Exhibit A

Retail Price Equivalents and Incremental Cost Multipliers: Theory and Reality as Applied to Federal CAFE/GHG Standards.

By Michael Whinihan, Ph. D., Dean Drake and David Aldorfer

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Abstract

Retail Price Equivalent (RPE) is a methodology used by accountants and financial managers at vehicle manufacturers to determine the markup required from direct manufacturing costs - the costs of materials and labor - to the retail price at which a vehicle or component must sell in order to earn at least a competitive rate of return on their investments in technology.

The appropriate markup consists of the indirect or overhead costs associated with R&D, pensions and health care, warranties, advertising, maintaining a dealer network, and profits. The National Research Council (NRC) finds a consensus among internal financial managers and outside analysts for an average RPE of around or slightly above 2.0, or twice the level of direct manufacturing costs. Historically, the government has used the RPE methodology to mark up direct manufacturing costs to retail. For the MY 2012-2016 greenhouse gas (GHG) and Corporate Average Fuel Economy (CAFE) standards, the government used a lower RPE of 1.5 in conjunction with the newly developed concept of Indirect Cost Multipliers (ICMs). Most recently, for MYs 2017-2025, it scrapped the RPE approach in favor of ICMs which results in an average markup of 1.25. This paper confirms the NRC's consensus estimate of a 2.0 RPE markup and implies that the agencies have underestimated the increased consumer prices resulting from their proposal by a factor of 1.6.

The ICM approach substantially underestimates the costs of the proposed standards and the significant losses of light vehicle sales and manufacturer, supplier, and dealer jobs. When an appropriate 2.0 RPE factor is applied to the proposal's estimated costs, the per vehicle price increase increases from an estimated $2,937 to $4,803.

Introduction

In 1975, Congress enacted the Corporate Average Fuel Economy (CAFE) program which set a vehicle fuel economy of 27.5 mpg for cars.[1] Since then, CAFE standards have been incrementally increased (See Figure 1 below). In December 2007, Congress enacted the Energy Independence and Security Act, which raised the CAFE standard to at least 35 mpg for the combined fleet of cars and light trucks in 2020.[2] Under the Obama administration, the Environmental Protection Agency (EPA) and the National Highway Transportation Safety Administration (NHTSA) have proposed aggressive increases to the current fuel economy standards. As a result, EPA and NHTSA have provided impact analyses of their proposed rules. A required part of these impact analyses are per vehicle cost increase estimates. Historically, NHTSA has used an accounting methodology known as retail price equivalents (RPE) to calculate the per vehicle cost increase of its CAFE rules. In the current rulemaking, EPA and NHTSA have proposed using a new accounting method known as indirect cost multipliers (ICM) to conduct their cost analyses.

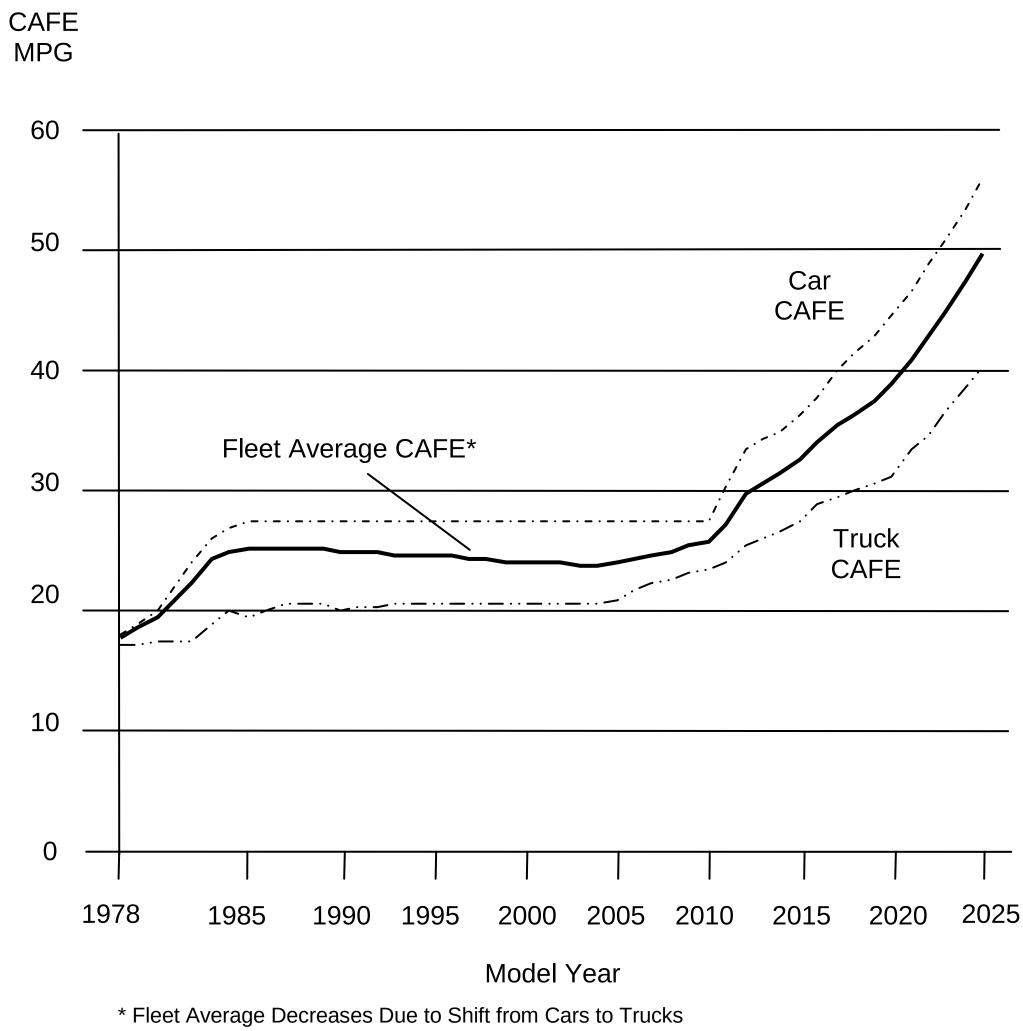

Figure 1. Corporate Average Fuel Economy History and Future Mandates

[1] 49 U.S.C. § 32901 et seq.
[2] Pub. L. No.110-140, 121 Stat. 1492 (2007).

The Departure from Retail Price Equivalents

When new regulations require equipment or components of vehicles to be added, altered or replaced, Original Equipment Manufacturers (OEMs) can provide estimates of the direct materials, labor required, and manufacturing costs required to meet the new regulations. Traditionally, direct costs have been adjusted upward to recover sufficient revenue by applying a multiplier to the direct costs. RPE is a number greater than 1.0 developed using data from many products that when applied to aggregate direct costs results in sufficient total revenue to recoup OEM's investment.

For many years, various regulatory agencies in the United States have used this industry-provided input and other data to estimate the impact of regulations on prices in the automobile industry by using RPE multipliers.[3] The process for calculating RPEs and using them to estimate the increase in retail price due to a regulation is shown in Figure 2, below.

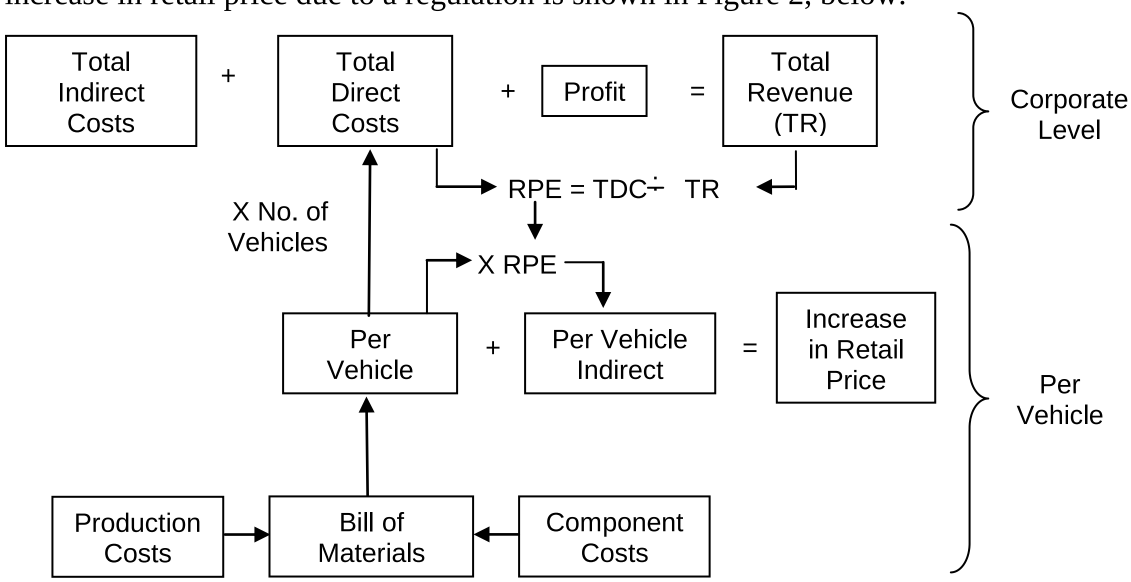

Figure 2. The Calculation and Use of RPEs

As noted above, EPA and NHTSA have developed the ICM method to calculate the indirect costs of regulations to OEMs. Apparently the government believes that: (1) a single-value multiplier like the RPE, which is developed from aggregated data including all indirect costs, overstates the true regulatory cost for virtually all potential compliance technologies, that (2) each different technology has some unique "menu" of indirect costs that is a subset of all those traditionally included in RPEs, and that (3) only those subsets of indirect costs should be included in the estimate of the increased retail cost attributable to the proposed regulation. The analysis below demonstrates that these concerns are unwarranted and that the use of ICMs seriously undermines EPA and NHTSA's regulatory cost analysis.

[3] Bussmann, Wynn V. and Michael Whinihan, "The Estimation of Impacts on Retail Prices of Regulations: A Critique of 'Automobile Industry Retail Price Equivalent and Indirect Cost Multipliers'", 2009, 1.

Differentiating between RPE and ICMs

The use of the ICM method in the MY 2017-2025 proposal marks a significant departure from the well-understood, widely-practiced RPE methodology. In order to understand why this new approach is so significant it is necessary to understand the difference between ICMs and RPEs. The government describes the difference between RPEs and ICMs as follows:

> Prior to developing the ICM methodology … EPA and NHTSA both applied a retail price equivalent (RPE) factor to estimate indirect costs. RPEs are estimated by dividing the total revenue of a manufacturer by the direct manufacturing costs. As such, it includes all forms of indirect costs for a manufacturer and assumes that the ratio applies equally for all technologies. ICMs are based on RPE estimates that are then modified to reflect only those elements of indirect costs that would be expected to change in response to a regulatory-induced technology change. For example, warranty costs would be reflected in both RPE and ICM estimates, while marketing costs might only be reflected in an RPE estimate but not an ICM estimate for a particular technology, if the new regulatory-induced technology change is not one expected to be marketed to consumers. Because ICMs calculated by EPA are for individual technologies, many of which are small in scale, they often reflect a subset of RPE costs; as a result, for low complexity technologies, the RPE is typically higher than the ICM. This is not always the case, as ICM estimates for particularly complex technologies, specifically hybrid technologies (for near term ICMs), and plug-in hybrid battery and full electric vehicle technologies (for near term and long term ICMs), reflect higher than average indirect costs, with the resulting ICMs for those technologies equaling or exceeding the averaged RPE for the industry.[4]

The ICM method begins with a "tear down" of existing components that represent a technology package the government believes is necessary to comply with a proposed standard. The direct cost of manufacturing these technologies is then estimated. Separate ICMs are calculated based on the level of complexity of each technology, for both short-term and long-term effects. In estimating ICMs, the government determines what indirect costs should and should not be applied to the direct costs in estimating increases in retail price. This contrasts with the RPE approach where one RPE is used to adjust the price of all components added to the vehicle. The ICM applied to a specific technology requires a subjective judgment which varies from component to component and from rulemaking to rulemaking and is not subject to validation by independent analysts.

ICMs look only at the cost of additional hardware and not the total cost of complying with the standards. ICMs do not include all of the indirect costs that manufacturers incur and therefore do not totally reflect the real increase in retail price. Anticipating which indirect costs should and should not be included in ICMs require nearly perfect foreknowledge. There is no reason to believe that NHTSA and EPA or even manufacturers have the ability to anticipate how a given regulation will impact indirect costs. The RPE approach, on the other hand, does not rely on nearly perfect foresight or judgment.

[4] 2017 and Later Model Year Light Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, 76 Fed. Reg. 74854 et. seq. (December, 2011) Pg. 74927

One indirect cost that results from regulation but is not included in the ICM is marketing costs. EPA and NHTSA admit that costs such as marketing are not included in their calculations of ICMs, even though significant marketing will likely be required to sell more expensive, higher fuel economy vehicles. With the RPE approach, all of these additional marketing costs would be attributed to the regulation. Under the ICM method, none are. Public education is another indirect cost not included in the ICM approach. Even simple technology improvements may require manufacturers to spend significant sums to educate owners, dealers and repair facilities about specific features or problems[5]. ICMs also do not account for the costs of complying with the midterm. The extensive midterm review will require thousands of man hours for preparation and presentation of the required information.

<u>The Flawed Logic of ICMs</u>

EPA and NHTSA spent significant effort researching and applying the untested ICM method for both the MY 2012-2016 and MY 2017-2025 rules. EPA explains its justification for this expense in its draft technical support document:

> To produce a unit of output, auto manufacturers incur direct and indirect costs. Direct costs include the cost of materials and labor costs. Indirect costs may be related to production (such as research and development [R&D]), corporate operations (such as salaries, pensions, and health care costs for corporate staff), or selling (such as transportation, dealer support, and marketing). Indirect costs are generally recovered by allocating a share of the costs to each unit of goods sold. Although it is possible to account for direct costs allocated to each unit of goods sold, it is more challenging to account for indirect costs allocated to a unit of goods sold. To make a cost analysis process more feasible, markup factors, which relate total indirect costs to total direct costs, have been developed. These factors are often referred to as retail price equivalent (RPE) multipliers. Cost analysts and regulatory agencies including EPA and NHTSA have frequently used these multipliers to estimate the resultant impact on costs associated with manufacturers' responses to regulatory requirements. A concern in using the RPE multiplier in cost analysis for new technologies added in response to regulatory requirements is that the indirect costs of vehicle modifications are not likely to be the same for different technologies. For example, less complex technologies could require fewer R&D efforts or less warranty coverage than more complex technologies. In addition, some simple technological adjustments may, for example, have no effect on the number of corporate personnel and the indirect costs attributable to those personnel. The use of RPEs, with their assumption that all technologies have the same proportion of indirect costs, is likely to overestimate the costs of less complex technologies and underestimate the costs of more complex technologies. … To address this concern, the

[5] An example of this occurred in the 1980s, when on-board engine control computers were first used for emission control. A feature of this system was a "Check Engine" light on the instrument panel to alert people when emission control maintenance was needed. This was a simple technology that under the ICM approach would be assigned only minimum indirect costs. Unfortunately, owners would panic when the light came on, pull over to the side of the road and have their vehicles towed to the dealership. Solving this problem required an extensive and expensive public education campaign.

agencies have developed modified multipliers. These multipliers are referred to as indirect cost multipliers (ICMs).[6]

Although the agencies expressed concern that the continued use of the traditional RPE approach might result in inaccurate forecasts of costs, they presented no evidence that this in fact has or will occur.[7] In fact, evidence supports the continued use of the RPE approach. NHTSA could have easily done a historical look back to assess the accuracy of the RPE method yet failed to do so. For example, the U.S. Bureau of Labor Statistics (BLS), in creating the various price indices, calculates the actual price increase of vehicles due to past safety standards (and in the past, emission standards). Knowing its own RPE estimates for these safety standards, NHTSA could easily compare their estimates with BLS's after the fact price increase calculations. Such a comparison would show the accuracy of the RPE methodology. NHTSA and EPA offer no evidence that RPE approach is flawed.

An additional flaw of the ICM approach is that it fails to properly incorporate dealer and OEM profits on automobile sales. In fact, EPA argues that its ICM approach is superior to the RPE approach because both manufacturer and dealer profit should be excluded and that less than the full costs of the regulation should be passed on to the ultimate consumer.[8] The NRC study quite-properly rejects this argument because "[i]n the long run, monopolistically competitive supply is perfectly elastic at the long-run average cost of production (this includes a normal rate of return on capital)."[9] Manufacturer profit amounts to as much as 17% of direct costs in the independent studies and this is in addition to dealer profits. Appendix C shows that not only must "monopolistically competitive" auto manufacturers earn a normal or sustainable rate of return on capital, but also that the long-run supply curve is characterized by declining marginal costs, which means more than the total of direct and indirect costs will be passed on to the consumer – a finding that has considerable empirical support. For all of these reasons, the use of the ICM approach inappropriately results in estimated retail-price impacts that are substantially lower than those estimated in the past by using the RPE method.

Academic Support in Favor of RPEs

The use of RPEs has been extensively researched, while the use of ICMs is still experimental. As the National Research Council (NRC) observes, "there is a very limited understanding of how to determine the costs . . . [U]nambiguous attribution of costs to specific vehicle components is difficult. For example, despite extensive reliability testing, it is not possible to predict with certainty what impact a technology or design will have on warranty costs. Furthermore, there are significant cost components that cannot logically be allocated to any individual component."[10]

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[6] "Draft Joint Technical Support Document, Rulemaking for 2017 - 2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards", November, 2011, pg. 3-11, 3-12

[7] 2017 and Later Model Year Light Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, 76 Fed. Reg. 74854 et. seq. (December, 2011) Pg. 74927-74929.

[8] 2017 and Later Model Year Light Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, 76 Fed. Reg. 74854 et. seq. (December, 2011) Pg. 74927

[9] NRC, *Assessment of Fuel Economy Technologies for Light Duty Vehicles,* 2011, pg. 24.

[10] Ibid, 26.

RPEs for in-house components have been studied in 4 scholarly papers, with estimates resulting in the 2.0 to 2.1 range. Argonne National Laboratories (ANL) released a study that estimated an appropriate RPE to be 2.0.[11] An earlier paper by Dr. Chris Barroni-Bird (1996) and estimates implied by the Energy and Environmental Analysis (EEA) in a report by the Office of Technology Assessment[12] put the RPE estimate at 2.05[13]. After the authors of the ANL study applied the EEA methodology on the same basis as their own, they estimated the EEA-implied RPE multiplier at 2.14.[14] It should be noted that in both the EEA and the ANL estimates, the RPE for outsourced components was approximately 1.5, instead of the approximate 2.0 RPE for components produced in-house. This number must be used carefully or will result in serious underestimation of costs for the reasons discussed in Appendix A, attached.

The NRC chose the lowest of these three estimates and stated that an RPE of 2.00 (2.00 – 2.14) is justified.[15] In 2008, a committee of the NRC met to assess technologies to improve vehicle fuel economy. Before that committee, Dr. Bussmann discussed the methods and data that he and Dr. Whinihan would use later in their joint 2009 paper.[16] Their paper also showed two different estimates of the supplier RPE (1.35 – 1.45).[17] After the committee finished its research, the NRC published a report titled *Assessment of Fuel Economy Technologies for Light Duty Vehicles* which, among other things, found:

> "An appropriate RPE markup over the variable (or direct) costs of a component is approximately 2.0…For in-house direct (variable) manufacturing costs, including only labor, materials, energy, and equipment amortization, a reasonable *average* RPE markup factor is 2.0."[18]

The NRC's estimates likely understate the full costs of fuel economy standards for at least four reasons. First, they exclude the cost of premature obsolescence of tools and equipment that were devoted to an existing product plan. Tools and equipment for powertrains can last as long as 25 years in the absence of a mandate. Second, they exclude the costs of retraining dealer sales and service personnel to sell and service the new components. Third, they exclude the costs of disruption to product and marketing plans when firms and dealers are forced to sell product their customers are unwilling to purchase. And fourth, they exclude the opportunity costs of diverting their engineering, financial and marketing talent from design, production and sale of market-driven technologies. As the authors of the MIT study, "On the Road in 2035" point out, even a "negative 'net price' does not imply that a technology is 'zero cost.' Instead of lowering fuel consumption, efficiency improvements can also be used to offset the effects of increases in the size and power of vehicles. The full cost of reducing fuel consumption would

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[11] Vyas, et al., 2000.
[12] OTA-ETI-638
[13] National Research Council, *Assessment of Fuel Economy Technologies for Light Duty Vehicles*, 171.
[14] Ibid., 171.
[15] Ibid, 33.
[16] Bussmann, Wynn V. and Michel Whinihan, "The Estimation of Impacts on Retail Prices of Regulations: A Critique of 'Automobile Industry Retail Price Equivalent and Indirect Cost Multipliers'", 2009, 1
[17] National Research Council, *Assessment of Fuel Economy Technologies for Light Duty Vehicles,* 2011, 173.
[18] Ibid, 36.

account for how changes in vehicle attributes such as fuel consumption, power and size affect the value that consumers derive from those products."[19]

On the other hand, the ICM approach has only been reviewed once and modified twice by the EPA. No evidence has so far been presented to demonstrate that the RPE approach leads to incorrect estimates of the increase in retail price of regulatory compliance, and no real world validation has been published for the ICM hypothesis.

A Case Study of RPEs and ICMs

It is possible to compare ICMs and RPEs by examining how features and costs of similar vehicles have changed over time. This analysis shows that RPEs much more accurately account for the price increases of vehicles over the past four decades.

Table 1: Partial List of Technologies and Content Added Since 1972

Unibody Construction	Catalytic Convertors
Double Galvanized Body Panels	Two Stage Catalytic Convertors
Front Wheel Drive	Evaporation Emission Systems
Bumper Standards	Low Resistance Tires
Side Impact Standards	Disk Brakes
Fuel Injection	Anti-lock Brakes
Direct Injection	Three Point Seat Belts
Overhead Cam Drive	Passenger Side Airbags
Double Overhead Cams	Shatter Resistant Windshields
EGR Valves	Variable Speed Wiper Blades
Oxygen Sensors	Cruise Control

Regulatory changes and shifts in consumer preferences have been extensive over the last 40 years. In response, over this period, manufacturers have added significant new technologies and added a great deal of new content to vehicles. Table 1, above, is a partial list of vehicle changes since 1972. Vehicles have shifted from rear wheel drive to front wheel drive, requiring

[19] Anup Bandivadekar, et al., *On the Road in 2035,* Massachusetts Institute of Technology, Report No. LFEE 2008-05, 55.

changes of every part in the car frame and every body panel. Often, this shift has required the construction of entirely new assembly plants and component plants. These fundamental differences make comparisons between then and now very difficult. It is possible, however, to find vehicles of the same market class made in the same assembly plant over this 40 year span. Using such a vehicle pair, it is possible to start with the base price of the 1970s model (adjusted for inflation), add to it the cost of new technologies adjusted by both the RPE approach and the ICM approach, and compare to the actual cost of the MY 2012 model.[20]

Table 2. Vehicle Pair Used to Compare ICMs and RPEs

	1971 Vega	**2011 Cruze**
		
Manufacturer	Chevrolet Division of General Motors	Chevrolet Division of General Motors
Production	1970 - 1977	2010 - Present
Assembly	Lordstown, Ohio Assembly Plant	Lordstown, Ohio Assembly Plant
Price	$2,090 Base Price, Notchback	$16,800 Base Price
Body Style	2-Door Notchback Sedan	4-Door Sedan
Platform	GM H Body (RWD)	GM Delta Platform (FWD)
Engine	2.3 L OHC 4 Cyl. 90 HP Manufactured in Tonawanda, NY	1.43 L 4 Cyl. 138 HP Manufactured in Tonawanda, NY
Transmission	3-Speed Manual	6-Speed Manual
Seating	2 Bucket Seats, Ft. 3 Seat Bench, Rear	2 Bucket Seats, Ft. 3 Seat Bench, Rear
Wheelbase	97.0”	105.7”
Length	169.7”	181.0”
Width	65.4”	70.4”
Height	51.0”	58.1”
Curb Weight	2,181 – 2,270 lb.	3,102 lb.
Fuel Economy (MPG)	30 Highway (no city value available)	25 City / 36 Highway

U.S. automakers have historically used an RPE of about 2.0. In the mid-80s, one OEM tried to identify why a major Japanese OEM could make a compact sedan for about $2,000 less than its own cost. Using a “tear-down” lab, several dozen differences in direct costs were identified. Examples included differences in die set change budgets, the number of Engine

[20] Since the proposed 2017-2025 MY LDV GHG/CAFE standards stretch out for at least 8 years, the long-term ICM values should be used when comparing to RPE methodology.

Control Module functions, and multiplicity of choices at U.S. OEM assembly plants. These differences in direct costs explained essentially the entire cost differential, which strongly implied that the Japanese automakers had nearly identical ratios of indirect costs as U.S. automakers. Thus, Japanese OEMs were using their equivalent of a 2.0 RPE. Therefore, in comparing a MY 1971 vehicle to a MY 2011 vehicle, the direct costs can be estimated by dividing the average transaction cost (what the dealers actually receive from the purchaser) by the appropriate 2.0 RPE.

The pair of vehicles used in this study for comparison are the 1971 Chevrolet Vega and the 2012 Chevrolet Cruze (See Table 2 above). Both vehicles were built domestically under traditional labor contracts, were assembled at the same assembly plant in Lordstown, Ohio, and used engines manufactured in Tonawanda, NY. In 1971 the Chevrolet Vega cost about $2,090. This price must be adjusted to 2011 dollars in order to estimate the increases in content for the Cruze relative to the Vega. Based on increases in the BLS Producer Price Index for "Motor Vehicles including Motorcycles" a 1971 Vega would have a MSRP of about $6,070.[21] The Chevrolet Cruze had an MSRP about $16,800. Assuming a 10% discount from MSRP to average transaction price, the MY 2011 Vega would cost about $5,464 and the Cruze $15,120.

Assuming both cars were priced using an RPE of 2.0, the direct cost of the Vega is about $2,732 and the direct cost of the Cruze is about $7,560. The difference in direct cost is about $4,800. If an OEM had decided to use an ICM of 1.27 on all new content since 1971, it would have added indirect costs of only about $1,300 instead of the $4,800 that was added to direct cost of the Cruze, which would give that OEM a $3,500 cost advantage over the Cruze, a 23% price reduction. Applying a long-term average ICM of 1.27 to the direct costs of this added technology increases the cost by about $1,300, to $6,100. Adding the base price of the Vega to this total brings the increased transaction price of the Chevrolet entry level vehicle to $11,600, far short of the Cruze's average transaction price of $15,100 Alternatively, using a 2.0 RPE would have increased the indirect costs of the added content by about $4,800, to $7,560. Adding the base price of the Vega to this total brings the increased transaction price of the Chevrolet entry level vehicle to $15,120. This analysis is summarized in Table 3.

Based on this comparison, it is clear that simply using the ICM approach to cost each component of the added content to our 1971 base vehicle would have dramatically understated the ultimate retail price of the 2011 vehicle. Similarly, adding the government's estimate of the cost of the MY 2012 – 2016 fuel economy regulations, which were calculated using the ICM approach, to the government's estimate of the costs of the MY 2017 – 2025 fuel economy regulations calculated using ICMs will, like the example above, also dramatically understate the increase in the retail price of the 2025 MY vehicle. Only by using the RPE approach, which encompasses all indirect costs, can the true increase in the retail price of a vehicle in 2025 compared to today be estimated.

[21] bls.gov.

Table 3. Comparison of Costing Additional Content of Entry Level Sedan, 1971 – 2011

Accounting Method	1971 Price (in 2011 Dollars)	Direct Cost of Added Content	Indirect Cost of Added Content	2011 Price (in 2011 Dollars)
Indirect Cost Multiplier	$5,464	$4,800	$1,300	$11,600
Retail Price Equivalent	$5,464	$4,800	$4,800	$15,100
Actual Cost, Chevrolet Cruze				**$15,100**

Retail Price Equivalents and the True Cost of the MY 2011-2025 Fuel Economy Standards

To fully understand the probable impact of the fuel economy standards currently under consideration on vehicle sales, it is necessary to compare the price of a new vehicle today to the price in 2025 as a result of this ongoing effort to improve fleet fuel economy. As discussed above, when adding the compliance costs of different rulemakings together, using the ICM approach can significantly understate the total costs. For this reason, the direct costs of compliance must be determined and then converted to retail price using the RPE methodology. The government has estimated that compliance with its 2011 rulemaking will cost consumers on average $91 per vehicle. This calculation was done using an RPE analysis and thus requires no adjustment. For the 2012-2016 rule, NHTSA, using an ICM methodology, estimated that consumers would pay an extra $903 per vehicle. For its most recent rule, NHTSA, using an ICM methodology, estimated that consumers would be forced to pay an additional $1,876 per vehicle. Adding the three values together, after adjusting them to 2010 dollars, would result in a total increase in retail price of $2,937. However, the ICM approach omits consideration of some indirect costs that still must be recovered by the manufacturer to remain a viable business. Thus, these values must be adjusted using the RPE methodology, which encompasses all indirect costs. Adjusting for an RPE of 2.0 results in a total increase in retail price of $4,803. Complete results are shown in Table 4.

In order to better understand the magnitude of these numbers, it is important to keep in mind that the fuel efficiency induced $4,800 per vehicle cost increase exceeds the price of one half of all added content to vehicles over the last 40 years.[22] Furthermore, today's vehicle emission controls are estimated to cost $1,700 per vehicle in today's dollars. The proposed fuel economy regulations are nearly 3 times more expensive.

[22]The monetary approximation for total added content comes from the total added content calculated in the Chevy Vega vs Chevy Cruze Comparison.

Table 4. Increase in Retail Price in 2011 Dollars from 2011 – 2025 Due to Fuel Economy[23,24]

	Government Estimate of Total Cost Increase	ICM Value Used	Direct Cost	Total Price Increase Using RPE of 1.5	Total Price Increase Using RPE of 2.0
Passenger Car					
2011	$67	RPE used no adjustment necessary			$67
2012-2016	$921	1.13**	$815	$1,223	$1,630
2017-2025	$2045	1.25	$1,636	$2,454	$3,272
Total	**$3,034**		**$2,452***	**$3,744**	**$4,970**
Truck					
2011	$132	RPE used no adjustment necessary			$132
2012-2016	$992	1.13**	$877	$1,316	$1,755
2017-2025	$1,595	1.25	$1,276	$1,914	$2,553
Total	**$2,719**		**$2,153***	**$3,362**	**$4,439**
Fleet					
2011	$95	RPE used no adjustment necessary			$95
2012-2016	$945	1.13**	$837	$1,255	$1,673
2017-2025	$1,897	1.25	$1,331	$2,275	$3,035
Total	**$2,937**		**$2,354***	**$3,626**	**$4,803**

* Does not include 2011 direct costs ** Long-term ICM to best compare to 2025

Summary and Conclusions

In determining the retail price of an automobile, manufacturers must mark up the direct cost of manufacturing the vehicle to include all indirect costs and profits. This is traditionally done by the use of an RPE. Government agencies have recently attempted to substitute an untested new method known as ICM for RPE in their rulemakings.

The agencies have relied on theoretical constructs and studies in developing their ICM approach to calculate what consumers might be expected to pay for vehicles that meet the new fuel economy standards. By definition, ICMs only reflect a subset of total indirect costs, yet the costs omitted from the ICM are real costs which must ultimately be reflected in the retail price of the vehicle. Over time, the cumulative use of the ICM approach vs. the RPE approach can dramatically distort the actual costs of the regulations. Continued use of ICMs in rulemaking could adversely impact the economy by enabling agencies to seriously underestimate the cost of their regulations. An agency might decide, for example, to raise a mandatory requirement by more than can be justified by the real costs of compliance. That type of excessive stringency could bankrupt one or more OEMs, increase unemployment among autoworkers, harm dealers,

[23] 74 Fed. Reg. 14196, 14413 (Mar. 30, 2009); 75 Fed. Reg 25324, 25635 (May 7, 2010); 76 Fed. Reg 74854, 74889 (Dec. 1, 2011).
[24] Derivation of average ICM values is discussed in Appendix D.

impose excessive costs on consumers, and cause resources to be misallocated to the detriment of the long-term health of both the economy and the environment. EPA argues that some technological changes needed for regulatory compliance do not incur as many indirect costs as other changes[25]. To the contrary, changes required to meet regulations incur higher indirect costs than others, because regulatory changes have to be tested for compliance, while completely cosmetic changes require almost no regulatory certification.

In short, the estimated cost of compliance derived from the use of ICMs in this rulemaking does not reflect the actual price increases that will be realized by the consumer. To correct for this, costs need to be adjusted to reflect on the RPE approach before they can be totaled. When this is done, the expected increase in retail price due to the proposed MY 2017-2025 until 2025 standards is $4,4803 not $2,937 (in 2010 dollars).[26]

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[25] 2017 and Later Model Year Light Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, 76 Fed. Reg. 74854 et. seq. (December, 2011) Pg. 74927
[26] For more information on the unintended consequences see Appendix B

About the Authors

Michael Whinihan has a BA from Harvard, an MBA from the University of Chicago, and a Ph. D. in Business Administration from the University of Chicago. For 23 years, he worked on many public policy issues such as taxes, the employment and economic effects of plant openings and closings and cost/benefit analyses on ethanol fuels, hybrids, plug-in hybrids, and fuel cell vehicles for General Motors. In 2009, he co-authored the paper *The Estimation of Impacts on Retail Prices of Regulations: A Critique of "Automobile Industry Retail Price Equivalent and Indirect Cost Multipliers"* with former Chrysler Corporation Chief Economist Wynn Van Bussmann.

Dean Drake has a Bachelor of Mechanical Engineering degree from General Motors Institute (now Kettering University) and a Master of Business Administration degree from Michigan State University. He retired from General Motors in 1999 following 34 years of service, most of which was in corporate Public Policy. During his career at GM, Dean initiated the GM-Environmental Defense Fund dialogue, served on the President's Council for Sustainable Development, developed guidelines for one of the nation's first "cash for clunkers" programs and is a co-inventor of the Virtual Emissions Sensor. Dean founded the Defour Group (now Defour Group LLC) in 2007.

David Aldorfer has a Bachelor of Mechanical Engineering degree from General Motors Institute (now Kettering University) and a Master of Science – Environmental Health Science degree from the University of Michigan. He retired from General Motors in 2006 following 44 years of service, most of which were in staff support of facility environmental management at GM's Environmental Activities and Financial Staffs.

Appendix A. Correct and Incorrect Treatment of Outsourced Components

Purchased components need to be treated no differently from components produced in-house when estimating retail prices. Care must be taken to avoid a relatively serious error. Assume that component X costs $100 in direct costs and has an additional $100 of indirect costs. For convenience, assume there are 100 sources of indirect costs, each costing $1. If the same supplier has identical direct costs as the Original Equipment Manufacturer (OEM), it cannot charge the OEM $100, because it must pay for its own indirect costs including its profit margin. If there are no additional indirect costs, the contract between the supplier and the OEM will determine how many of the 100 indirect costs will be transferred to the supplier. For example, if 33 of these costs are assumed by the supplier, then it will charge $133 for the component, and the OEM only needs to assume the other 67 costs. So, if there are no additional indirect costs, the component will be priced at $200 ($133 + $67), and the RPE for that purchased component will be 1.50 ($200/$133).

But there are additional costs due to outsourcing. The purchasing department at the OEM must choose which components to outsource and must choose which suppliers are qualified both technically and financially to bid on the contract. Once a winner has been chosen, the purchasing department must negotiate a contract including incentives and performance penalties. And once the contract is operating, the purchasing department has expensive monitoring costs over and above those needed for in-house production to insure that quality is adequate.
So an OEM would outsource only if savings from purchasing the component more than offset contracting and monitoring costs. Sources of these savings might be the supplier having a patent, superior direct costs based on better technology, or economies of scale not available to the OEM.

Define RPES as the ratio of the supplier's selling price to its direct costs of a component. Define RPEO as the ratio of the OEMs retail price to the purchase price of a component from a supplier. Then define RPEP as the ratio of a supplier's direct costs to the OEM's retail price. Then
(1) RPEP = RPES * RPEO
The National Research Council's 2011 study showed low and high estimates of the supplier RPES (1.35 – 1.45). The NRC also cites 3 estimates of RPEO of 1.50, 1.56, and 1.56. The NRC chose to use the lowest of these 3 estimates, 1.50. The resulting estimate for RPEP is 2.02 to 2.08, which is consistent with the theory that the markup from the purchase price for components will be higher than from the direct manufacturing cost of in-house components due to monitoring costs.

So regulatory agencies need to use an RPEO for outsourced components of about 1.50 for what OEMs pay for outsourced components or use an RPEP of about 2.05 for supplier direct costs when available. It would be serious underestimation of costs to apply the 1.50 RPE (RPEO) for component prices to estimates of supplier direct costs, because the appropriate RPE for supplier direct costs (RPEP) is about 2.05, strikingly similar to the NRC's estimate of 2.06 for OEM direct costs.

Appendix B. How Distorted Government Cost Numbers Can Misallocate Capital

As discussed in this report, using indirect cost multipliers (ICM) to adjust manufacturing costs to expected increase in retail price instead of the more traditional retail price equivalents (RPE) results in costs that significantly understate the cost that a manufacturer must charge to cover its costs of doing business and obtain a reasonable return on investment. While EPA believes that "ICMs are indeed fully developed for regulatory purposes," [27] there are many reasons to dispute this belief. One reason not previously discussed is the potential use of costs generated using ICMs outside of the regulatory arena.

For instance, on March 14, 2011, Citi Research and Analysis, a division of Citigroup, issued a report entitled "Fuel Economy Implications: Perspectives on 2020 Industry Implications" in which it assessed the impact of future fuel economy standards on the automotive industry. In this report, they predicted:

> *"Our baseline analysis suggests that improving fuel economy could have positive implications for sales units and variable profits, both for the industry as a whole and the Detroit Three, with the latter possibly fairing better than the industry. Relative to our initial forecast for 2020, improving fuel economy results in a 6% increase in industry sales and a 9% increase in Detroit Three sales. More importantly, total industry variable profit rises by 8% and Detroit Three variable profit rises by 12%."*

The Citigroup prediction of sales increases due to more stringent fuel economy standards is in contrast to other predictions of sales losses in 2025 for a 62 mpg standard by other organizations such as the U.S. Energy Information Agency[28] (14% sales loss), the Center for Automotive Research[29] (30% sales loss) and the Defour Group LLC[30] (15% sales loss). This discrepancy between Citigroup's analysis and that of other organizations raises the following two questions:

- What factors may have led Citigroup to predict sales gains when others predicted sales losses due to higher fuel economy standards?
- What impact might the Citigroup prediction have had on investors?

Citigroup itself did not perform the cost analysis of future fuel economy standards: that task was done by a consulting firm. The information sources used by the consultant in calculating these costs were listed in Appendix A and B of the Citigroup report. These sources were almost exclusively National Highway Traffic Safety Administration (NHTSA) studies that utilized the ICM approach for adjusting compliance costs. The use of ICMs instead of RPEs in calculating the sales impacts of future standards, while not the only factor, certainly was an influential factor in Citigroup's prediction of sales increases while others predicted sales decreases as a consequence of more stringent fuel economy standards. Thus, an artifact of the regulatory process became a key component of an investment analysis.

[27] Notice of Proposed Rulemaking, pg. 137-138
[28] EIA Energy Information Outlook, April, 2011
[29] Center for Automotive Research, "The U.S. Automotive Market and Industry in 2025," June, 2011. This report, however, also includes the effect of future safety standards on their calculated sales losses.
[30] SAE Paper 2012-01-0754, "Using Economic Analysis to Assess the Viability of Post-2016 MY Greenhouse Gas Emission and Fuel Economy Standards for Light Duty Vehicles," April, 2012

The extent that private investors and fund managers took the Citigroup report into account in making investment decisions is unknown. If they had taken Citigroup's prediction in the March 14, 2011 report that more stringent fuel economy standards would increase the profits of the Detroit Three and invested more heavily in the two Detroit Three companies then publically traded (GM and Ford), what would have been the impact on their portfolio? The graph below shows what happened to the Dow Jones Industrial Average (DJIA) and the stocks of GM and Ford between March 14, 2011 and January 6, 2012.

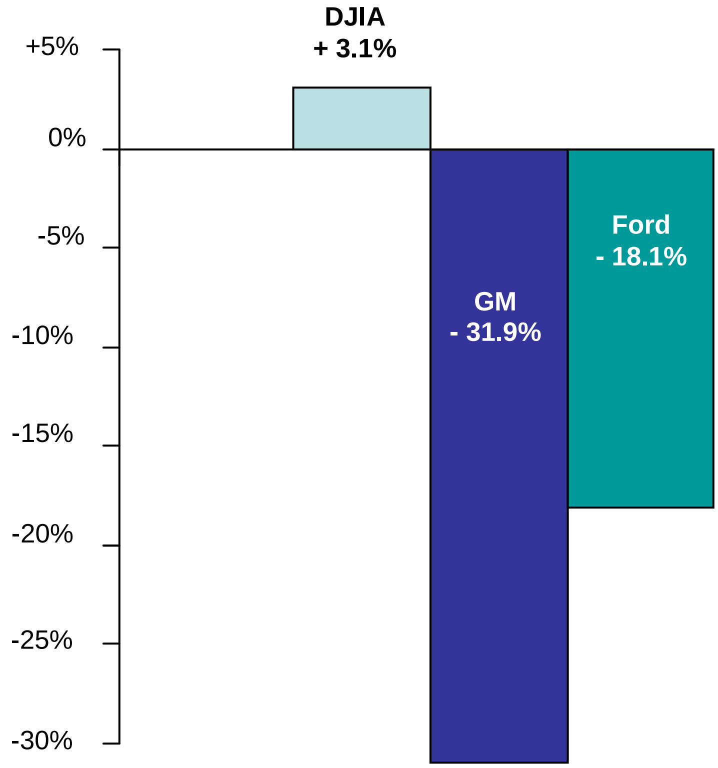

Figure 5. The Change of the DJIA and Auto Stocks after the Citigroup Report

Had the fund managers remained invested in a portfolio that approximated the DJIA, they would have gained 3.1% over that period. If they had invested in Detroit Three stocks instead, based the Citigroup report predictions (which were influenced in part by the use of ICMs instead of RPEs), the portion of their portfolio so invested would have lost 18% - 31% of its value.

Appendix C. Auto Industry Profits and Cost Pass Through

The EPA/RTI study claims that in the "monopolistically competitive" auto industry profits should not be included in the markup of manufacturing costs to retail and that less than the full costs of production will be passed on to consumers. As the NRC correctly concluded, both statements are incorrect. A normal, competitively sustainable return must be included because it is necessary to keep the companies from going bankrupt, as two of them did in 2009, partly because of the crush of regulations. Both theory and empirical research find that the full costs of increased regulation, together with a sustainable profit, are, in the long run, passed through in most "monopolistically competitive" industries and especially in those with declining average and marginal external industry costs.

Beasley and Rosen found, in particular, in a study of several "monopolistically competitive" industries not including autos – i.e., industries in which sellers can influence the price they charge for their products – that the average pass through of sales tax increases to consumers was greater than 100%.[31] They found that this was consistent with economic theory:

> As we stressed in the third section, recent developments in incidence theory in imperfectly competitive markets indicate that over-shifting is by no means a pathological phenomenon. There are, of course, many models of imperfect competition. Not all of them are plausible representations of the retail sector. A model with free entry and decreasing average cost seems a sensible starting point for this section. Can over shifting occur in such a model? As shown by Delipalla and Keen, the answer is yes.[32] Indeed, in a conjectural variations model with fixed costs, constant marginal costs of production, entry, and locally constant price elasticity of demand, over shifting must occur, at sufficiently low tax rates. While we do not know if these assumptions on parameters are correct in the markets of the commodities we study, they are certainly the kinds of assumptions that economists are comfortable building into their models.

Beasley and Rosen also noted that even in perfectly competitive industries where individual sellers cannot influence the prices at which their products sell, over-shifting is "possible in a decreasing cost industry because of scale economies external to the firm."[33] The auto industry is "monopolistically competitive" and is characterized by decreasing external costs.... As the industry has expanded over the years costs external to the industry have fallen with improvements in the transportation system, with increased access to nearby lower cost suppliers, to higher quality and lower cost skilled labor (especially for the Southern transplant operations), and with improved financial networks.

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[31] Timothy J. Besley and Harvey J. Rosen, "Sales Taxes and Prices: An Empirical Analysis," *National Tax Journal*, June 1999.

[32] Delipalla, Sofia, and Michael Keen. "The Comparison between Ad Valorem and Specific Taxation under Imperfect Competition." Journal of Public Economics 49 (December, 1992): 351-68.

[33] See also Robert S. Pindyck and Daniel L. Rubinfeld, *Microeconomics*, (New Jersey, Upper Saddle-River, Prentice-Hall, 2001), 277-80.

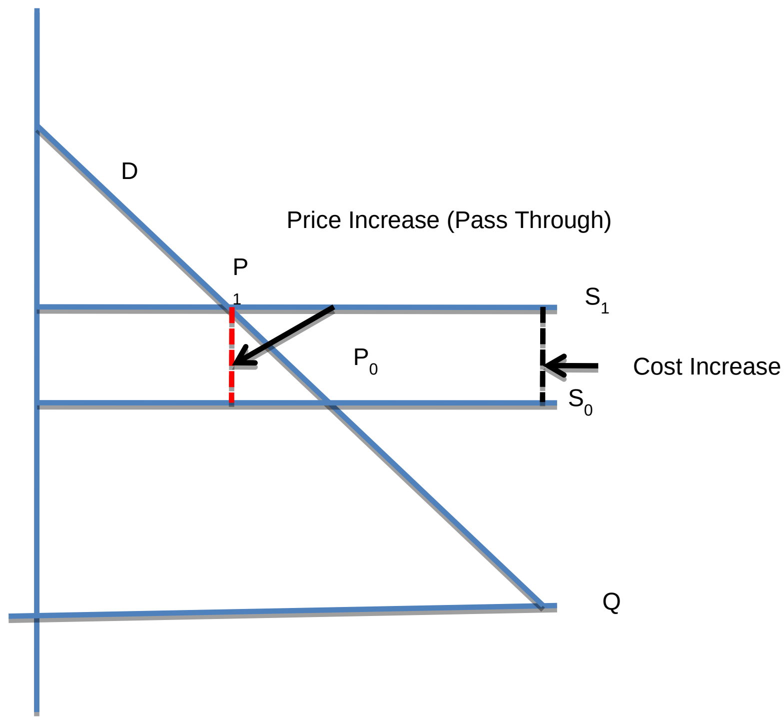

Figure 6: Constant Industry Marginal Cost Curve: Pass Through Equals Cost Increase

Figures 6 and 7 illustrate why 100% of any increase in manufacturing costs is passed through in a constant external cost industry and why more than 100% is passed through in an industry characterized by decreasing costs. (Note that scale economies *within* the industry are not the question. This analysis applies no matter what the scale economies are to each firm – no matter what the shape of the long-run individual firm cost curves.)

In Figure 6 the long-run industry marginal and average cost curve is flat, reflecting constant external costs. The initial equilibrium is at the point P_0 where the Demand function (D) intersects the initial Supply function (S_0), which is a horizontal industry marginal cost curve. The black broken line represents the increase per vehicle marginal cost caused by the regulation and that causes industry supply to shift to S_1. The red broken line represents the price increase at the new equilibrium at P_1. The vertical distances are the same, which means the price increase equals the per unit cost increase.

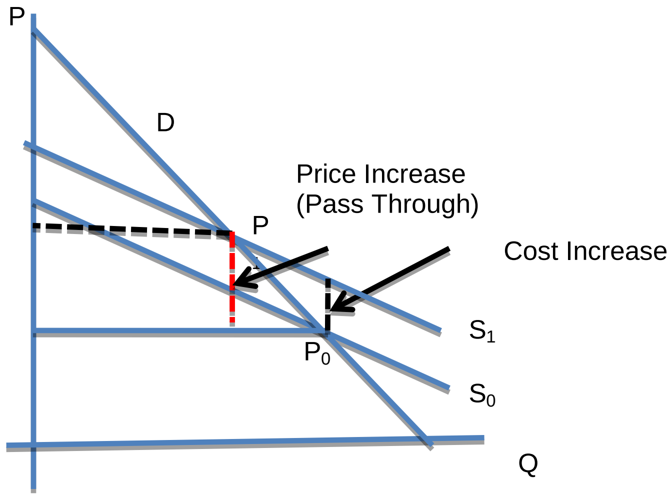

Figure 7: Falling Industry Marginal Cost Curve: Pass through Greater Than Regulatory Cost Increase

Figure 7 shows what happens in the case of declining industry marginal cost external (external) cost. The black broken line is the increase in per unit cost, while the red broken line is the increase in price and is greater than the increase in per unit cost. Thus more than the cost of the regulation is passed through to the customer, which is consistent with Beasley and Rosen's study of the impact of sales tax increases in monopolistically competitive industries.

Appendix D. Calculation of Average ICMs

In order to calculate the true RPE cost per vehicle, it is first necessary to derive the average ICM value for the government's 2012-2016 and their 2017-2025 rules. This study's determination of the appropriate ICM value for use in this analysis was formed by reviewing conclusions of the following three sources:

1. An EPA Sponsored Study by RTI International and University of Michigan. A comprehensive study of the ICM methodology is examined in a paper entitled "Automobile Industry Retail Price Equivalent and Indirect Cost Multipliers" published by the EPA in 2009 and written for it by staff at RTI International and the Transportation Research Institute (RTI) at the University of Michigan (UM). As of 2009, the ICM proposal would have resulted in a RPE of 1.46, as shown in the Table 5, below. Some indirect costs (such as marketing) incurred by manufacturers in the conduct of business are not allocated in the ICM approach to components added to the vehicle for purposes of regulatory compliance. One question not addressed by RTI or the EPA is which parts should be charged with paying for the rest of the indirect costs the do not attribute to regulatory compliance. Table 5 lists components that have been added to the vehicle since 1972. Nearly all of these parts are required for or affect regulatory compliance, and the remainder are largely for the cosmetic "freshening" of the vehicles' design to give them a new appearance.

Table 5: Comparison of Multiplier Contributors, ANL vs. RTI Papers[34]

Cost Category	ANL	RTI
Manufacturing	1.00	1.00
Warranty	0.10	0.03
R&D	0.13	0.05
Depreciation/Amortization	0.11	0.07
Maintenance and Repair	0.00	0.03
Corporate Overhead	0.14	0.08
Selling	0.47	0.14
Profit	0.05	0.06
Total	**2.00**	**1.46**

2. The MY 2012-2016 Rulemaking. In this rulemaking, the agencies used short-term ICMs ranging from 1.11 to 1.64 across four levels of complexity (low, medium, high and very high). Long-term ICMs range from 1.07 to 1.39. To compare these meaningfully with the 2.0 RPE used previously for all in-house technologies, a single value to represent these ranges is needed. A weighted average can be computed from the number of compliance technologies assigned to each complexity level, i.e., 20 low + 8 medium + 4 high + 2 high+ = 34 total. Thus, in this rulemaking, the number-weighted average short term ICM is 1.21 and the long term average ICM is 1.13. Using this methodology, the implied RPE multiplier that would correspond to for the ICM methodology is 1.27, a significant decrease from the 1.46 determined in the RTI/UM study.

[34] Bussmann and Whinihan, 9.

3. The MY 2017-2025 Proposal. In this rulemaking, the number of technologies by complexity level is 12 low + 13 medium + 3 high + 2 very high = 30 total. The number-weighted average short term (now called "near term") ICM is 1.37. The long term average is 1.27 over the nine model years. The average over the last three model years (2023 – 2025), which reflects the ICM values used to compute 2025 model year costs, is 1.25. Although computed somewhat differently than the 2012 -2016 MY ICMs, the 2017 – 2025 MY ICMs nevertheless provide useful points of comparison with the RPE methodology used previously for such a long time.

Thus, for the calculations done above in Table 4, an average 1.13 ICM value is used for the 2012-2016 standards and an average 1.25 ICM is used for the 2017-2025 standards.