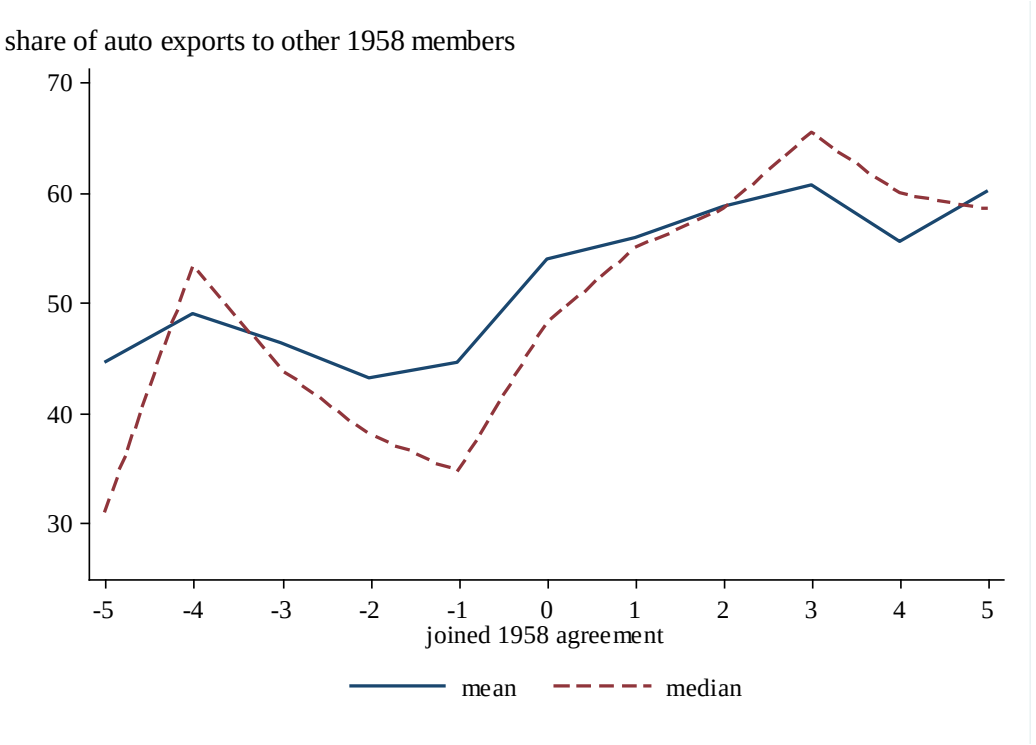
Sources: World Health Organization Global Health Observatory Data Repository, 2010, http://apps.who.int/gho/data/node.main.A997; authors' calculations using data from US National Highway and Traffic Safety Administration, 2012, FARS database, www.nhtsa.gov/FARS, and US Census Bureau, 2012, www.census.gov/popest/data/historical/2010s/index.html.

Figure 2 Export expansion relative to accession to 1958 Agreement



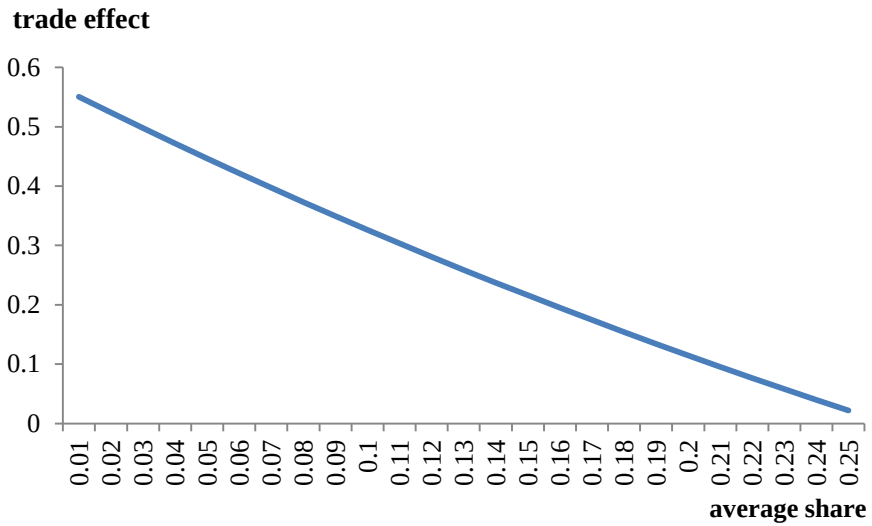
Source: Authors' calculations.

Figure 3 Export share to 1958 Agreement members relative to accession year



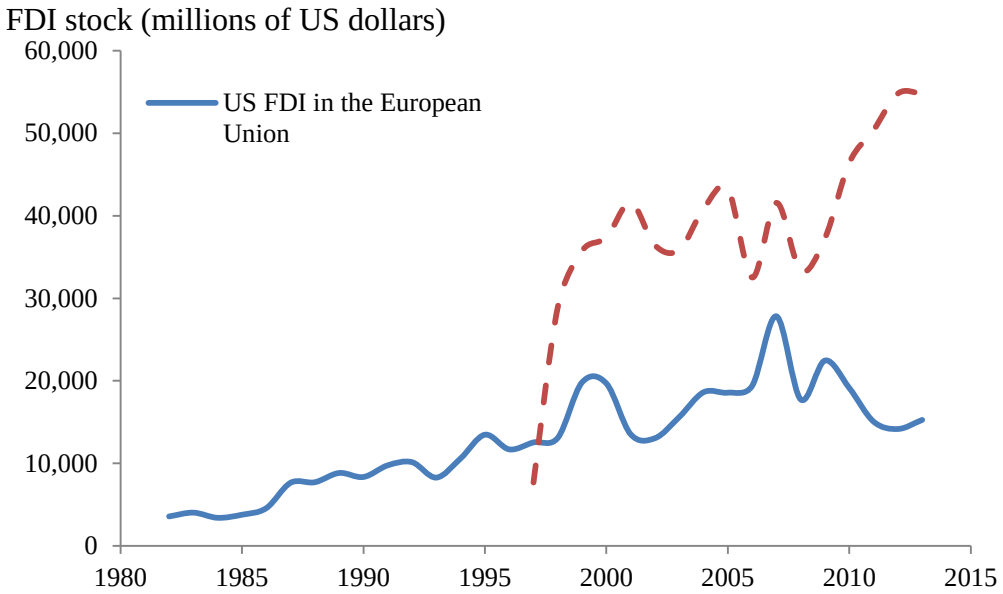
Source: Authors' calculations.

Figure 4 Trade effect by average market share



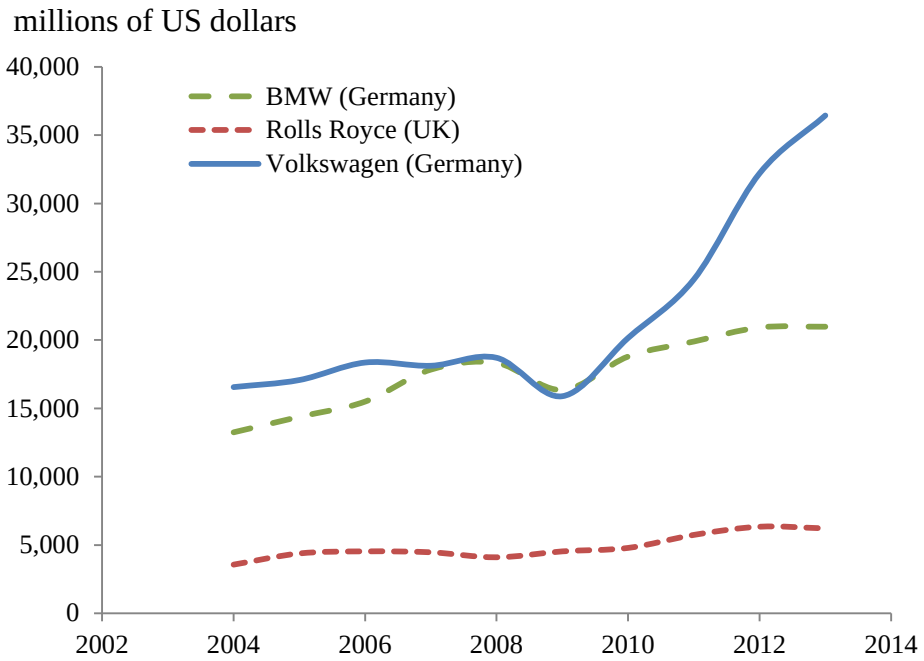
Source: Authors' Calculations

Figure 5 Foreign direct investment position in transportation equipment, 1982-2013



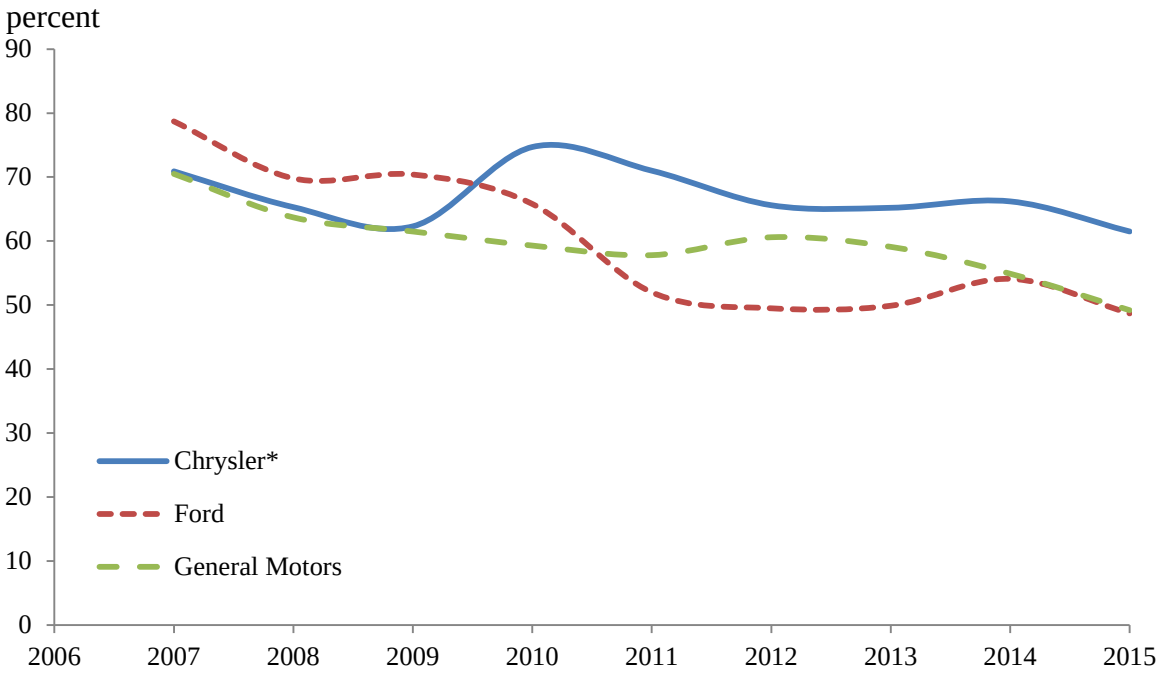
Source: US Bureau of Economic Analysis, International Data, Direct Investment and MNE, www.bea.gov.

Figure 6 EU manufacturers' revenue from US operations, 2004-2013



Source: Bloomberg.

Figure 7 Average share of US and Canadian content, by company, 2007-2015 models



*Chrysler 2015 average includes Fiat models, following the merging of the two companies in 2014.

Source: Data from the 1992 American Automotive Labeling Act.

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