How Do Federal Regulations Affect Consumer Prices?

An Analysis of the Regressive Effects of Regulation

Dustin Chambers and
Courtney A. Collins

February 2016

MERCATUS WORKING PAPER

MERCATUS CENTER
George Mason University

3434 Washington Blvd., 4th Floor, Arlington, Virginia 22201
www.mercatus.org

Dustin Chambers and Courtney A. Collins. "How Do Federal Regulations Affect Consumer Prices? An Analysis of the Regressive Effects of Regulation." Mercatus Working Paper, Mercatus Center at George Mason University, Arlington, VA, February 2016.

Abstract

While several scholarly papers have documented potential costs associated with the burden of federal regulations, none have provided a comprehensive empirical analysis of the effect of regulations on consumer prices. This study examines the relationship between regulatory expansion and higher prices and asks whether those price increases have a disproportionately negative effect on low-income households. By combining microdata from the Consumer Expenditure Survey with industry-specific regulation information from RegData and price changes in the Consumer Price Index, we find evidence of regressive regulatory effects. Our results suggest that the poorest households spend a larger proportion of their income on goods that are heavily regulated and subject to both high and volatile prices.

JEL codes: I18, D12, H23, L51

Keywords: regulation, federal regulations, regressive effects, distributional effects, consumer prices, Consumer Expenditure Survey, RegData

Author Affiliation and Contact Information

Dustin Chambers, PhD
Associate Professor of Economics
Salisbury University
DLChambers@salisbury.edu

Courtney A. Collins, PhD
Assistant Professor of Economics
Rhodes College
collinsc@rhodes.edu

How Do Federal Regulations Affect Consumer Prices?

An Analysis of the Regressive Effects of Regulation

Dustin Chambers and Courtney A. Collins

1. Introduction

The 2012 *Code of Federal Regulations* includes more than a million individual restrictions, representing a regulatory burden that has grown by more than 28 percent over the previous 15 years (Al-Ubaydli and McLaughlin 2015). Certain industries have experienced even higher regulatory growth over the same time period. For example, federal regulations related to highway and street construction increased by 94 percent over the past decade and a half. The natural gas distribution industry experienced a 109 percent rise in regulations, and the corresponding increase in the water and sewage industry was 125 percent.[1]

There is substantial variation in the types of regulations that exist both across and within industries, as well as in their numerous potential effects on consumers. This study focuses specifically on how regulation growth affects consumers through its impact on prices. While most regulations are not passed with the explicit goal of raising prices (and, in fact, some are created specifically to decrease prices), compliance with regulations often translates into higher costs for businesses, which in turn may drive up prices for consumers. If this rise in prices occurs, regulatory growth is unlikely to affect all consumers equally. Because high- and low-income families have different spending patterns, regulations that increase prices in a particular market sector often have a disparate socioeconomic impact.

[1] All estimates of the regulatory burden are from the RegData database of the Mercatus Center at George Mason University (North American Industry Classification System [NAICS] 2212—natural gas, NAICS 2213—water sewage, and NAICS 2373—highway and street construction).

Recent information from the Consumer Expenditure Survey (CE) reveals that households just below the poverty line spend a substantially larger percentage of their income on transportation and gasoline, utilities, food, and health care than do high-income households (Goldstein and Vo 2012). To the extent that, on balance, regulations raise prices, regulations will cause regressive effects if they are concentrated in the economic sectors where low-income households spend the most. The purpose of this study is to analyze the potential regressive effects of federal regulations—first by documenting differences in consumer spending patterns across income levels and then by examining how regulatory growth has affected the prices of goods and services for consumers across the income distribution spectrum.

By using detailed microdata from the CE, we first assess whether there are meaningful differences in the spending habits of average consumers from different income groups. We join these data with information on regulatory restrictions by industry, available from the RegData database of the Mercatus Center at George Mason University, and data from the Consumer Price Index (CPI) to determine the effect of regulatory expansion on price levels. We allow for differences in the inflation rate by consumer income group to examine potential regressive regulation effects. We find evidence of a statistically significant relationship between regulation and price levels: specifically, a 10 percent increase in total regulations leads to a 0.687 percent increase in consumer prices. We also find that households from the poorest income groups experience both the highest overall levels of inflation and the highest levels of price volatility.

2. Background on the Costs of Federal Regulations

Measuring the full costs of federal regulations is difficult. The Regulatory Right-to-Know Act of 1999 requires the Office of Management and Budget (OMB) to publish an annual report detailing the costs and benefits of major federal regulations. In its May 2014 report, OMB

estimates the annual cost of regulations to be between $74 billion and $110 billion.[2] However, OMB openly acknowledges that this estimate is far from a complete approximation of all federal regulatory costs. For example, the report excludes costs associated with rules that are more than 10 years old and rules that are not defined as *major* (i.e., rules that have an annual economic effect of less than $100 million).

Crain and Crain (2014) estimate that the true comprehensive cost is more than $2 trillion,[3] including all regulations and accounting for many indirect costs, such as reduced economic productivity, that are absent from OMB's analysis. The authors note that some portion of these costs is passed on to consumers in the form of higher prices, although they neither model nor empirically estimate this increased consumer inflation.

Several papers address the potentially harmful unintended consequences of regulations. McLaughlin and Williams (2014) outline some of the adverse outcomes related to regulatory accumulation, or the "buildup" of old or obsolete regulations inherent in the US regulatory system, including lower rates of economic growth, reductions in the establishment of new businesses, and reduced international competitiveness. There is a substantial literature illustrating these regulatory consequences in both the United States and abroad.

For example, Dawson and Seater (2013) examine the specific impact of federal regulations on economic growth and estimate that since 1949 increased regulation has significantly decreased the rate of economic growth, resulting in an accumulated GDP loss of $38.8 trillion by 2011. Other papers report a negative relationship between regulatory growth and economic productivity, including Nicoletti and Scarpetta (2003); Djankov, McLiesh, and

[2] This cost estimate is in 2014 dollars, as quoted by Crain and Crain (2014). The actual estimate cited in OMB (2014) is $68.5 billion to $101.8 billion, in 2010 dollars.
[3] This estimate is in 2014 dollars.

Ramalho (2006); and Crafts (2006). Gørgens, Paldam, and Würtz (2003) explore the possibility of a nonlinear relationship between regulation and economic growth and find that the bulk of the effect stems from a transition from moderate to heavy levels of regulation.

One key channel through which federal regulations are likely to affect economic growth is by creating significant barriers to new business entry. Benson (2004) discusses this barrier as a significant opportunity cost to regulation. Empirical studies find that increased regulatory start-up costs lead to lower rates of new business entry in both Europe (Klapper, Laeven, and Rajan 2006) and the United States (Fisman and Sarria-Allende, 2004). Ciccone and Papaioannou (2007) examine the time it takes new businesses to comply with regulatory entry requirements and find that reducing red tape is associated with increases in the number of start-ups.[4]

A significant body of literature examines the potential unintended consequences and costs of environmental regulations, specifically the Clean Air Act, the Clean Water Act, and their succeeding amendments. Becker and Henderson (2000) show how the Clean Air Act altered businesses' decisions regarding the construction, location, and size of new plants. In response to the new regulations, firms were more likely to build smaller plants in low-pollution areas. Although the firms' decisions were in compliance with environmental legislation, the costs of building inefficiently sized plants in suboptimal locations were significant.[5] Greenstone (2002) documents substantial job losses, decreases in capital investments, and reduced output as a result of the same regulations. Hazilla and Kopp (1990) emphasize the importance of accounting for social costs when evaluating the effects of environmental regulations, rather than simply including private expenditures. They highlight the potential spillover effects outside the industry

[4] For other examples detailing the relationship between regulation and economic growth, see Ardagna and Lusardi (2010) and Benson (2015).
[5] For related research detailing the effects for specific industries, see Becker and Henderson (2001). Additionally, Becker (2003) examines how local community attributes predict the level of investment in pollution abatement.

that are directly affected by the regulations and note that the social costs of regulation likely increase across time.

An additional consequence of federal regulations is their potential regressive effects. While there is a substantial body of literature on the regressive effects of taxation,[6] few studies explore the distributional consequences of regulation. Two exceptions are Crain and Crain (2010) and Thomas (2012). Crain and Crain analyze the effects of regulations on businesses and find that small firms bear a disproportionate burden of compliance costs.

Thomas (2012) argues that many health and safety regulations are regressive because they target risks that often reflect the preferences of high-income households. Relative to their low-income counterparts, high-income households have a stronger preference for reducing low-probability risks that are costly to mitigate. When these risks are addressed by regulations, all market participants (regardless of income) pay the cost—in the form of higher prices for consumers and lower wages for workers. Thomas contends that regulatory costs are disproportionately borne by low-income households, inasmuch as they are obliged to pay for higher levels of health and safety than they would in the absence of regulation. In addition, these costs potentially crowd out private risk-reduction spending by low-income households.

Miller (2012) allows for the possibility of distributional effects in her analysis of the federal energy conservation regulation for new residential dishwashers. The Department of Energy, which issued the new regulation in 2012,[7] estimated that it would increase dishwasher prices by 13 percent. Interestingly, Miller reports that the breakeven point for a consumer to

[6] See Poterba (1991) for an analysis of gasoline taxes, Wier et al. (2005) for an analysis of carbon dioxide taxes, and Borren and Sutton (1992) for an examination of cigarette taxes.

[7] Department of Energy, Direct Final Rule: Energy Conservation Standards for Residential Dishwashers, RIN No. 1904-AC64, May 30, 2012, https://www.federalregister.gov/articles/2012/05/30/2012-12340/energy-conservation-program-energy-conservation-standards-for-residential-dishwashers#h-12.

recover a higher dishwasher price from energy savings is 11.8 years of use, which is longer than the average 9- to 12-year life span of a new residential dishwasher. Miller calculates that the breakeven point for senior adults and low-income households is more than 13 years, suggesting that these consumers are harmed even more than other households by the energy savings regulation.

While studies such as Miller's examine the effect of specific regulations on prices in particular industries, no study to date offers a comprehensive analysis of the impact of regulations on consumer prices in general. This paper contributes to the literature by empirically estimating the relationship between increased regulations and inflation and by examining the extent to which regulations are regressive. We begin by examining basic spending differences across different income strata, using data from the CE and incorporating regulatory restrictions from the RegData database. We then use the expenditure data to create basket weights to construct several CPI-based price indexes. Finally, we use the price indexes in an analysis of the effect of regulations on consumer prices.

3. Differences in Spending Patterns across Income Groups

Our fundamental argument is based on the assumption that low- and high-income households differ in their spending habits. In particular, low-income households spend a larger percentage of their income on particular goods and services relative to high-income households. Before determining how regulations affect consumer prices and exploring any potential heterogeneity in the effect for different types of consumers, it is important to document the differences in spending patterns across income groups. Specifically, we are interested in whether spending by low-income households is more heavily concentrated in consumption categories that are subject to higher levels of regulation.

The Consumer Expenditure Survey

To answer this question, we combine two sets of data: public-use microdata from the CE and industry-specific data on regulatory restrictions from the RegData database. The CE includes quarterly interview surveys, conducted by the Bureau of Labor Statistics (BLS), of approximately 7,000 US households. It is constructed as a rotating panel, in which each household is interviewed once every three months for five quarters and then is dropped from the survey. The survey contains information related to household income levels and demographic characteristics, as well as detailed data that describe household expenditures.

The CE dataset is organized by the Universal Classification Codes (UCC) system, which consists of six-digit codes that categorize goods and services into specific purchase groups. Households are queried about the details of their monthly spending habits. Each purchase is recorded and labeled with an appropriate UCC. The CE also includes income files for each household. Matching the expenditure files with the income files allows us to examine UCC expenditure habits by income level. We examine the spending activities of five income quintiles—the lowest 20 percent of income earners, the second-to-lowest 20 percent of income earners, the middle 20 percent of income earners, the second-highest 20 percent of income earners, and the highest 20 percent of income earners. By aggregating monthly spending values across the year and averaging by income quintile, we derive average annual spending by UCC for each income quintile.

Merging these data with information on the regulatory burden for each expenditure category allows us to determine if there are differences in spending habits in terms of regulations between households of different income levels.

RegData

While *regulations* can be used to refer to the guidelines published in the *Code of Federal Regulations*, it is important for our empirical work that we precisely define the term. Our regulation measures come from RegData, the Mercatus Center's database of industry-specific federal regulations. RegData is unique in its method of measuring regulatory burden. It analyzes rules and guidelines published in the *Code of Federal Regulations*, but instead of reporting page counts or number of rules, it counts each specific binding restriction that appears in the text of policies. Each time a policy includes a word indicating an obligation, such as *must* or *shall*, that word is counted as a restriction.[8] These restrictions are weighted by their industry relevance and summed to produce a regulatory index value.[9] Regulatory index values are reported by industry and by year, so it is possible to track regulatory restrictions within a particular industry over time. All our empirical calculations and estimates of "regulations" refer to this regulatory index from RegData.

RegData reports regulations by two-, three-, and four-digit codes of the North American Industry Classification System (NAICS). To combine this information with the expenditure and income data from the CE, we link NAICS codes to UCCs using commodity input-output tables from the Bureau of Economic Analysis and the Consumer Expenditure/Personal Consumption Expenditure Concordance from the BLS.[10]

We have approximately 350 unique UCCs for each year. To create broader spending categories—and to facilitate an eventual examination of the effect of regulation on prices—we collapse UCCs into the basic CPI expenditure categories used by the BLS. Using the BLS's CE-

[8] Five words are coded as restrictions in RegData: *shall*, *must*, *may not*, *prohibited*, and *required*.
[9] For details on the methodology of calculating measures of regulation, see www.regdata.org/methodology.
[10] For a detailed description of the methodology mapping regulations from the NAICS space onto goods and services in the UCC space, see appendix A.

to-UCC aggregation scheme, we match the 61 expenditure categories from the CE with our regulation dataset indexed by UCC code.[11] Our combined dataset includes data for the years 2000–2012.

By using income information available from the CE, we divide households into five income quintiles. This division allows us to examine spending habits across a broad range of income levels. Our measures of regulation include both *direct regulations*, which capture restrictions affecting a good or service itself, and *input regulations*, which capture restrictions affecting the supply chain of inputs for a particular good or service (see appendix A for details). The variable *total regulations* is the sum of direct and input regulations.

Consumer Expenditure Patterns

Table 1 (page 24) shows the percentage of spending for each income quintile in categories with very high and very low levels of regulation. These numbers represent average values for each income quintile spanning the time period 2000–2012. Households in the highest-income quintile make 54.5 percent of all their expenditures in the 25 most heavily regulated expenditure categories, where regulations for goods and services are measured directly (excluding input regulations). The corresponding number for the lowest-income households is 60.3 percent, which is a 10 percent higher consumption share compared to high-income households. Including all regulations, the relative difference is about 12 percent.

A mirror-opposite pattern is evident when comparing expenditures in the *least regulated* expenditure categories. The highest-income group allocates 32.19 percent of its total spending to

[11] As a starting point, we used the expenditure category to UCC mapping contained in the BLS's Dstub2010.txt aggregation processing file. For missing or sparsely covered expenditure categories, we used an additional expenditure category to the UCC mappings. For more information on this file, see "2010 Consumer Expenditure Diary Survey: Public Use Microdata, User's Documentation," http://www.bls.gov/cex/2010/csxdiary.pdf.

goods and services subject to the fewest direct regulations, while the bottom-income quintile spends 25.64 percent of its total expenditures in the same category. Total regulations reflect the same patterns, with high-income households spending more (38.6 percent) in lightly regulated areas than low-income households (31.9 percent).

Table 2 (page 25) presents the expenditure categories for which the difference in expenditure allocation between the bottom- and top-income quintiles is the greatest.[12] These are areas in which the lowest-income families allocate a larger share of their overall spending than do higher-income families. These categories contain rent and utilities, including electricity, telephone services, and audio and visual equipment and services. Households from the lowest-income quintile spend more than five-and-a-half times as much on rented dwellings than households from the highest-income quintile, as a percentage of total expenditures.[13] They spend almost 85 percent more on electricity as a percentage of total expenditures and 50 percent more on telephone service. Other areas where the poorest households spend a larger proportion of their income are drugs and medical supplies, medical insurance, and miscellaneous food items.

To explore the regulatory restrictions that apply to these categories, figure 1 (page 26) plots annual direct regulations for each of these expenditure categories from 2000 to 2012.[14] For most categories, there is a general upward trend in regulations over the sample period. Exceptions are the cigarette industry, which has experienced a downward trend (at least until recently), and the category that includes medical services and insurance, which experienced a

[12] For a complete list of the top 20 expenditure categories and their corresponding direct and total regulation ranks for each of the five income quintiles, see appendix B.
[13] Note that spending for each quintile is reported as a percentage of overall total expenditures for each income group. The level of total spending in most categories is greatest for households in the top quintile.
[14] RegData contains no federal direct restrictions for the nonalcoholic beverages expenditure category, so we include no corresponding graph of changes in regulation for this category.

sharp initial drop in regulations, followed by a steep increase. The category containing rented dwellings also experienced a recent spike in regulations, following earlier variation across time. Most of the expenditure categories that capture basic utilities show substantial growth in regulations: direct regulations for electricity, telephone service, and audio and visual equipment and services all increased by 33 percent to 37 percent. Regulations in the gasoline industry grew by 33 percent. The largest increase occurred in the drugs and medical supplies category, which experienced an almost 90 percent increase in direct regulations.

Taken together, these data support the argument that there are important differences in consumer spending patterns by income groups. We find that, relative to the wealthiest households, the poorest households spend a larger percentage of their income on goods and services that are more highly regulated and a smaller percentage of their income on goods that are less regulated. There are particularly large differences in spending patterns for utilities, including natural gas, electricity, and cable or satellite television service. The regulatory burden for these industries has increased sharply over time. In most cases, these increases have outpaced the overall average growth rate of all regulations.

4. Calculating Price Changes by Income Group

Given the established differences in spending habits across income groups, we seek to determine whether increased regulations have a disproportionately negative effect on low-income households in the form of higher prices for goods and services, which compose a large share of their expenditures. To explore these potential regressive regulatory effects, we must link our expenditure/regulation dataset with price changes across time. Because our data are organized by CPI expenditure categories, we can easily merge annual CPI price levels into our existing

dataset. The BLS publishes expenditure data by household income quintiles for the same categories, allowing us to examine differences across income groups.[15]

By using these data, we construct consumption expenditure basket weights for five household income groups. We exclude nonconsumption expenditures (e.g., charitable contributions, life insurance payments, and retirement contributions) and match the remaining 61 expenditure categories with the CPI price data.[16] The resulting balanced panel contains price and basket weight data for 61 categories spanning the years 2000–2012 (793 observations). Table 3 (page 27) contains the names of each expenditure category, the average basket weight by income group, and the direct, input, and total regulations for each expenditure category. We also use the expenditure basket weights to construct annual aggregate weighted regulation series for each income group:

$$Reg_t^h = \sum_i w_{it}^h \cdot Reg_{it}, \quad (1)$$

where w_{it}^h are expenditure basket weights equal to the proportion of spending in year t on expenditure category i by households in quintile h ($h = 1, 2, \ldots, 5$), and Reg_{it} are the regulations that apply to expenditure category i in year t. Table 4 (page 29) reports the weighted regulations that apply to the combined, all-households group.

By combining the basket weights and price data, we construct two alternative price indexes for each income group. The first is a classic Laspeyres price index, whereby for each income group (h), fixed basket weights from the base year (2000), denoted by $\overline{w}_{i,2000}^h$, are multiplied by their corresponding current-year category prices (P_{it}) and summed over the expenditure categories (indexed by i) to derive the following index:

[15] See Expenditure Shares Tables by income quintile, 1989–2011: http://www.bls.gov/cex/csxshare.htm.
[16] See Archived Consumer Price Index Detailed Report Information: http://www.bls.gov/cpi/cpi_dr.htm. For the lowest-income quintile, the included categories covered 85.2 percent of expenditures in 2012. For the highest-income quintile, said categories covered 79.9 percent of expenditures in 2012.

$$P_t^{h,Laspeyres} = \sum_i \overline{w}_{i,2000}^h \cdot P_{it}. \quad (2)$$

The widely used Laspeyres price index suffers from a number of well-known problems, most notably substitution bias. To overcome this shortcoming, we calculate the following chained price index:

$$P_t^{h,chained} = P_{t-1}^{h,chained} \times \prod_i \left(\frac{P_{it}}{P_{it-1}}\right)^{\frac{w_{it}^h + w_{it-1}^h}{2}}. \quad (3)$$

Table 5 reports the aggregate price indexes for both foregoing methodologies. Interestingly, regardless of the index used, the rate of inflation is highest for the poorest households, declining with increased income.

5. The Effect of Regulations on Prices

Price Levels

Figure 2 (page 30) provides a scatter plot of the weighted total regulations from each of the five income groups against their corresponding group-specific chained price series. Clearly, there is a strong positive correlation between total regulatory burden and total prices. That said, both prices and regulations trended upward over the sample period (2000–2012), so it is important to explicitly control for this common trend to rule out any spurious correlation. To do this, we compare the growth rate of prices over time (i.e., inflation) against the growth rate of regulations.[17] The simplest model of this relationship is the following autoregressive time series equation:

$$p_t^h = \alpha + \beta reg_{t-1}^h + \rho p_{t-1}^h + u_t^h, \quad (4)$$

where p_t^h is the log first difference of the chained price series for household h, reg_{t-1}^h is the log first difference of the total regulations series for household h lagged one year, and u_t^h is a mean

[17] In practice, we transform the price and regulation data by taking their natural logarithm and first differencing each series. This calculation effectively yields the growth rate of each series.

zero error term. Intuitively, this equation specifies that for a given income group the current rate of inflation (p_t^h) is determined by the prior year's inflation rate (p_{t-1}^h), as well as the prior growth rate in regulations (reg_{t-1}^h), which accounts for the natural lag that exists between creation and publication of new regulations and their measurable impact on the market for goods and services. The estimation results for equation (4) are provided in column 1 of table 6B (page 33). The coefficient on lagged regulatory growth is positive and strongly statistically significant, equaling 0.0648, implying that a 1 percent increase in total regulatory restrictions increases consumer prices by an additional 0.0648 percent.[18]

To ensure that these results are robust and that inclusion of a one-period lag ($t-1$) of prior regulatory growth is appropriate, we consider seven alternative specifications of equation (4), which include every combination of the following three variables: current regulatory growth (t), a one-period lag ($t-1$) of regulatory growth, and a two-period lag ($t-2$) of regulatory growth. The results are reported in table 6A (page 32). Without exception, current regulatory growth and the two-period lag of regulatory growth are statistically insignificant in every variant of equation (4) in which they appear. This result supports our earlier theory that there is a natural gestation period between the publication of new regulatory restrictions and their measurable impact on prices. After the impacted production processes have been altered to comply with new regulatory dictates, there is an associated jump in the price of these goods and services. Moving forward, these regulations do not promote additional inflation as their effect is already captured in the change in the price level of the affected goods and services, suggesting that longer lags of regulatory growth should not have a statistically significant effect on current inflation. We also perform a lag selection exercise, examining the Akaike Information Criterion

[18] We use White (period) robust standard errors throughout unless otherwise specified.

and the Schwarz Information Criterion for alternative versions of equation (4). The version of equation (4) that includes only reg_{t-1}^{h} was selected by both the Akaike and the Schwarz criteria as it possessed the lowest values for both.

One obvious shortcoming of equation (4) is that the rate of inflation for each income group differs (see table 5). Therefore, the common intercept assumption of equation (4) should be replaced with unique intercepts for each income group, as in the following:

$$p_t^h = \alpha^h + \beta reg_{t-1}^h + \rho p_{t-1}^h + u_t^h. \quad (5)$$

Equation (5) is a dynamic fixed-effect panel model. Unfortunately, standard fixed or random effects methods yield biased coefficient estimates in such models. Therefore, we use Arellano and Bond's (1991) generalized method of moments (GMM) estimator, which was specifically developed to estimate dynamic fixed-effect panel models. A brief sketch of this estimation procedure will follow; those interested in a fuller exposition should see Arellano and Bond. To begin, equation (5) is first-differenced to eliminate the income-group fixed effects. Next, a suitable instrument set is constructed, consisting of lagged predetermined endogenous variables expressed in levels (i.e., $p_{t-2}^h, p_{t-3}^h, p_{t-4}^h$) and the exogenous variables expressed in first differences (i.e., Δreg_{t-1}^h).[19] For the Arellano and Bond estimator to yield consistent and efficient estimates, the model's errors cannot be autocorrelated; that is, $E(u_t^h u_s^h) = 0$ for $s \neq t$. Following Arellano and Bond, we use the Sargan test for overidentifying restrictions, which tests the validity of moment restrictions implied by the instruments. Under the null hypothesis that the moment restrictions are valid (which implies the absence of second- or higher-order autocorrelation), the test statistic is asymptotically chi-square distributed.

[19] Arellano and Bond (1991) specify the use of all predetermined lagged endogenous variables, whereas we follow the common practice of using less than the full set of lagged variables (i.e., we use periods $t-2$, $t-3$, and $t-4$ inflation rates but not period $t-5$ and prior). We did use larger instrument sets that included more lags, but the results (not reported in this paper but available on request) were nearly identical.

The Sargan test statistic for equation (5) is equal to 4.95 with an associated p value of .176. Therefore, we cannot reject the null hypothesis that the overidentifying restrictions are valid. Therefore, the *n*-step GMM estimation results reported below are both consistent and efficient.[20]

The estimation results for equation (5) are given in column 2 of table 6B. Despite the major differences in model specification and estimation of equations (4) and (5), the estimated coefficient values are remarkably similar. Specifically, the coefficient on lagged regulatory growth is statistically significant, equaling 0.0687, implying that a 10 percent increase in total regulations increases consumer prices by an additional 0.687 percent.

Our results strongly support the assertion that regulatory restrictions promote inflation across the socioeconomic spectrum, as measured by changes in the cost of baskets of goods and services purchased by various income groups. To ensure that this result is not driven by the basket weights themselves, we eliminate them completely and investigate the relationship between regulatory growth and price changes for each expenditure category (e.g., bakery products, major appliances, men's apparel). Specifically, we estimate the following dynamic panel model, which does not employ *any* household expenditure weights:

$$p_{it} = \alpha_i + \beta reg_{it-1} + \rho p_{it-1} + u_{it}, \tag{6}$$

where p_{it} is the log first difference of the original price series for expenditure category i ($i = 1, \dots, 61$), α_i is the unique intercept for each expenditure category, reg_{it-1} is the log first difference of the regulations that apply to expenditure category i in the prior year, and u_{it} is a

[20] The original Arellano and Bond (1991) estimator involves two steps, whereby an initial consistent estimate of the dynamic panel yields residuals that are used to construct a GMM weighting matrix, that is, used to more efficiently reestimate the dynamic panel. Our software package, Eviews, iteratively repeats this process, each time updating the GMM weighting matrix until convergence is achieved. The result is a more efficient estimator than that proposed by Arellano and Bond.

mean zero error term.[21] Essentially, equations (5) and (6) are very similar except that we are modeling the price increases for individual expenditure categories rather than the broader rate of inflation over a basket of goods. The unique intercepts accommodate different long-run rates of inflation by category type. The results are reported in column 3 of table 6B. While smaller in magnitude, the coefficient on lagged regulatory growth is statistically significant, equaling 0.0360, implying that a 10 percent increase in total category-specific regulatory restrictions increases the price of goods and services in that category by an additional 0.36 percent.

Price Volatility

Clearly, increased regulations promote inflation, which is bad for all households but especially so for poor households as they already experience the highest rate of inflation of any income group (see table 5). Alarmingly, it is also the case that regulations are positively correlated with price volatility. This result is especially important given the potential claim that regulations are a form of social insurance and drive up prices but reduce price volatility. Examining the data, the opposite is true.

For each expenditure category, we calculate its price variance and rank categories from least to most volatile. Next, we divide the 61 categories into quartiles by volatility, with the 15 least volatile categories in quartile 1 and the 16 most volatile categories in quartile 4 (see table 7, page 34). For each quartile, we calculate the average price variance, average price levels, average regulations (direct, input, and total), and average budget shares for each income group over the sample period (2000–2012). The results, provided in table 8 (page 36), are striking. Each successive price variance quartile is much more volatile, and the average price level and average total regulations are also sharply higher. In comparison to wealthier households, poorer

[21] See table 3 for a list of the detailed expenditure categories.

households allocate a much larger share of total expenditures in the most volatile price categories. In the two most stable price quartiles, wealthier households allocated 15.3 percentage points more spending than the poorest households. By contrast, the poorest households allocated 15.3 percentage points more spending than the wealthiest households in the two most volatile quartiles. In summary, poor households spend a substantially larger proportion of their income on more expensive, volatile, and heavily regulated goods and services.

6. Conclusion

A significant and often hidden cost of regulation is its effect on consumer prices. As with taxes, the burden of regulatory costs is likely to be passed along, at least in part, to consumers in the form of higher prices. While the literature explores other specific costs of regulation, noting that increased consumer prices are a probable consequence of heavy regulation, this study is the first to provide a thorough empirical analysis of that relationship across industries. Our dataset, which combines information from the CE, RegData, and price changes from the CPI, allows us to determine the effects of regulations on prices and to ask whether those effects are regressive.

We document consumer spending patterns by income group and find that the lowest-income households spend a larger fraction of their income in areas that are more heavily regulated. The opposite is true of the wealthiest households; they allocate more of their spending to goods and services that are subject to fewer regulations. Our estimates of the effect of increased regulations on price levels suggest a positive and statistically significant relationship. A 10 percent increase in regulations is associated with a 0.687 percent increase in prices. This increase is particularly concerning for low-income households, which face higher levels of overall inflation than high-income households. Finally, our analysis of price volatility suggests that low-income households also face higher price volatility.

It is important to emphasize that these results do not include state regulations. If state regulations have a qualitatively similar impact on consumer prices, the regressive regulatory impact of all regulations on poor households is even greater than what our results suggest. If policymakers want to improve the welfare of the most vulnerable members of society, they should earnestly seek ways to cut the regulatory burden faced by US firms.

References

Al-Ubaydli, Omar, and Patrick A. McLaughlin. 2015. "RegData: A Numerical Database on Industry-Specific Regulations for All United States Industries and Federal Regulations, 1997–2012." *Regulation & Governance*, doi: 10.1111/rego.12107.

Ardagna, Silvia, and Annamaria Lusardi. 2010. "Heterogeneity in the Effect of Regulation on Entrepreneurship and Entry Size." *Journal of the European Economic Association* 8 (2–3): 594–605.

Becker, Randy A. 2003. "Pollution Abatement Expenditure by U.S. Manufacturing Plants: Do Community Characteristics Matter?" *B.E. Journal of Economic Analysis & Policy* 3 (2): 1–23.

Becker, Randy A., and J. Vernon Henderson. 2000. "Effects of Air Quality Regulations on Polluting Industries." *Journal of Political Economy* 108 (2): 379–421.

———. 2001. "Costs of Air Quality Regulation." In *Behavioral and Distributional Effects of Environmental Policy*, edited by Carlo Carraro and Gilbert E. Metcalf, 159–68. Chicago: University of Chicago Press.

Benson, Bruce L. 2004. "Opportunities Forgone: The Unmeasurable Costs of Regulation." *Journal of Private Enterprise* 19 (Spring): 1–25.

———. 2015. "Regulation as a Barrier to Market Provision and to Innovation: The Case of Toll Roads and Steam Carriages in England." *Journal of Private Enterprise* 30 (Spring): 61–87.

Borren, Pim, and Matthew Sutton. 1992. "Are Increases in Cigarette Taxation Regressive?" *Health Economics* 1 (4): 245–53.

Ciccone, Antonio, and Elias Papaioannou. 2007. "Red Tape and Delayed Entry." *Journal of the European Economic Association* 5 (2–3): 444–58.

Crafts, Nicholas. 2006. "Regulation and Productivity Performance." *Oxford Review of Economic Policy* 22 (2): 186–202.

Crain, Nicole V., and W. Mark Crain. 2010. "The Impact of Regulatory Costs on Small Firms." Small Business Administration, Office of Advocacy, Washington, DC, September.

Crain, W. Mark, and Nicole V. Crain. 2014. "The Cost of Federal Regulation to the U.S. Economy, Manufacturing and Small Business." National Association of Manufacturers, Washington, DC, September.

Dawson, John W., and John J. Seater. 2013. "Federal Regulation and Aggregate Economic Growth." *Journal of Economic Growth* 18 (2): 137–77.

Djankov, Simeon, Caralee McLiesh, and Rita Maria Ramalho. 2006. "Regulation and Growth." *Economics Letters* 92 (3): 395–401.

Fisman, Raymond, and Virginia Sarria-Allende. 2004. "Regulation of Entry and the Distortion of Industrial Organization." Working Paper 10929, National Bureau of Economic Research, Cambridge, MA, November.

Goldstein, Jacob, and Lam Vo. 2012. "How the Poor, the Middle Class, and the Rich Spend Their Money." National Public Radio, Planet Money. http://www.npr.org/sections/money/2012/08/01/157664524/how-the-poor-the-middle-class-and-the-rich-spend-their-money.

Gørgens, Tue, Martin Paldam, and Allan Würtz. 2003. "How Does Public Regulation Affect Growth?" Economics Working Paper 2003-14, University of Aarhus, Aarhus, Denmark.

Greenstone, Michael. 2002. "The Impacts of Environmental Regulations on Industrial Activity: Evidence from the 1970 and 1977 Clean Air Act Amendments and the Census of Manufactures." *Journal of Political Economy* 110 (6): 1175–219.

Hazilla, Michael, and Raymond Kopp. 1990. "Social Cost of Environmental Quality Regulations: A General Equilibrium Analysis." *Journal of Political Economy* 98 (4): 853–73.

Klapper, Leora, Luc Laeven, and Raghuram Rajan. 2006. "Entry Regulation as a Barrier to Entrepreneurship." *Journal of Financial Economics* 82 (3): 591–629.

McLaughlin, Patrick A., and Richard Williams. 2014. "The Consequences of Regulatory Accumulation and a Proposed Solution." Working Paper 14-03, Mercatus Center, George Mason University, Arlington, VA, February.

Miller, Sophie. 2012. "Public Interest Comment on the Department of Energy's Direct Final Rule: Energy Conservation Standards for Residential Dishwashers." George Washington University Regulatory Studies Center, Washington, DC, September.

Nicoletti, Giuseppe, and Stefano Scarpetta. 2003. "Regulation, Productivity and Growth: OECD Evidence." *Economic Policy* 18 (36): 9–72.

OMB (Office of Management and Budget). 2014. "Draft 2014 Report to Congress on the Benefits and Costs of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities." OMB, Washington, DC, May.

Poterba, James M. 1991. "Is the Gasoline Tax Regressive?" In *Tax Policy and the Economy, Volume 5*, edited by David F. Bradford, 145–64. Cambridge, MA: MIT Press.

Thomas, Diana. 2012. "Regressive Effects of Regulation." Working Paper No. 12-35, Mercatus Center, George Mason University, Arlington, VA, November.

Wier, Mette, Katja Birr-Pedersen, Henrik Klinge Jacobsen, and Jacob Klok. 2005. "Are CO_2 Taxes Regressive? Evidence from the Danish Experience." *Ecological Economics* 52 (2); 239–51.

Table 1. Average Percentage of Total Expenditure by Income Quintiles from Consumer Expenditure Survey, 2000–2012

	Bottom 20%	Quintile 2	Quintile 3	Quintile 4	Top 20%	% Difference (Bottom Quintile vs. Top Quintile)
Top 25 Most-Regulated Expenditure Categories						
Direct Regulations	60.15%	58.42%	57.22%	57.22%	54.51%	10.35%
Total Regulations	58.73%	58.13%	56.64%	54.31%	52.23%	12.44%
Top 25 Least-Regulated Expenditure Categories						
Direct Regulations	25.64%	27.28%	28.99%	30.97%	32.19%	-20.35%
Total Regulations	31.88%	32.22%	33.92%	36.07%	38.63%	-17.47%

Source: Authors' calculations using the Consumer Expenditure Survey and the RegData database of the Mercatus Center at George Mason University.

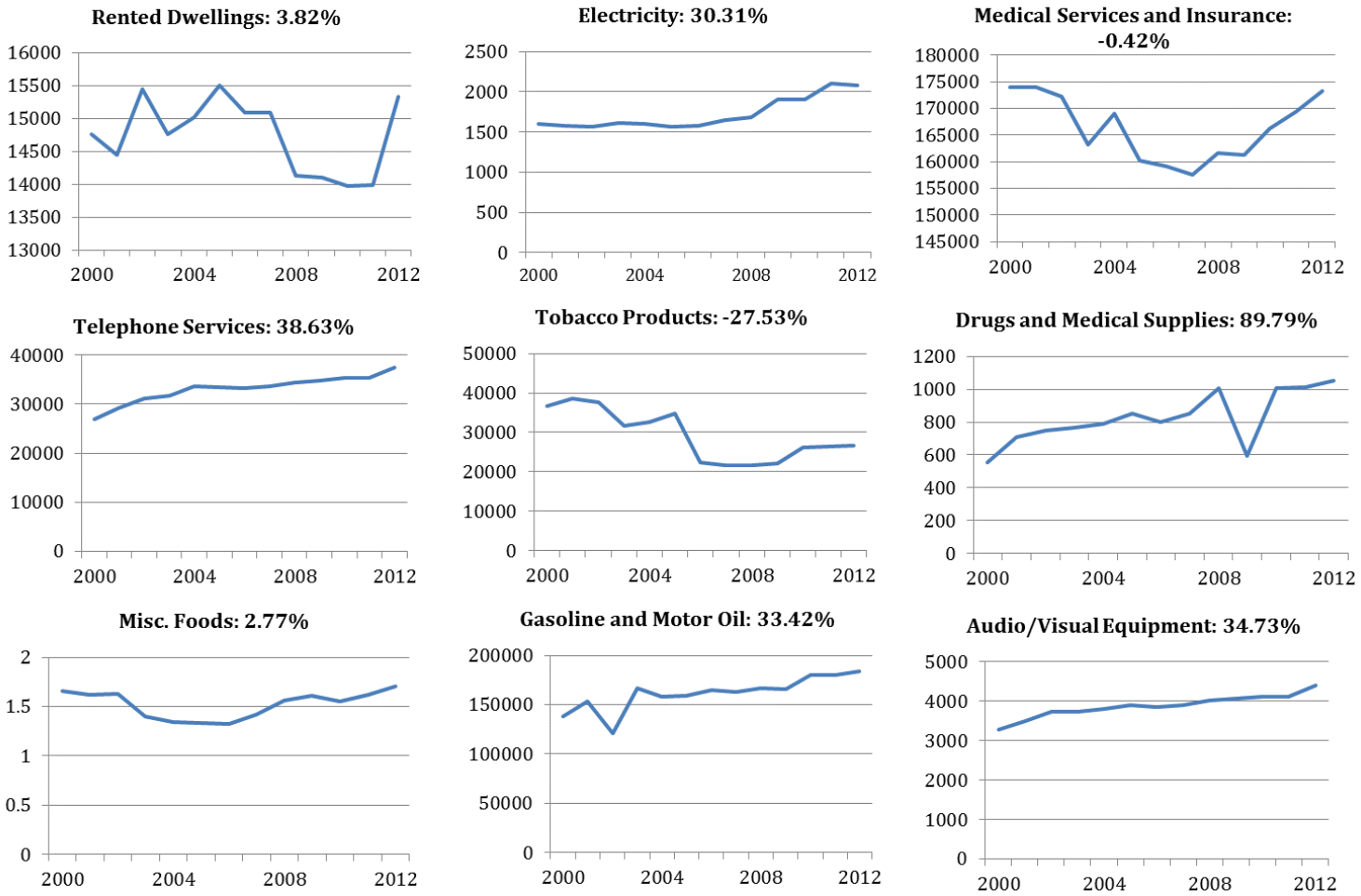
Table 2. Universal Classification Codes Categories with Largest Differences in Spending between Bottom and Top Income Quintiles, 2000–2012

Expenditure Category	Bottom Quintile	Top Quintile	Difference	% Difference
Rented dwellings	14.67%	2.17%	12.50%	576.04%
Electricity	4.19%	2.27%	1.92%	84.58%
Medical services and insurance	5.80%	4.60%	1.20%	26.09%
Telephone services	3.25%	2.14%	1.11%	51.87%
Tobacco products and smoking supplies	1.41%	0.41%	1.00%	243.90%
Drugs and medical supplies	2.07%	1.13%	0.94%	83.19%
Miscellaneous foods	1.86%	1.26%	0.60%	47.62%
Gasoline and motor oil	4.66%	4.21%	0.45%	10.69%
Nonalcoholic beverages	1.04%	0.62%	0.42%	67.74%
Audio and visual equipment and services	2.37%	1.95%	0.42%	21.54%

Note: Numbers represent the percentage of expenditures each income quintile allocates to specific expenditure categories.

Source: Authors' calculations using the Consumer Expenditure Survey.

Figure 1. Changes in Direct Regulations across Time (2000–2012) for Selected Universal Classification Codes



Note: Direct regulations, measured on the y-axes, are measured by way of industry regulation index value; see appendix A for more details. Numbers after chart titles represent the overall percentage growth from 2000 to 2012.

Source: Authors' calculations using the Consumer Expenditure Survey and the RegData database of the Mercatus Center at George Mason University.

Table 3. Average Basket Shares and Regulations by Income Quintile

	Average Basket Weights (2000 to 2012)					Average Regulations		
Expenditure Category	Bottom 20%	2nd Quintile	3rd Quintile	4th Quintile	Top 20%	Direct	Input	Total
Alcoholic beverages	0.98%	0.96%	1.06%	1.13%	1.20%	1,000	18,139	19,140
Audio and visual equipment and services	2.37%	2.34%	2.31%	2.22%	1.95%	3,877	9,396	13,272
Bakery products	1.05%	0.96%	0.87%	0.81%	0.67%	411	15,695	16,106
Beef	0.76%	0.74%	0.65%	0.59%	0.48%	11,219	30,471	41,691
Boys' apparel, ages 2 to 15	0.23%	0.23%	0.23%	0.23%	0.24%	1,255	16,200	17,456
Cars and trucks, new	2.05%	2.72%	3.64%	4.41%	5.29%	101	6,311	6,412
Cars and trucks, used	3.55%	4.47%	4.59%	4.59%	3.33%	0	0	0
Cereals and cereal products	0.56%	0.49%	0.44%	0.39%	0.33%	180	22,418	22,597
Children's apparel, under age 2	0.26%	0.24%	0.23%	0.23%	0.18%	620	14,451	15,071
Drugs and medical supplies	2.07%	2.18%	1.71%	1.40%	1.13%	826	15,754	16,580
Education	3.12%	1.29%	1.31%	1.71%	3.30%	1,917	12,682	14,599
Eggs	0.18%	0.11%	0.11%	0.12%	0.10%	21,764	25,261	47,025
Electricity	4.19%	3.86%	3.39%	2.88%	2.27%	1,725	90,877	92,603
Fats and oils	0.34%	0.31%	0.24%	0.23%	0.16%	8	21,970	21,978
Fees and admissions	0.79%	0.81%	1.04%	1.35%	2.15%	0	29,019	29,019
Fish and seafood	0.38%	0.35%	0.31%	0.29%	0.25%	235,349	147,703	383,052
Floor coverings	0.06%	0.08%	0.09%	0.10%	0.14%	0	14,270	14,270
Food away from home	5.47%	5.61%	6.20%	6.70%	6.90%	473	15,957	16,430
Food prepared by consumer unit on out-of-town trips	0.10%	0.11%	0.11%	0.12%	0.12%	473	15,957	16,430
Footwear	0.99%	0.88%	0.84%	0.79%	0.76%	1,790	25,395	27,184
Fresh fruits	0.64%	0.60%	0.53%	0.49%	0.43%	2	17,568	17,569
Fresh milk and cream	0.53%	0.48%	0.40%	0.35%	0.25%	24	27,026	27,050
Fresh vegetables	0.62%	0.59%	0.51%	0.47%	0.41%	1	14,492	14,493
Fuel oil and other fuels	0.41%	0.39%	0.33%	0.32%	0.28%	116,284	251,824	368,108
Furniture	0.72%	0.75%	0.85%	0.95%	1.35%	17	17,310	17,327
Gasoline and motor oil	4.66%	5.33%	5.58%	5.29%	4.21%	161,726	266,598	428,323
Girls' apparel, ages 2 to 15	0.25%	0.29%	0.30%	0.31%	0.33%	1,236	16,040	17,276
Household operations	1.67%	1.81%	1.81%	2.06%	2.91%	70	6,543	6,613
Household textiles	0.25%	0.30%	0.32%	0.33%	0.37%	71	15,403	15,475
Housekeeping supplies	1.64%	1.63%	1.51%	1.61%	1.42%	9,331	22,819	32,149
Maintenance and repairs	1.62%	1.84%	1.90%	1.90%	1.79%	13,006	11,935	24,941
Major appliances	0.42%	0.47%	0.51%	0.55%	0.59%	217	13,578	13,796

	Average Basket Weights (2000 to 2012)					Average Regulations		
Expenditure Category	Bottom 20%	2nd Quintile	3rd Quintile	4th Quintile	Top 20%	Direct	Input	Total
Medical services and insurance	5.80%	6.60%	6.09%	5.52%	4.60%	166,222	96,644	262,865
Men's apparel, age 16 and over	0.69%	0.71%	0.78%	0.86%	1.00%	1,255	16,200	17,456
Miscellaneous	1.80%	1.99%	2.04%	2.04%	2.05%	34,464	19,803	54,266
Miscellaneous foods	1.86%	1.68%	1.60%	1.54%	1.26%	2	20,638	20,640
Natural gas	1.30%	1.29%	1.14%	1.03%	0.91%	18,733	259,424	278,157
Nonalcoholic beverages	1.04%	0.95%	0.86%	0.80%	0.62%	0	17,400	17,400
Other apparel products and services	0.59%	0.55%	0.54%	0.54%	0.86%	110	16,175	16,286
Other dairy products	0.69%	0.65%	0.62%	0.59%	0.51%	19	24,429	24,448
Other entertainment supplies, equipment, and services	0.57%	0.81%	0.90%	1.23%	1.44%	3,533	17,021	20,554
Other lodging	0.89%	0.76%	0.89%	1.17%	2.27%	5,352	21,054	26,406
Other meats	0.36%	0.34%	0.31%	0.25%	0.25%	20,967	30,794	51,761
Other vehicles and vehicle finance charges	0.45%	0.71%	1.03%	1.24%	0.99%	0	14,706	14,706
Owned dwellings	8.55%	10.24%	12.75%	15.50%	18.55%	84,121	51,666	135,787
Personal care products and services	1.46%	1.48%	1.45%	1.47%	1.48%	613	12,729	13,342
Pets, toys, hobbies, and playground equipment	0.96%	1.27%	1.25%	1.29%	1.31%	868	19,231	20,099
Pork	0.62%	0.55%	0.48%	0.40%	0.30%	12,844	30,525	43,369
Poultry	0.53%	0.47%	0.40%	0.38%	0.29%	11,219	39,140	50,359
Processed fruits and vegetables	0.73%	0.67%	0.55%	0.51%	0.42%	0	22,501	22,501
Public transportation	0.88%	0.85%	0.92%	1.03%	1.64%	382,599	53,333	435,932
Reading	0.30%	0.29%	0.29%	0.31%	0.33%	432	14,104	14,536
Rented dwellings	14.67%	11.38%	8.47%	4.99%	2.17%	14,741	11,343	26,084
Small appliances, misc. housewares, and household equip.	1.58%	1.72%	1.95%	2.15%	2.48%	593	16,964	17,557
Sugar and other sweets	0.41%	0.38%	0.34%	0.34%	0.27%	21	19,472	19,493
Telephone services	3.25%	3.18%	3.04%	2.74%	2.14%	33,094	13,961	47,054
Tobacco products and smoking supplies	1.41%	1.24%	1.10%	0.83%	0.41%	29,159	6,696	35,854
Vehicle insurance	2.23%	2.65%	2.75%	2.61%	2.11%	306,785	170,400	477,185
Vehicle rentals, leases, licenses, and other charges	0.75%	0.84%	1.01%	1.20%	1.53%	0	34,902	34,902
Water and other public services	1.16%	1.17%	1.09%	1.03%	0.84%	27,845	62,090	89,935
Women's apparel, age 16 and over	1.51%	1.37%	1.43%	1.51%	1.66%	1,236	16,040	17,276

Source: Authors' calculations using the Consumer Expenditure Survey and the RegData database of the Mercatus Center at George Mason University.

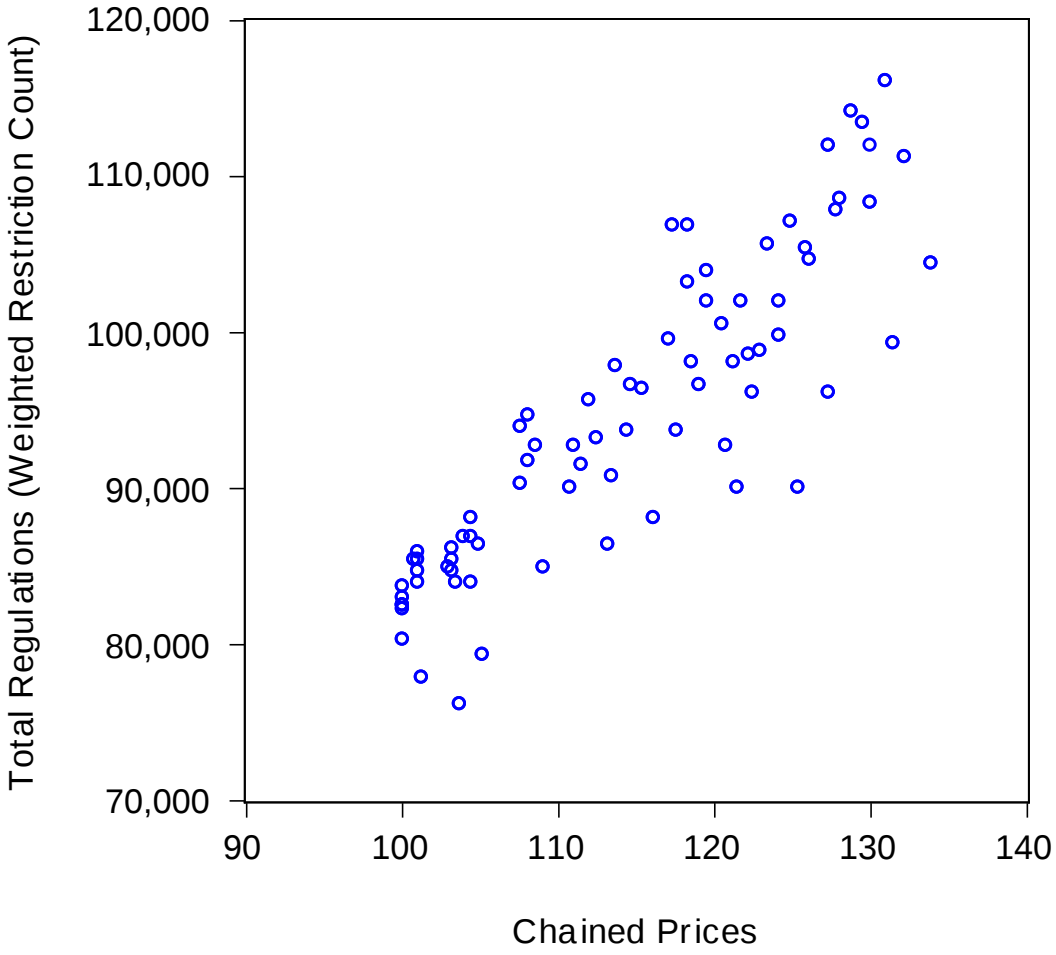
Table 4. Combined Household Weighted Regulations, All Households

Year	Direct Regulations	Input Regulations	Total Regulations
2000	42,283	41,608	83,890
2001	43,454	42,697	86,151
2002	42,998	42,661	85,659
2003	43,578	43,651	87,228
2004	45,786	46,266	92,051
2005	44,926	46,868	91,793
2006	46,056	47,990	94,046
2007	47,627	49,188	96,815
2008	50,214	53,343	103,556
2009	47,575	48,833	96,409
2010	50,569	51,759	102,328
2011	52,399	55,618	108,017
2012	54,523	57,570	112,092

Note: Regulations are measured by way of industry regulation index value; see appendix A for details.

Source: Authors' calculations using the Consumer Expenditure Survey and the RegData database of the Mercatus Center at George Mason University.

Figure 2. Total Regulations vs. Chained Prices



Note: Authors' calculations using the RegData database of the Mercatus Center at George Mason University and the Consumer Price Index.

Table 5. Laspeyres and Chained Price Indexes

Laspeyres						
Year	All Households	Bottom 20%	2nd Quintile	3rd Quintile	4th Quintile	Top 20%
2000	100	100	100	100	100	100
2001	101.114	101.388	101.216	101.149	100.999	101.117
2002	103.395	103.832	103.568	103.449	103.18	103.234
2003	104.8	105.473	105.125	104.847	104.42	104.523
2004	108.431	109.297	108.923	108.517	108.019	107.828
2005	112.241	113.488	112.967	112.342	111.663	111.272
2006	115.064	116.487	115.776	115.141	114.357	114.032
2007	120.292	122.091	121.307	120.522	119.504	118.74
2008	119.927	122.36	121.272	120.115	118.848	118.631
2009	124.303	126.703	125.765	124.819	123.432	122.479
2010	126.459	129.117	128.177	127.099	125.57	124.288
2011	130.628	133.545	132.644	131.392	129.711	128.136
2012	132.976	135.989	135.048	133.772	132.003	130.391
Inflation Rate	2.40%	2.59%	2.54%	2.45%	2.34%	2.24%

Chained						
Year	All Households	Bottom 20%	2nd Quintile	3rd Quintile	4th Quintile	Top 20%
2000	100	100	100	100	100	100
2001	100.937	101.201	101.008	100.88	100.821	100.955
2002	103.225	103.595	103.403	103.186	103.028	103.077
2003	104.479	105.248	104.827	104.35	104.001	104.257
2004	108.019	108.995	108.553	108.063	107.524	107.474
2005	111.638	113.126	112.483	111.865	111.083	110.777
2006	114.326	116.119	115.251	114.56	113.731	113.377
2007	119.122	121.388	120.529	119.649	118.631	117.646
2008	118.218	121.336	119.509	118.279	117.283	117.105
2009	122.411	125.388	124.097	122.958	121.777	120.834
2010	124.121	127.319	126.048	124.829	123.548	122.313
2011	127.872	131.422	130.034	128.741	127.312	125.842
2012	130.085	133.85	132.318	130.983	129.46	127.977
Inflation Rate	2.22%	2.46%	2.36%	2.27%	2.17%	2.08%

Source: Authors' calculations using the Consumer Price Index and the Consumer Expenditure Survey.

Table 6A. Regulation Lag Length Specification and Robustness

Coefficient	Equation (4): Time Series						
Regulation growth (t)	−0.0159	---	−0.0482	0.0087	−0.0149	---	---
	(0.0434)		(0.0355)	(0.0233)	(0.0263)		
Regulation growth ($t-1$)	0.046*	0.0539**	---	0.0671***	---	0.0648***	---
	(0.0251)	(0.0226)		(0.0197)		(0.0213)	
Regulation growth ($t-2$)	−0.0247	−0.0155	−0.0535	---	---	---	−0.0339
	(0.0394)	(0.0193)	(0.0323)				(0.0221)
Lagged inflation	−0.4855***	−0.5106***	−0.4515***	−0.4761***	−0.4954***	−0.4651***	−0.5408***
	(0.0977)	(0.0405)	(0.0903)	(0.0599)	(0.0509)	(0.0366)	(0.0274)
Observations	50	50	50	55	55	55	50
Goodness of Fit	0.356	0.356	0.347	0.323	0.289	0.322	0.336
Akaike Information Criterion	−5.92	−5.959	−5.946	−6.018	−6.006	−6.053[(a)]	−5.969
Schwarz Information Criterion	−5.729	−5.806	−5.793	−5.872	−5.897	−5.944[(a)]	−5.854

* = statistically significant at the 10% level; ** = statistically significant at the 5% level; *** = statistically significant at the 1% level.
(a) The baseline specification of equation (4), which includes a single, one-period lag of regulation growth, minimizes both the Akaike and Schwarz information criteria.

Note: White robust (period) standard errors are in parentheses.

Table 6B. Inflation and Regulation Growth Regression Results

Coefficient	Equation (4) Time Series	Equation (5) Dynamic Panel	Equation (6) Expenditure Panel
Lagged regulation growth	0.0648*** (0.0213)	0.0687*** (0.0148)	0.0360*** (0.0089)
Lagged inflation	−0.4651*** (0.0366)	−0.4857*** (0.0397)	−0.1998*** (0.0031)
Observations	55	50	610
Sargan test	---	4.95	47.36
Sargan *p*-value	---	0.176	0.1684

*** = statistically significant at the 1% level.

Note: White robust (period) standard errors in parentheses. Intercept for equation (4) not reported; Sargan test not applicable to equation (4). Sargan test fails to reject null hypothesis that overidentifying restrictions are valid at any standard level of significance in equations (5) and (6).

Table 7. Price Volatility of Expenditure Categories

Volatility Rank	Price Quartile	Expenditure Category	Average Price, $	Price Variance, $	Average Total Regulations
61	1	Audio and visual equipment and services	100.7	4.87	13,272
60	1	Cars and trucks, new	97.1	6.3	6,412
59	1	Telephone services	100.8	7.1	47,054
58	1	Women's apparel, age 16 and over	92.6	8.43	17,276
57	1	Furniture	93.2	11.29	17,327
56	1	Footwear	100.2	12.08	27,184
55	1	Vehicle rentals, leases, licenses, and other charges	95.9	12.86	34,902
54	1	Men's apparel, age 16 and over	91.7	14.26	17,456
53	1	Major appliances	100.5	14.68	13,796
52	1	Children's apparel, under age 2	92.5	18.73	15,071
51	1	Floor coverings	105.3	21.72	14,270
50	1	Boys' apparel, ages 2 to 15	87.6	33.52	17,456
49	1	Cars and trucks, used	88.7	37.05	0
48	1	Reading	109.8	40.02	14,536
47	1	Girls' apparel, ages 2 to 15	88.7	40.6	17,276
46	2	Housekeeping supplies	109.3	72.21	32,149
45	2	Nonalcoholic beverages	110.2	73.87	17,400
44	2	Miscellaneous foods	110.6	79.61	20,640
43	2	Personal care products and services	114.5	84.48	13,342
42	2	Fresh fruits	115.1	105.47	17,569
41	2	Pork	113.9	108.06	43,369
40	2	Owned dwellings	118.4	112.38	135,787
39	2	Fees and admissions	118.7	113.53	29,019
38	2	Other lodging	119.1	113.7	26,406
37	2	Alcoholic beverages	115.8	118.07	19,140
36	2	Other apparel products and services	103.9	120.7	16,286
35	2	Small appliances, misc. housewares, and household equip.	83.4	129.19	17,557
34	2	Other meats	118.4	135.48	51,761
33	2	Fresh vegetables	116.3	137.14	14,493
32	2	Other dairy products	116.5	138.32	24,448
31	3	Drugs and medical supplies	119.1	144.12	16,580
30	3	Cereals and cereal products	113.9	148.29	22,597
29	3	Public transportation	111.3	150.23	435,932
28	3	Food prepared by consumer unit on out-of-town trips	117.3	157.54	16,430
27	3	Poultry	118.2	160.35	50,359
26	3	Other entertainment supplies, equipment, and services	77.7	160.89	20,554
25	3	Rented dwellings	121.7	179.32	26,084
24	3	Household operations	121.3	183.93	6,613
23	3	Food away from home	119.7	190.52	16,430
22	3	Fresh milk and cream	118.8	192.91	27,050
21	3	Sugar and other sweets	116.6	193.77	19,493
20	3	Other vehicles and vehicle finance charges	115.2	226.32	14,706
19	3	Maintenance and repairs	122.5	232.8	24,941
18	3	Miscellaneous	124.3	234.73	54,266
17	3	Fish and seafood	115.6	235.39	383,052

Volatility Rank	Price Quartile	Expenditure Category	Average Price, $	Price Variance, $	Average Total Regulations
16	4	Household textiles	75.4	239.28	15,475
15	4	Bakery products	120.8	278.52	16,106
14	4	Vehicle insurance	130.2	284.93	477,185
13	4	Processed fruits and vegetables	123.4	303.96	22,501
12	4	Pets, toys, hobbies, and playground equipment	125.8	354.58	20,099
11	4	Fats and oils	121.1	362.84	21,978
10	4	Electricity	128.4	440.12	92,603
9	4	Medical services and insurance	132.3	451.88	262,865
8	4	Natural gas	120.6	515.35	278,157
7	4	Beef	137	535.25	41,691
6	4	Eggs	129.8	613.05	47,025
5	4	Water and other public services	133.5	704.02	89,935
4	4	Education	144.3	911.07	14,599
3	4	Tobacco products and smoking supplies	151	1831.84	35,854
2	4	Gasoline and motor oil	154	3006.99	428,323
1	4	Fuel oil and other fuels	159.4	3250.45	368,108

Source: Authors' calculations using the Consumer Expenditure Survey, the RegData database of the Mercatus Center at George Mason University, and the Consumer Price Index.

Table 8. Price Volatility vs. Average Regulations and Budget Shares

Price Variance Quartile	Average Price Variance, $	Average Price, $ (2000 = 100)	Average Regulations			Household Quintile Budget Shares (%)					Share Differential (Top − Bottom)
			Direct	Input	Total	Bottom	Q2	Q3	Q4	Top	
1	19	96	3,009	15,211	18,219	17.4	18.8	20.1	21	20.8	3.4
2	109	112	8,997	22,961	31,958	22.3	23.5	26.1	29.5	34.2	11.9
3	186	116	46,465	29,207	75,672	31.7	29.5	27	24.5	22.5	−9.2
4	880	130	54,046	85,485	139,531	28.6	28.2	26.8	25.1	22.4	−6.1

Note: Regulations are measured by way of industry regulation index value; see appendix A for details.

Source: Authors' calculations using the Consumer Expenditure Survey, the RegData database of the Mercatus Center at George Mason University, and the Consumer Price Index.

Appendix A. Methodological Description of the Construction of the Consumer Expenditure Survey/Regulation Dataset

To determine the disparate effects of government regulations on households in different socioeconomic strata, we construct a dataset that maps goods and services from the Consumer Expenditure Survey (CE) onto industry regulations from the Mercatus Center at George Mason University's industry regulation database (RegData).

The CE provides detailed household spending and price data for a wide array of goods and services by income group. These goods and services are organized using the Universal Classification Codes (UCC) system. RegData 2.0, however, reports the level of industry regulation by the two-, three-, and four-digit North American Industry Classification System (NAICS) code for each year between 1997 and 2012. Therefore, to construct a usable database, we map regulations from the NAICS space onto goods and services in the UCC space. The resulting balanced panel dataset contains 9,872 observations, covering 617 UCC-based goods and services over a 16-year period.

To construct the final dataset, the following steps are employed:

1. The RegData 2.0 dataset consists of two-digit, three-digit, and four-digit NAICS-based tables. Each regulation record in the tables contains the name of the government agency imposing the regulation, the year of the regulation, the industry affected by the regulation, the regulatory word count, the restriction count, and the industry regulation index value. For our purposes, we use the industry regulation index value, which equals the regulatory restriction count weighted by industry relevance.[22]

[22] For a description of the methodology used to construct RegData, see http://regdata.org/methodology.

For each industry-and-year pair, the industry regulation index values are summed across federal regulators. Therefore, for each industry-and-year combination, a single-industry regulation index value is derived, equaling the sum of all regulatory restrictions (weighted by industry relevance) imposed on that industry by all federal regulators for that year. The result is three aggregated datasets, one for each two-digit, three-digit, and four-digit NAICS-based table. Last, the three aggregated datasets are combined (stacked) to form a single dataset.

2. The spreadsheet containing the 2007 commodity-by-industry direct requirements (after redefinitions) table was downloaded from the Bureau of Economic Analysis (BEA) website (http://www.bea.gov/industry/xls/io-annual/CxI_DR_2007_detail.xlsx). This spreadsheet contains two work sheets, both of which are used below:
    a. The first work sheet is a concordance that converts the BEA's input-output (I-O) commodity/industry codes into 2007 NAICS codes.
    b. The second work sheet is the I-O direct requirements table, which contains I-O weights (α_{ij}) equal to the amount of input (measured in dollars) from industry (i) required to produce a dollar's worth of output by industry (j). By construction, these weights sum to 1 because, in addition to actual inputs, the BEA includes employee compensation, taxes, and gross operating surplus in the weighting schema.
3. The I-O commodity/industry code to NAICS concordance described in step (2a) above is matched with the aggregate industry regulations from step (1), to create a new table that lists the aggregate industry regulations by I-O commodity/industry code; the resulting table is further summed over commodity code by year to derive a table with a

single total regulation value for each commodity code–year pair. This second round of aggregation after the initial match is necessary because some commodity codes map onto multiple NAICS industries. I-O commodity/industry codes with no associated regulations are assigned an industry regulation index value of 0. The resulting table is a measure of the direct regulations (denoted $DirectReg_{it}$) applicable to a given I-O commodity/industry code.

4. To determine the level of regulation that applies to the inputs/supply chain of a given industry, the I-O direct requirements (α_{ij}) from step (2b) are matched with the direct regulations for each I-O commodity ($DirectReg_{it}$) from step (3) by way of their I-O commodity/industry codes. Note that if a commodity/industry is not needed to produce a given output, the associated input value is 0. This produces a large result set with more than 2.4 million rows of data. This dataset is then "grouped by" output industry (j) and year (t) and summed over the product of the direct input regulations (indexed by i) and I-O weights, producing an estimate of input–supply chain regulation:

$$InputReg_{jt} = \sum_i \alpha_{ij} \cdot DirectReg_{it}.$$

   See figure A1 (page 42) for a graphical summary of steps (1) to (4).

5. The direct regulations by industry and year are matched with the total input regulations by industry and year. The direct and input regulations are summed to determine the total direct and indirect regulations affecting a given industry:

$$TotalReg_{it} = DirectReg_{it} + InputReg_{it}.$$

6. To map regulations onto the UCC codes, a separate set of queries is executed to map the codes onto I-O commodity/industry codes.

a. As a beginning step, we import the personal consumption expenditures (PCE) concordance from the Bureau of Labor Statistics (BLS) (http://www.bls.gov/cex /pce_concordance_2012.xlsx). This file maps UCC codes onto PCE codes from the BEA's national income and product accounts (NIPAs).

b. Next, we import BEA table 2.4.5U (I-O, Personal Consumption Expenditures by Type of Product with 2007 Input-Output Commodity Composition). This latter bridge file (http://www.bea.gov/national/xls/2007-pcs-io-bridge.xls) maps NIPA line numbers onto PCE codes.

c. The tables from steps (6a) and (6b) are matched by way of their common PCE codes. The resulting table serves as a bridge file that maps UCC codes onto NIPA line numbers.

7. Finally, we import the BEA's PCE bridge file, which maps NIPA line numbers onto I-O commodity/industry codes (www.bea.gov/industry/xls/io-annual/PCEBridge_2007 _Detail.xlsx), along with the total value of all purchases of the linked I-O commodity/industry in 2007.

    a. Matching the NIPA line items from the PCE bridge with the results from step (6c) provides a clear mapping from UCC code to I-O commodity/industry codes. See figure A2 (page 43) for a graphic summary of steps (6) and (7).

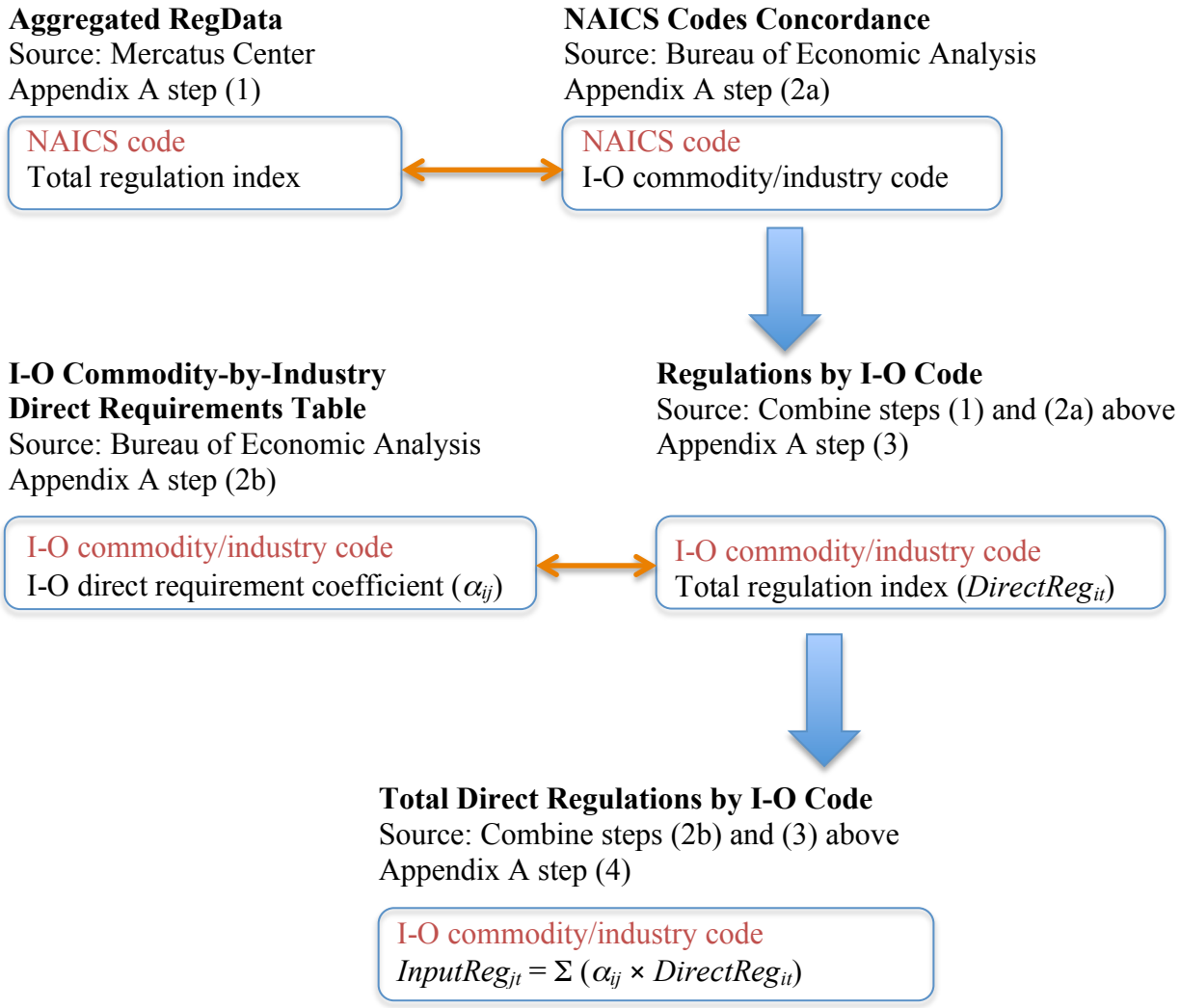
8. The resulting table from step (7a) maps a given consumer product from the CE onto all I-O industries that produce that product. In many cases, more than one industry produces a given UCC product. To produce a single regulation value for each consumer product, we derive industry weights equal to a given industry's 2007 level of output relative to the

total output of all industries that supply a given UCC product.[23] For example, the UCC code for flour is 10110. This consumer product is produced by seven I-O industries. Assigning each of these industries a weight equal to its total output relative to the total output of all seven industries produces a set of weights that sum to 1 (see table A1, page 44). Although it would be preferable to update these weights annually, the BLS derives these output data from the US Census Bureau's Economic Census, which is conducted only every five years.

9. Finally, UCC codes, I-O commodity/industry codes, and output shares from step (8) are matched with the regulation-by-industry data from step (5). These matched data are then "grouped by" UCC code and year and aggregated over the product of industry regulation and output shares.

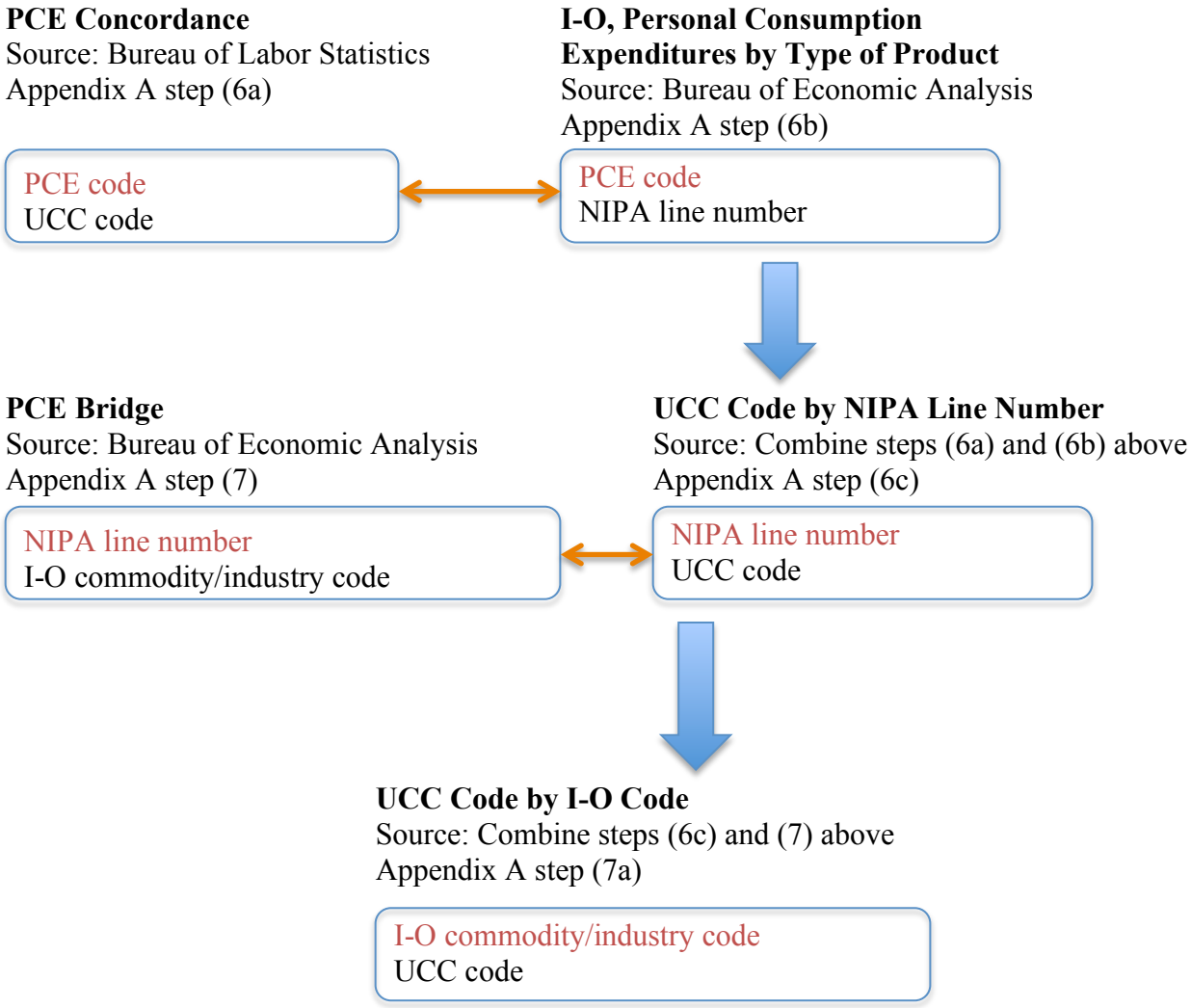
[23] Consumption-based weights equal to each industry's market share for a given commodity would be preferable to weights based on the overall relative size of the industries that produce said commodity. Unfortunately, to our knowledge, such data do not exist.

Figure A1. Mapping Regulations onto Input-Output (I-O) Codes



Note: NAICS = North American Industry Classification System.

Figure A2. Mapping Input-Output (I-O) Codes onto Consumer Expenditure Codes



Note: PCE = personal consumption expenditures; UCC = Universal Classification Codes; NIPA = national income and products accounts.

Table A1. Input-Output Industries that Produce Flour (UCC: 10110)

Commodity Code	Commodity/Industry Description	Purchase Value	Output Share, %
311230	Breakfast cereal manufacturing	12,889	34.7
31122A	Soybean and other oilseed processing	114	0.3
3118A0	Cookie, cracker, pasta, and tortilla manufacturing	16,255	43.8
311210	Flour milling and malt manufacturing	4,659	12.5
311990	All other food manufacturing	660	1.8
1111B0	Grain farming	618	1.7
311420	Fruit and vegetable canning, pickling, and drying	1,939	5.2

Source: Authors' calculations using the Consumer Expenditure Survey, the Bureau of Economic Analysis's PCE bridge file, and the Bureau of Labor Statistics's PCE concordance file.

Appendix B. Top 20 Expenditure Categories by Income Quintile and Corresponding Regulations

Income Quintile 1 (Bottom 20%)					
Expenditure Category	% Expenditure	Direct Reg Rank	Direct Regs	Total Reg Rank	Total Regs
Rented dwellings	14.67%	15	14,741	25	26,084
Owned dwellings	8.55%	7	84,121	8	135,787
Medical services and insurance	5.80%	4	166,222	7	262,865
Food away from home	5.47%	37	473	45	16,430
Gasoline and motor oil	4.66%	5	161,726	3	428,323
Electricity	4.19%	26	1,725	9	92,603
Cars and trucks, used	3.55%	55	0	61	0
Telephone services	3.25%	9	33,094	14	47,054
Education	3.12%	24	1,917	52	14,599
Audio and visual equipment and services	2.37%	22	3,877	58	13,272
Vehicle insurance	2.23%	2	306,785	1	477,185
Drugs and medical supplies	2.07%	33	826	44	16,580
Cars and trucks, new	2.05%	44	101	60	6,412
Miscellaneous foods	1.86%	53	2	31	20,640
Miscellaneous	1.80%	8	34,464	11	54,266
Household operations	1.67%	46	70	59	6,613
Housekeeping supplies	1.64%	20	9,331	20	32,149
Maintenance and repairs	1.62%	16	13,006	26	24,941
Small appliances, misc. housewares, and household equip.	1.58%	36	593	37	17,557
Women's apparel, age 16 and over	1.51%	30	1,236	43	17,276

Income Quintile 2					
Expenditure Category	% Expenditure	Direct Reg Rank	Direct Regs	Total Reg Rank	Total Regs
Rented dwellings	11.38%	15	14,741	25	26,084
Owned dwellings	10.24%	7	84,121	8	135,787
Medical services and insurance	6.60%	4	166,222	7	262,865
Food away from home	5.61%	37	473	45	16,430
Gasoline and motor oil	5.33%	5	161,726	3	428,323
Cars and trucks, used	4.47%	55	0	61	0
Electricity	3.86%	26	1,725	9	92,603
Telephone services	3.18%	9	33,094	14	47,054
Cars and trucks, new	2.72%	44	101	60	6,412
Vehicle insurance	2.65%	2	306,785	1	477,185
Audio and visual equipment and services	2.34%	22	3,877	58	13,272
Drugs and medical supplies	2.18%	33	826	44	16,580
Miscellaneous	1.99%	8	34,464	11	54,266
Maintenance and repairs	1.84%	16	13,006	26	24,941
Household operations	1.81%	46	70	59	6,613
Small appliances, misc. housewares, and household equip.	1.72%	36	593	37	17,557
Miscellaneous foods	1.68%	53	2	31	20,640
Housekeeping supplies	1.63%	20	9,331	20	32,149
Personal care products and services	1.48%	35	613	57	13,342
Women's apparel, age 16 and over	1.37%	30	1,236	43	17,276

Income Quintile 3					
Expenditure Category	% Expenditure	Direct Reg Rank	Direct Regs	Total Reg Rank	Total Regs
Owned dwellings	12.75%	7	84,121	8	135,787
Rented dwellings	8.47%	15	14,741	25	26,084
Food away from home	6.20%	37	473	45	16,430
Medical services and insurance	6.09%	4	166,222	7	262,865
Gasoline and motor oil	5.58%	5	161,726	3	428,323
Cars and trucks, used	4.59%	55	0	61	0
Cars and trucks, new	3.64%	44	101	60	6,412
Electricity	3.39%	26	1,725	9	92,603
Telephone services	3.04%	9	33,094	14	47,054
Vehicle insurance	2.75%	2	306,785	1	477,185
Audio and visual equipment and services	2.31%	22	3,877	58	13,272
Miscellaneous	2.04%	8	34,464	11	54,266
Small appliances, misc. housewares, and household equip.	1.95%	36	593	37	17,557
Maintenance and repairs	1.90%	16	13,006	26	24,941
Household operations	1.81%	46	70	59	6,613
Drugs and medical supplies	1.71%	33	826	44	16,580
Miscellaneous foods	1.60%	53	2	31	20,640
Housekeeping supplies	1.51%	20	9,331	20	32,149
Personal care products and services	1.45%	35	613	57	13,342
Women's apparel, age 16 and over	1.43%	30	1,236	43	17,276

Income Quintile 4					
Expenditure Category	% Expenditure	Direct Reg Rank	Direct Regs	Total Reg Rank	Total Regs
Owned dwellings	15.50%	7	84,121	8	135,787
Food away from home	6.70%	37	473	45	16,430
Medical services and insurance	5.52%	4	166,222	7	262,865
Gasoline and motor oil	5.29%	5	161,726	3	428,323
Rented dwellings	4.99%	15	14,741	25	26,084
Cars and trucks, used	4.59%	55	0	61	0
Cars and trucks, new	4.41%	44	101	60	6,412
Electricity	2.88%	26	1,725	9	92,603
Telephone services	2.74%	9	33,094	14	47,054
Vehicle insurance	2.61%	2	306,785	1	477,185
Audio and visual equipment and services	2.22%	22	3,877	58	13,272
Small appliances, misc. housewares, and household equip.	2.15%	36	593	37	17,557
Household operations	2.06%	46	70	59	6,613
Miscellaneous	2.04%	8	34,464	11	54,266
Maintenance and repairs	1.90%	16	13,006	26	24,941
Education	1.71%	24	1,917	52	14,599
Housekeeping supplies	1.61%	20	9,331	20	32,149
Miscellaneous foods	1.54%	53	2	31	20,640
Women's apparel, age 16 and over	1.51%	30	1,236	43	17,276
Personal care products and services	1.47%	35	613	57	13,342

Income Quintile 5					
Expenditure Category	% Expenditure	Direct Reg Rank	Direct Regs	Total Reg Rank	Total Regs
Owned dwellings	18.55%	7	84,121	8	135,787
Food away from home	6.90%	37	473	45	16,430
Cars and trucks, new	5.29%	44	101	60	6,412
Medical services and insurance	4.60%	4	166,222	7	262,865
Gasoline and motor oil	4.21%	5	161,726	3	428,323
Cars and trucks, used	3.33%	55	0	61	0
Education	3.30%	24	1,917	52	14,599
Household operations	2.91%	46	70	59	6,613
Small appliances, misc. housewares, and household equip.	2.48%	36	593	37	17,557
Electricity	2.27%	26	1,725	9	92,603
Other lodging	2.27%	21	5,352	24	26,406
Rented dwellings	2.17%	15	14,741	25	26,084
Fees and admissions	2.15%	55	0	21	29,019
Telephone services	2.14%	9	33,094	14	47,054
Vehicle insurance	2.11%	2	306,785	1	477,185
Miscellaneous	2.05%	8	34,464	11	54,266
Audio and visual equipment and services	1.95%	22	3,877	58	13,272
Maintenance and repairs	1.79%	16	13,006	26	24,941
Women's apparel, age 16 and over	1.66%	30	1,236	43	17,276
Public transportation	1.64%	1	382,599	2	435,932

Note: Regulations are measured by way of industry regulation index value; see appendix A for details.

Source: Authors' calculations using the Consumer Expenditure Survey and the RegData database of the Mercatus Center at George Mason University.