ANALYZING REGULATORY BENEFITS AND COSTS

A guide for Rhode Island executive agencies

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Introduction

Why Analyze Policy?

A policy or regulation is usually written to target a specific problem or goal. But how can we be sure the policy will accomplish its objective? What groups will be affected by the policy? Can we improve the regulation's net benefit to Rhode Island? What unintended consequences might result from a rule change? Good policy analysis can answer all these questions.

What is regulatory analysis?

A regulatory analysis – also known as benefit-cost analysis or BCA – evaluates the feasibility of a range of policy options in order to:

- Identify the best available alternative
- Fulfill the Administrative Procedures Act (APA) and Executive Order 15-07 (EO 15-07) requirements, thereby aligning with the spirit of the APA: transparency
- Allow the public to respond with useful – including clarifying – information

Regulatory analysis can involve the reasonable extrapolation of information that is not directly observable from what is known. This includes an analysis of the status quo, which represents the environment prior to any policy adjustments. It also requires establishing a baseline by examining the status quo and historical data, making assumptions that current trends will persist. Additionally, agencies will explore the counterfactual scenario, considering what would have transpired in an "unobservable world" had the policy never been implemented. The estimated true effect will be a focal point, representing the difference between the actual outcomes following policy implementation and the reasonable projections of what would have occurred without the policy. Regulatory analysis encompasses the consideration of how regulatory changes can prompt unexpected individual behaviors and how risk is intricately linked to regulatory actions.

Overview

The goal of policy analysis is to carefully *define* the problem that is being addressed, *identify* the various regulatory alternatives that can address that problem, and *evaluate* those alternatives by measuring the costs, benefits, economic impact, and the distribution of the effects of the regulatory change.

A good analysis has many merits:
- It attempts to measure and capture the *total societal effect* of a policy change
- It considers multiple alternative methods of achieving the intended effect
- It is produced with timely and accurate information
- It is conducted in a transparent and reproducible manner
- It provides specific references and explanations of data sources and estimation methods

This guide introduces many of the tools that can be used to evaluate regulatory changes. The last half of this guide reviews many of the foundational economic principles of regulatory analysis.

The APA and EO 15-07 govern agency rulemaking. All regular and direct final rulemakings by executive branch agencies require an "analysis of the benefits and costs of a reasonable range of regulatory alternatives reflecting the scope of discretion" provided to the agency in the authorizing statute. Alternatives for each regulatory action should also be quantified to the extent possible. EO

15-07 also states that the level of analysis shall be proportional to the significance of the rulemaking.

Separate statute also requires a fiscal note for regulations, quantifying the impact of a proposed regulation on state or local expenditures and/or revenues. These impacts can be mentioned in the benefit-cost analysis, but do not need to be counted as part of the net cost or benefit as they are already accounted for in the fiscal note. Examples include the revenue from new fees, or expenditures of state funds to run a program implemented by a regulation.

Prior to the 2016 updates to the Administrative Procedures Act (APA), the separate economic analyses (e.g., economic impact statements and regulatory flexibility analyses) that agencies conducted examined the impacts of proposed regulatory changes on discrete populations without considering holistic effects on the regulatory landscape. Economic impact statements (EIS) as required under R.I. Gen. Laws § 42-35.1-3 must identify and estimate the number of small businesses subject to a proposed regulation, as well as quantify associated compliance costs. The EIS must also delineate the projected reporting, recordkeeping, and other administrative costs required for compliance, specifying the professional skills necessary for the preparation of the report or record. The regulatory flexibility (Reg Flex) analysis outlined in R.I. Gen. Laws § 42-35.1-4 must certify that, for proposed regulations which affect small businesses, the agency has considered less intrusive or less costly regulatory alternatives.

The components of these separate EIS and Reg Flex analyses have generally been incorporated into the comprehensive economic analysis required by the 2016 APA amendments. A comprehensive benefit-cost analysis (BCA) as required by R.I. Gen. Laws § 42-35-2.9 must specifically evaluate the disparate effects on vulnerable sub-populations, business categories (including small businesses), and other stakeholder groups. Additionally, this analysis must highlight the impacts of the proposed regulatory changes against a reasonable suite of alternatives.

The applicable guidance and analyses for proposed rules are accessible on the Secretary of State's website (https://rules.sos.ri.gov/organizations) and may also be posted by the regulating agency on their website.

Checklists

This section includes two checklists related to the analytical components of rulemakings: (1) analytical requirements and (2) BCA components.

There are four analytical components that are required when an agency participates in the rulemaking process -- regulatory analysis (BCA), fiscal note, economic impact statement, and regulatory flexibility analysis. If your agency has any difficulty or questions as to how to properly adhere to meeting these requirements, please reach out to your assigned analyst.

Benefit-cost analysis provides a useful framework to evaluate regulatory options and is the basis for this analysis guide. Benefit-cost analysis allows you to identify the wide array of stakeholders affected by a policy change, estimate the societal benefits and costs that affect these stakeholders, and compare those benefits and costs among alternative approaches.

This guide outlines various methods to quantify and/or monetize a policy's societal effects. This quantification will help you compare the benefits and costs of a policy change and understand the ways in which policy mechanisms affect different groups throughout Rhode Island.

Analytical Requirements Check List
❒ Regulatory Analysis/Benefit-Cost Analysis (BCA) – R.I. Gen. Laws § 42-35-2.9
❒ Fiscal Note – R.I. Gen. Laws § 22-12-1.1
❒ Economic Impact Statement – R.I. Gen. Laws § 42-35.1-3
❒ Regulatory Flexibility Analysis – R.I. Gen. Laws § 42-35.1-4

BCA Components Check List
❒ Define the societal problem being addressed by regulatory change
❒ Define the goal of the regulatory change
❒ Set the scope of regulatory analysis (including which provisions are discretionary per R.I. Gen. Laws § 42-35-2.9(b)(1))
❒ Establish a baseline
❒ Identify stakeholders affected by proposal and alternatives
❒ Identify the benefits and costs for each stakeholder
❒ Quantify benefits, costs, and transfers
❒ Create schedule of costs, benefits, and transfers over time
❒ Adjust future benefits/costs/transfers through discounting
❒ Calculate present values of regulatory proposal
❒ Perform risk/sensitivity analysis to check the effect of assumptions
❒ Consider and evaluate alternatives to proposal

Problem Definition

Before analyzing a proposed regulatory change and alternative approaches, it is important to identify the *problem* being addressed and the *goal* of the policy change. It may also be appropriate to discuss any background information that contextualizes the underlying motivation for the regulatory change (such as relevant federal or state statutes, history of the policy, etc.).

Hypothetical A: Logging Permits
The Rhode Island Department of Environmental Management (DEM) is writing a rule that requires property owners to receive a state permit before logging any lands.
What is the problem and goal?
This regulation could seek to address several different issues revolving around the environment, safety, or compliance. In this case, DEM identified a problem of logging occurring in an unsafe manner. The goal of the permit is to provide a check in the process so that property owners can be notified about proper logging safety protocols, and compliance with these protocols can be checked.

Setting the Scope of Analysis

The goal of a regulatory impact analysis is to measure the marginal effect of the rule change being proposed. It attempts to measure the additional benefits and costs that the regulation under analysis directly causes, and not changes that are caused by other factors.

The analysis should measure the societal benefits and costs that accrue to the entire state of Rhode Island. This includes the benefits and costs that accrue to individual citizens, businesses, organizations, and governmental institutions.

The timeline of an analysis should start at implementation and extend long enough to encompass the important benefits and costs of the regulatory change. In some cases, the timeframe is fixed and fairly obvious; in others, it can be more difficult to determine. If additional change to the policy is fairly certain to happen at a specific point in the future, set the timeframe of analysis up to that point. Use your discretion and try to set a timeframe that captures as much of the societal benefits and costs of the regulatory change as possible.

Hypothetical B: Youth Sports Concussions
The Rhode Island Department of Education (RIDE) is considering a rule that would mandate a concussion testing protocol performed by a licensed paramedic for all high school athletic events.
What is the scope of analysis?
This regulation will be implemented over a five-year period so that schools can comply with the mandate. But is a five-year scope of analysis appropriate? There will be annual compliance costs for schools in perpetuity. During the creation of the regulation, RIDE stated that the goal was to see a decline in the rate of youth concussions within 10 years. Tallying benefits and costs over 10 years would be a better analytical approach.

Establishing a Baseline, Proposal, and Alternatives

Establishing a Baseline

A baseline is the best assessment of the state of the world in the future if a regulatory change is not adopted. A baseline measurement gives an analyst something against which to measure different regulatory alternatives.

This baseline is not necessarily the status quo—that is, it is not simply the current state of the world. Rather, a baseline takes any other external forces or future trends into account. A good baseline is our best guess *of how the future would look* in the absence of the policy change under consideration. Establishing accurate baseline measurements is important because a policy analysis attempts to measure the impact that the regulatory change—and only the regulatory change—has on society.

Proposed Action

Ultimately, a policy analysis presents an evaluation of the societal effect of an agency's proposed policy change, as well as the alternative approaches that the agency considered before arriving at that proposed action. In addition to being good economic practice, these items – an evaluation of effects and a description of alternative approaches considered – are required by statute and under EO 15-07. Any regulatory action proposed by an agency should be clearly outlined in plain and simple language minimizing the use of technical language or jargon. This proposed regulatory action will be measured against the baseline to determine the overall societal effect the policy will have on Rhode Island.

Hypothetical B: Youth Sports Concussions
What is the baseline and effect of the proposal?

The easiest measure would be to take the current rate of concussions in youth sports.

However, this rate has been decreasing at about 3% per year as knowledge about the dangers of concussions spreads.

You find data that indicates that a similar policy in Michigan decreased concussion rates by 17% within five years of adoption.

You decide that the baseline should be a steady 3% decrease, and the proposed action should be measured as a 17% decrease every five years. These assumptions should be clearly stated in the analysis.

Youth Sports Concussions
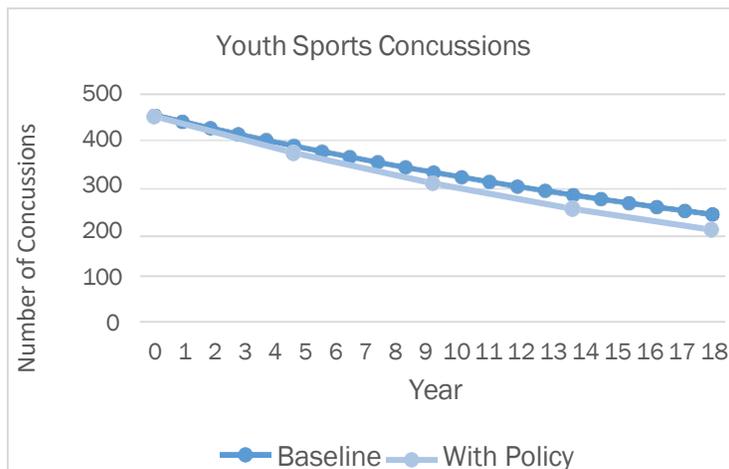
Identifying Stakeholders

Since the goal of the regulatory analysis is to evaluate all the societal benefits and costs of a regulatory change, it is necessary to identify all stakeholders whom the regulation would directly and/or indirectly impact. Affected stakeholders can include government agencies, private businesses, and individual citizens and consumers.

Some stakeholders will be obvious, but a good analysis should try to capture the full range of affected stakeholder groups. For example, it is generally not sufficient to include "business" as a singular stakeholder — rather, careful consideration should be given as to whether some businesses are impacted differently than others.

Below are some examples of regulatory stakeholders, as well as some questions that can suggest ways they may be affected by a regulatory change:

Type of Stakeholder	Key Questions to Identify Stakeholders
State government agencies	• Which agencies will be affected by this rule change, either directly or indirectly? • Will any other agencies need to devote more/less time or resources [to work] due to this change?
Local governments	• How are city and local governments—as well as their departments and agencies— affected by this regulatory change? • Are some localities affected differently than others?
Private businesses and organizations	• Which businesses will be primarily affected, either directly or indirectly? • Are some firms affected more than others? • Will they need to purchase licenses or new equipment? Will compliance impose fiscal and/or temporal costs, and if so, how significant will they be? • Will they face changes in prices, quantity supplied, and/or quantity demanded? • What secondary businesses are affected by the cost changes, if any, among primary businesses? • Are any other private organizations, such as nonprofits, affected by this rule change?
Individuals, consumers, and constituencies	• How are individuals affected by this change? • Are some individuals affected differently—either due to geographic location, socioeconomic status, or other demographic differences, etc.? • Do some consumers face different benefits or costs? • Will the regulation have any direct or indirect effects on the prices of goods and services?

When identifying stakeholders, it is important to consider how the regulatory change will impact the relationship between incentives and behavior. When a policy intervention occurs, it brings about macro-level changes in the regulatory environment. Each regulatory change also changes the incentive structures that influence micro-level actions, as stakeholders, guided by their rational self-interest, adjust their behavior and decision-making processes. The examination of stakeholders should thus consider the broader environment of existing laws, social norms, and market failures. Finally, consider both direct and indirect effects of the policy on the individuals, households, firms,

and any other relevant stakeholder groups.

Hypothetical A: Logging Permits
Who are the stakeholders?
You identify six stakeholder groups: 1) Rhode Island Department of Environmental Management, 2) environmental advocacy groups, 3) property owners with commercial property intended for logging, 4) residential property owners who want to log their own property, 5) workers and businesses that perform logging operations, and 6) consumers of raw timber.

With a complete list of stakeholders, it is possible to identify each of the benefits and costs for analysis, as well as potential data sources to assist with the quantification of these benefits and costs. Even if you are not certain of the effects of policy on a given stakeholder, you should include the stakeholder on the list and suggest some of the ways the group may be affected.

Identifying Benefits and Costs

After identifying the relevant stakeholders, list the benefits and costs that accrue to each of these groups. You should view the regulatory change from the perspective of each stakeholder:
- What benefits and costs—monetary and non-monetary, direct and indirect—will each stakeholder face with the enactment of the regulation change?
- When do each of these benefits and costs occur?

The goal is to identify the marginal benefits and costs caused by the policy: what incremental increase or decrease in benefits or costs can be directly attributed to the policy, rather than external forces?

The analysis should list the benefits and costs and describe each one. This list should be as comprehensive as possible: it should include the benefits and costs that are known and easily quantifiable, as well as benefits and costs that are uncertain and difficult to measure.

Benefits
Benefits are often the easiest parts of a policy analysis to identify—after all, these benefits provide the motivation for the regulatory change in the first place—but they can be difficult to quantify. When identifying and listing the benefits of a regulatory alternative, try to identify all the direct and ancillary benefits that accrue to each stakeholder.
- *Direct benefits* occur as first-order results of the regulatory change. These direct benefits can take many forms and may accrue to many different stakeholders in different ways.
- *Ancillary benefits* are unrelated to the stated goal of the regulatory change, but nonetheless lead to a societal benefit. Since the goal of regulatory analysis is to estimate the total societal effect of a policy change, ancillary benefits should be identified and quantified when possible.

Additionally, when considering the types of stakeholders and their associated benefits, be sure to recognize the potential for transfers between state government agencies, local governments, and the regulated public. Transfers occur when there is a financial transaction between the government and the individuals or entities that result in the redistribution of resources. These transfers are an important component of the overall fiscal impact of a regulation. While these types of transfers may

be discussed in the benefit-cost analysis, any fiscal impacts to state or local government budgets through the change in expenditures or revenues must be analyzed in the agency's fiscal note. Transfers are covered in greater detail beginning on page 13.

Type of Stakeholder	Key Questions to Identify Benefits
Private businesses and organizations	• Do compliance costs decrease? • Can firms expect to increase revenue? • Are markets affected in a way that increases efficiency or alters the prices that firms face?
Individuals, consumers, and constituencies	• Are prices, quality, or the availability of goods and services impacted by the regulatory change? • Are health and safety outcomes affected in a positive way? • What is the impact of the regulation on risk and uncertainty? • Are there positive distributional or equity impacts?
State government agencies*	• Are government expenditures decreasing due to this regulation change? • How will revenue change? • Do streamlined processes lead to saved time or resources?
Local governments*	• Will local governments see decreased expenditures or higher revenue?

* While it may be appropriate to discuss the change in revenue (e.g., from taxes, fees) in the benefit-cost analysis, a symmetric transfer can be shown as both a benefit to the government and a cost to consumers. Considering these questions is a crucial component to understanding the impacts of the regulation and communicating the agency's decision-making calculus to the regulated public. This transfer must be analyzed in the agency's accompanying fiscal note.

An additional consideration is the difference between total revenue and profit. Profit rises if total revenue rises and/or the total costs decrease, assuming total revenue exceeds total costs. There is also a difference between accounting profit (which the regulated firm is more concerned with) and economic profit (which, if the market is competitive, should be zero in the long run).

Some scenarios where higher profits could occur include:

- Increase in price
- Increase in quantity demanded
- Decrease in costs of production (lower labor costs, including wages or labor hours necessary to produce; technological improvements promote efficiency, etc.)
- Gains from trade or comparative advantage
- Introduction of economies of scope or economies of scale

Hypothetical B: Youth Sports Concussions
What are the benefits?
The main benefit is a certain number of concussions avoided per year. Remember, this number should be the difference between your policy proposal and your baseline.

Costs

Quantifying costs in a regulatory analysis is often more straightforward than assessing benefits. However, the identification of the full range of costs becomes intricate when considering the potential unintended consequences of regulatory actions. In delineating the costs associated with a regulatory alternative, it is essential to scrutinize and enumerate all direct, indirect, and potential unintended consequences affecting each stakeholder.

Direct costs encompass the expenses tied to the implementation, administration, and enforcement of a regulation. Additionally, direct costs account for the financial implications borne by businesses and individuals directly impacted by the regulation. This includes initial start-up costs, recurring annual costs, and termination costs linked to concluding a project.

Indirect costs extend beyond the immediate financial outlays. They involve the portion of an office's administrative budget utilized and the opportunity cost of affected resources*:*

- *Opportunity cost* represents the value of the next best alternative use of resources – a measure of the option forgone in favor of the regulation. It considers the highest-valued alternative use of resources, such as employee time or office resources redirected to the project under consideration. For instance, if a regulatory change necessitates an agency employee to allocate more time to a specific task, the value of this additional time should be considered as a cost, given that the employee's time could have been utilized elsewhere.

- *Costs of reduced competition and substitution effects* should be identified and measured when possible. Regulations that alter competition in markets, such as those that increase barriers to entry, reduce the number of participants in a market, or raise the prices of goods and services, may have rippling effects on related industries. Please refer to Appendix A for more information.

- *Unintended consequences* denote costs or inefficiencies resulting from the regulatory change that were not intended effects aligned with the policy's normative goals. These consequences represent outcomes that deviate from the anticipated impacts of the regulatory alteration.

Navigating the intricacies of costs involves a comprehensive examination of these categories, ensuring a nuanced understanding of both the direct financial implications and the broader, often subtle, effects on stakeholders and industries.

Type of Stakeholder	Key Questions to Identify Costs
Private businesses and organizations	• Are there initial costs to plan, train, or otherwise prepare for the regulation? • Do firms face license fees or charges? • Are there higher costs due to equipment or other requirements? • Are there compliance costs associated with inspections, record-keeping, or auditing? • Will firms face higher prices or lost sales due to changes to the market?
Individuals, consumers, and constituencies	• Will consumers face higher prices for goods or services? • Will consumers see a reduced range of available products? • Will consumers experience an increased risk of negative health or safety effects?
State government agencies*	• What administrative and/or implementation costs do agencies incur in the execution of the proposed regulation or program? • Will employees need to be trained? • Are there processes that use employee time or other resources (e.g., application approvals, inspections, investigations, prosecutions, audits, and monitoring?)
Local governments*	• Will local governments face any additional costs? • Will local governments need to devote more time or resources to meet the regulation? • Will it alter local government revenue streams?

* As highlighted in the benefits section, impacts to these stakeholders may be discussed in the benefit-cost analysis but should be done so through the lens of a transfer. The full analysis of impacts to these government entities is conducted in the fiscal note.

Unintended Consequences

As noted above, unintended consequences can be a cost that must be accounted for in a benefit-cost analysis. But how can you anticipate those consequences, especially if they are unintended?

- *Substantive surprises* – Simply put, if the substance—the facts—around which the analysis exists are incorrect, there can be unintended consequences. In the concussion example, if the analysis overestimates the supply of paramedics available to work at athletic events, then the policy could result in staffing shortages that harm emergency medical services.

- *Unexpected incentives, for both individuals and firms* – Most policies try to affect behavior, often by changing incentives. These incentives can be at the person level, or at the level of a business or organization. A tax on cigarettes, for example, attempts to make smoking expensive so that smokers decrease their consumption of cigarettes or quit altogether. Failing to think through incentives, especially the less obvious ones, can be disastrous. In the concussion example, what if the policy creates incentives for players or coaches to underreport concussions? The problem could worsen.

- *Implementation problems* – Implementing a policy or regulation is often the hardest part of the process. A policy should be written with the implementation phase in mind. If the logging permits in our forestry example only allowed for an in-person cash payment, logging operations could potentially grind to a halt as property owners clog up the DEM offices.

- *System issues* -- This is related to implementation but takes a broader view. Policies are not created in a vacuum but rely on larger systems. If the system that trains paramedics to administer concussion protocols is inadequate, then mandating their presence on the sidelines will not do much good.

Thinking About How Benefits and Costs Are Distributed

Outlining all the stakeholders offers the advantage of considering how the various benefits and costs fall on each group differently. For example, a policy might have the goal of helping all car owners, and you identified owners of SUVs and owners of sedans as two different stakeholder groups. If the costs fall mostly on sedan owners, whereas the benefits accrue mostly to SUV owners, this should be noted in the analysis.

While not all policy changes must impact everyone equally, it remains important to clarify how cost and benefits are distributed to each stakeholder group. If a policy is burdensome to a group–especially a group that is often protected by law, such as those in poverty or small business owners—it should be reconsidered.

The Difference between Transfers and Benefits/Costs

Transfer payments are monetary payments from one group to another that do not affect total resources in Rhode Island. Transfer payments do not count toward net costs or benefits as the resources on each side have not changed. However, the effects of transfer payments can generate real costs or benefits.

For example, in the logging example noted below, the $5 permit fee is counted as a transfer from applicants to DEM. However, the permitting program may still yield societal benefits in the form of health and safety benefits, and costs in the form of time and travel expenses needed to obtain the license.

Each side of a transfer payment can be documented in the benefit and cost sections of a regulatory analysis and should always at minimum be listed in a separate section regarding transfers so that the regulation's distributional and equity effects are examined. Transfer payments often appear to be costs or benefits at an individual stakeholder level. However, when considering all the stakeholders in Rhode Island as a whole, transfer payments sum to zero.

The fiscal note should reflect the sum of costs and benefits to state and municipal governments. Thus, only the half of a transfer which occurs as a benefit or cost to state government should be shown in the fiscal note, as well as any other non-transfer costs or benefits. For example, the fiscal note and regulatory analysis should document the administrative costs associated with enforcing the regulation, such as training, the deployment of any necessary capital equipment (e.g., computers, database creation), and additional work hours, addressed either through an increased workload for existing workers or through hiring new workers. If the workload for existing workers is not expected to increase as a result of the proposed change, the fiscal note should explain this.

Consider the following examples of transfers:

Transfer Nets to Zero	Cost to _____	Benefit to _____
Fee to agency for service provided	Fee-payer/consumer	Government agency
Payment by RI government for private services	Government agency	Service provider
Transfer of resources between firms	Some firms increase their sales	Some firms decrease their sales
Transfer of resources between consumers	Some individuals consume less or face higher prices	Some individuals consume more or face lower prices

Hypothetical A: Logging Permits

What are the benefits and costs? Are there any transfers?

The $5 permit fee represents a direct $5 cost for applicants, and a $5 benefit to DEM. It is thus a *transfer* from applicants to DEM and has a net-zero effect. This transfer should not be ignored: the benefits and costs should be shown as summing to zero in the analysis. This can be accomplished by noting the transaction in a "transfer" section of the analysis, and/or documenting it in both the benefit and cost sections.

People will also have to spend time complying with the permitting regulation, and this time should be included as a cost. This can be estimated as the opportunity cost of people's time, that is, the next highest value of their time foregone. This further cost is counted because the additional time and travel needed to complete and otherwise comply with the permit application impact overall Rhode Island resources. The average hourly wage in Rhode Island, multiplied by the expected amount of time an individual would spend completing and filing the application, approximates this opportunity cost.

Here, we will assume that the average wage is $30 an hour, and each permit requires two hours of time to complete and file. The opportunity cost per permit is thus estimated to be $60.

Any change in the market price paid by consumers within scope of the analysis as a result of the regulatory change should be reflected as a cost (for price increases) or benefit (for price decreases). You estimate that because the logging permit is fairly simple, the fee is low, and the logging firms operating in Rhode Island have a relatively low market share concentration and do not have substantial market power to set prices in the regional timber market, the regulatory change will have a negligible effect on the market for timber. If compliance costs were sufficiently high, then timber production and/or regulated firms' ability to remain in operation could be negatively impacted, thereby reducing supply. The subsequent increase in the market price paid by the end-users within scope of the analysis (here, Rhode Island firms and households purchasing raw timber harvested within the state) would, in such case, constitute a cost that should be reflected in the benefit-cost analysis.

Considerations for the Fiscal Note

Here, the $5 permit fee creates revenue for the agency, and should be noted as a gain in the fiscal note by calculating (expected) total revenue. Total revenue should be estimated in the fiscal note as the anticipated number of permits issued per fiscal year multiplied by the permit fee (Total Revenue = Quantity * Price).

Salaries and wages paid to workers who live in Rhode Island are also considered transfers, as the transaction is treated a cost to state government and a gain, or benefit, to employees. Any *changes* in payroll costs should be reflected in the fiscal note.

DEM also faces administrative costs to establish a permitting system: DEM must draft forms, create a database, and train employees to administer the process. DEM plans to hire one new full-time staff member and transfer an existing staff member to handle this permitting process. All costs, benefits, and transfers should be noted in DEM's BCA, and the new salary and any new purchases should be documented in the fiscal note.

Quantifying, Estimating, & Monetizing Benefits, Costs, & Transfers

Quantifying benefits and costs are a vital part of benefit-cost analysis — it is what allows you to directly compare alternatives and weigh the benefits and costs against each other.

You should make every effort to quantify each societal cost and benefit by estimating the price and quantity of a benefit/cost by combining a range of information from multiple sources, including:

- Information revealed in the marketplace
- Data collected by government agencies
- Surveys/consultation with stakeholders
- Academic, technical, or professional literatures

The following data are examples that can be used to calculate the amount of a cost or benefit:

Type of Information	Example
Information revealed in the marketplace	The price of a good or service; the amount of a good or service consumed; wages of affected employees
Data collected from government agencies	The number of people affected; values of certain affected assets
Time necessary to complete a task	The time/effort needed to process an application, conduct an inspection, or comply with a regulation
Frequency of an action, cost, or benefit	Yearly, weekly, daily; sporadically, or constantly
Estimated number of stakeholders affected	Number of firms affected, individuals, etc.

Hypothetical B: Youth Sports Concussions		
How can you quantify costs?		
One cost you choose to quantify is how much school districts will spend on paramedic services each year.		
Type of Cost	**Location of Information**	**Amount**
Cost of paying a paramedic	Hourly wage/labor cost of employees used	$25 per hour
Number of athletic games in Rhode Island in one year	Estimates from school data	1,760 games
Average length of a youth athletic event	Estimates provided by youth sports leagues	3 hours per game
$25 per hour x 1,760 games x 3 hours per game = $132,000 per year		

Formal Quantification Methods

Several formal methods, introduced below, can be used to quantify and monetize benefit and costs. These methods rely on the principle of *opportunity cost* to measure the changes a new regulation under review causes.

These methods utilize the concepts of "willingness to pay" and "willingness to accept" to estimate the value that consumers place on a specific benefit (or cost).

- *Willingness to pay* measures the amount a person is willing to pay to receive a benefit or avoid a cost. For example, it is the amount of money a person is willing to pay a noisy neighbor to turn down a loud stereo.

- *Willingness to accept* is a similar concept—it measures the level of compensation a person requires to give up a benefit or receive a cost. For example, it is the amount of money a person is willing to accept from their noisy neighbor to allow that neighbor to play loud music.

We can use estimation methods—such as the **revealed preference method**, the **stated preference method**, or **equivalent analysis**—to arrive at a good approximation of the benefit or cost.

Revealed Preference Method

The preferred method for monetizing benefits and costs relies on revealed preferences. A *revealed preference method* uses market decisions—transactions that have occurred—to demonstrate the monetary value that should be used to generate an estimate for a cost or benefit. This method is preferred because it accurately shows what a person is willing to pay for a benefit/cost.

Hypothetical A: Logging Permits
Using the revealed preference method
Note: The following calculations and assumptions do not reflect actual data and are intended only as a mathematical example.

The normative goal of the logging permits is to ensure the safety of those doing the logging. How can you quantify a concept like safety?

Suppose you find an industry report that says a full set of protective gear (hard hat, boots, eye protection, hearing protection, and gloves) reduces the number of non-fatal injuries by 25%. If the market price of a full set of gear is $3,000, a person is willing to pay that amount to reduce the risk of an accident, or increase safety, by 25%. If you assume that there is a linear relationship between dollars spent and safety, then a person will spend $120 to increase safety by 1%:

Dollar Amount (Value to an Individual of Reducing Non-Fatal Injury Risk by X Percent)	Percent Increase in Safety (Percent Reduction in Risk of One Non-Fatal Injury Occurring)
$3000	25%
Divide by 25, assuming a one-to-one relationship between dollars spent and accidents avoided	
$120	1%

In other words, under these assumptions, a 1% decrease in the risk of a non-fatal logging accident is worth $120 to a person.

Example continues on the next page.

Suppose the following information has been estimated, reasonably assumed, or is known from industry data:
- Permits are expected to decrease the risk of non-fatal injuries by 15%, and the number of fatal injuries by 5%.
- There are, on average, 82 fatal work injuries per 100,000 full-time logging workers each year
- Rhode Island has 70 full-time loggers and no part-time loggers
- Value of a Statistical Life is treated at $9.1 million[1]
- The logging industry is expected to remain the same size for the foreseeable future

Under these conditions and assumptions, the revealed monetized benefit is estimated to be $152,117 per year, as shown below:

For non-fatal injuries,

Dollar Amount (Value to an Individual of Reducing Non-Fatal Injury Risk by X Percent)	Percent Increase in Safety (Percent Reduction in Risk of One Non-Fatal Injury Occurring)
$120	1%
Multiply by 15, assuming a one-to-one relationship	
$1800	15%

$1800 * 70 workers = $126,000
$126,000 is the revealed monetized benefit per year for avoiding non-fatal injuries

For fatal injuries,

$$\frac{82 \; fatal \; work \; injuries}{100,000 \; loggers} * 70 \; loggers$$

= 0.0574 fatal logging injuries per year, before permits are implemented

Because permits are expected to reduce fatal injuries by 5%, the estimated number of fatal logging injuries per year under the permit program is:

$$\frac{82 \; fatal \; work \; injuries}{100,000 \; loggers} * 70 \; loggers * 0.95$$

= 0.05453 fatal logging injuries per year, after permits are implemented

= 0.00287 fatal injuries avoided per year, after permits are implemented

$9,100,000 per statistical life * 0.00287 fatal injuries avoided per year =

$26,117 revealed monetized benefit per year for avoiding fatal injuries

In total, the revealed monetized benefit of the proposed permit regulation is $152,117.

$126,000 + $26,117 = $152,117

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[1] Note that value of a statistical life (VSL) is not the true value of a human life. It simply represents how much society would be willing to spend to prevent one unidentified death and is calculated using stated- and revealed-preference methods (Andersson, 2020). RI currently applies a VSL of $9.1 million.

To use market data, the price revealed in the market must not be subject to market failures: the market should be competitive, it should not have asymmetric information problems, and it should not have positive or negative externalities (see Appendix A for a discussion of these terms).

Stated Preference Method (Contingent Valuation)

The value of a benefit or a cost is not always revealed in a market transaction. Additionally, the price revealed in the market may not reflect the *shadow price,* or true value to society. *Stated preference methods* use surveys of affected groups to identify the *willingness to pay* that can be used in an estimate.

This method relies on a sample of selected stakeholders accurately stating their preferences through a well-constructed survey. This pricing information can then be used to generate an estimate of the benefit or cost. This method should be used cautiously, because it is susceptible to considerable biases: there are often significant differences between people's stated preference versus their actual preference, and surveys—even well-designed ones—can easily skew stated preferences.

Hypothetical B: Youth Sports Concussions
Using the stated preference method
A survey of parents is conducted where the questioned is asked "How much would you pay to have your son or daughter avoid a concussion playing sports?" Note that parents are likely to give an overly high estimate of the value of their children's well-being.

Health and Safety

The hardest benefits and costs to quantify usually occur in the realm of human health and safety. One approach is to look at the value of a statistical life.

Rhode Island uses $9.1 million as the value of a statistical life. If a policy saves lives, the benefit can be calculated as the anticipated number of lives saved or mortalities averted times the $9.1 million.

In addition, future earnings may, in some cases, offer a proxy for monetizing the effects of health and safety measures. If a policy is expected to increase life expectancy, the earnings from those additional years can be counted as a benefit (and the loss of years being able to earn can be counted as a cost).

Hypothetical B: Youth Sports Concussions
Monetizing health and safety
You find a study that says traumatic brain injuries (TBIs) are likely to reduce life expectancy by four years. While not all concussions are a TBI, data indicates that an average of seven TBIs occur each year in Rhode Island. The per capita income in Rhode Island is $30,469. If the regulation prevents one TBI each year, the benefit for the given year is $121,876.

Estimation, Quantification and Research

While it may not be possible to conduct detailed, formal studies on the benefits and costs associated with the regulation change under analysis, it is possible to create reasonable estimates with data that is available.

Prior research conducted by federal agencies, state agencies, or academic and professional publications may offer data or techniques that can be relevant to the analysis. Other Rhode Island

agencies, local academics and organizations, and stakeholder groups may be able to contribute data and suggestions that can help with the estimation of benefits and costs as well. You may even be able to find a benefit-cost analysis conducted by another state or organization that applies to your policy.

However, one policy context rarely generalizes perfectly to another. Before you utilize the benefits quantified in a separately identified report, be sure to state the assumptions made in that analysis, and any differences between the policy environments in Rhode Island and the source analysis.

Creating a Schedule of Benefits and Costs

After identifying and quantifying the costs, benefits, and transfers that are part of a regulatory change, it is useful to place these benefits and costs on a timeline. This timeline should cover the entire timeframe established in the scope of analysis, and should include all the initial, recurring, and termination benefits and costs. Unquantified benefits and costs should be listed to ensure that all the benefits and costs are captured on the schedule.

This schedule will make it easy to see the various benefits and costs that occur over the timeframe of the analysis. It will also make it possible to later adjust future benefits and costs in ways that make them directly comparable with present benefits and costs.

In our logging example, a schedule of benefits, costs, and transfers could look like the following, assuming 150 permits per year:

Hypothetical A: Logging Permits					
Benefit Schedule					
	Year 0	Year 1	Year 2	Year 3	Year 4
DEM					
	$0	$0	$0	$0	$0
Loggers					
Increased safety	$0	$152,117	$152,117	$152,117	$152,117
Individuals					
N/A	$0	$0	$0	$0	$0
Cost Schedule					
	Year 0	Year 1	Year 2	Year 3	Year 4
DEM					
Initial implementation / training costs	-$11,000	$0	$0	$0	$0
Loggers					
Time & travel for permit application	$0	-$9,000	-$9,000	-$9,000	-$9,000
Individuals					
N/A					
Net Benefit	-$11,000	$143,117	$143,117	$143,117	$143,117

Example continued on the next page.

Transfer Schedule					
	Year 0	Year 1	Year 2	Year 3	Year 4
DEM					
Salary for one new employee	$0	-$43,000	-$43,000	-$43,000	-$43,000
Permit fees collected	$0	$750	$750	$750	$750
Loggers					
Permit fees paid	$0	-$750	-$750	-$750	-$750
Individuals					
Salary to new DEM employee	$0	$43,000	$43,000	$43,000	$43,000

This combined schedule of benefits and costs provides a useful summary of the various effects of a regulatory change over time. Be sure to include any supporting calculations and estimates that were used to generate the data used on the schedule.

Discounting and the Time Value of Money

Not all the benefits and costs of a regulatory change occur at the same point in time. For example, a regulatory change may incur most of its costs in the present, with the benefits occurring years later. However, we cannot simply add together these benefits and costs that occur at different times; rather, we must take into account the time value of money.

The time value of money suggests that benefits or costs that occur sooner are generally more valuable than those that occur later. A dollar is worth more today than it will be tomorrow, due to the things it can purchase today or its ability to earn interest.

Discounting is the process of adjusting future benefits and costs by a discount factor, giving the present value of those benefits and costs. The formula for discounting a future amount to its present value is:

$$PV = \frac{FV}{(1 + r)^n}$$
…where FV is the future value amount, *r* is the discount rate, and *n* is the number of time periods (typically years) the benefit or cost is in the future.

The *Discount Rate* is the interest rate used in the discounting formula. It generally represents an estimate of the opportunity cost of pursuing one project over no action. **Policy analysts typically use two discount rates when conducting analyses: 7% and 3%.**

- The estimated rate of return for private capital in the United States, which represents the *opportunity cost* of capital (including real estate, small business, and corporate capital), can generally be estimated at 7%.

- Alternatively, the discount rate used for social costs—often called the *social rate of time preference*—is estimated at 3%.

When conducting an analysis, adjust the benefits and costs with both the 7% and 3% rates to demonstrate the range of the effect of discounting. This switch can easily be done in Microsoft Excel or similar spreadsheet programs.

For example, to calculate the present value of a cost of $100 that is four years into the future using a 7% discount rate, we can find that the present value is:

$$PV = \frac{100}{(1.07)^4} = 76.29$$

The same $100 cost that is four years into the future, adjusted using the 3% discount rate, gives a present value of:

$$PV = \frac{100}{(1.03)^4} = 88.85$$

By adjusting all future costs to a common present value, we can put all the benefits and costs throughout time on a level playing field. This allows us to directly compare these future benefits and costs in the present day by summing the present values of these benefits and costs into a *net present value*.

Use discounting to adjust the values on the schedule of benefits and costs. The analysis should present the un-discounted schedule, as well as the schedule with each of the discount rates applied.

Hypothetical A: Logging Permits			
Net Present Value			
	Net Benefit (undiscounted)	Present Value (3% discount rate)	Present Value (7% discount rate)
Year 0	-$11,000	-$11,000	-$11,000
Year 1	$143,117	$138,948.54	$133,754.21
Year 2	$143,117	$134,901.50	$125,003.93
Year 3	$143,117	$130,972.33	$116,826.10
Year 4	$143,117	$127,157.60	$109,183.27
	Net Value: $561,468	Net Present Value: $520,979.97	Net Present Value: $473,767.51
Using a 3% discount rate, the net present value of this policy is $520,980 over a four-year timeline, while at a 7% discount rate the net present value is $473,768.			

Generally, a positive net present value means the policy has more benefits than costs, and a negative net present value means the policy has more costs than benefits. Theoretically, because a benefit-cost analysis is scoped to the relevant stakeholders (i.e., the regulated public), the proposal with the highest positive net present value is weighed analytically as the having the greatest benefits to society.

Risk and Sensitivity Analysis: Dealing with Uncertainty

Some of the estimates in an analysis may include uncertainty. To test the effect of this uncertainty on an analysis, it is appropriate to conduct a sensitivity analysis. It is important to provide not only the best primary estimate for each benefit or cost, but to also make note of the full range of possible values.

Consider a sensitivity analysis of an earlier example:

Hypothetical B: Youth Sports Concussions				
Sensitivity analysis				
Type of Cost	**Location of Information**	**Initial Estimate**	**Best Case**	**Worst Case**
Cost of paying a paramedic	Hourly wage/labor cost of employees used	$25 per hour	$20 per hour	$38 per hour
Number of athletic games in Rhode Island in one year	Estimates from school data	1,760 games	1,520 games	1,980 games
Average length of a youth athletic event	Estimates provided by youth sports leagues	3 hours per game	2.5 hours per game	3.5 hours per game
	Total	$132,000	$76,000	$263,340

After conducting the initial analysis using what you have determined are standard parameters about the benefit-cost environment for your proposed policy, such as an hourly wage of $25 per hour, it is considered best practice to conduct a sensitivity analysis that projects possible outcomes in a world where reasonable changes to those assumptions occur—for example, where average wage decreases to $20 per hour or increases to $38 per hour. Changing these parameters would impact the net present value of the policy under consideration. Because labor costs increase in a high-wage scenario, total costs would rise. Assuming no other parameters change from the initial analysis, this would decrease the net present value. Conversely, since the low-wage scenario decreases labor costs, the net present value could increase. Reporting these potential outcomes helps the benefit-cost analysis present a more complete picture of the effects of changing—or not changing—a policy.

This analysis should be used on each cost and benefit that has uncertainty. Then input the best-case and worst-case estimates into your benefit-cost model to calculate the entire range of possible net present values.

Developing Alternatives

Benefit-cost analysis is useful not only as a regulation is being finalized, but at the beginning of the regulatory process. It helps assess different policy alternatives that attempt to accomplish the same overall goal. The policy with the *highest net present value,* that is, where the total benefits most exceed the total costs, is usually the best alternative. There are some quick questions you can ask yourself when developing policy alternatives:

Type of Alternative	Key Questions to Identify Alternatives
Alternative established by statute	• What options, choices, or flexibility does the statute give the agency? • What discretion is the agency using when constructing the rule change?
Different degrees of stringency	• Can the agency consider a more stringent standard? Less stringent? • How does stringency affect the size (magnitude) and distribution (across time and/or among stakeholders) of benefits and costs?
Different compliance dates	• Can compliance dates be altered? • Are there differences caused by choosing immediate compliance vs. delayed compliance? • What about different compliance dates for different groups?
Different enforcement methods	• What tools or methods can be used to enforce the rule? • Are there substantial differences between active or passive enforcement mechanisms? • Are there differences between constant and sporadic monitoring?
Varying requirements by firm size	• How does the rule affect firms of different sizes? • Does it affect small businesses differently than large businesses? • Can the rule be designed to treat different firms in different ways?
Varying requirements by geographic region	• How does the rule change affect different regions (e.g., rural vs. urban; coastal vs. inland)? • Will it affect different towns or neighborhoods in different ways? • In what ways can the regulation's design account for these differences?
Market-oriented tools vs. direct controls	• What market-oriented tools—such as taxes, subsidies, or tradable permits—can be used to meet the regulatory goal? • How can performance standards be used instead of design standards? • What direct controls can be used?
Informational measures vs. regulation	• What stakeholder information can be self-reported—or can the agency gather from existing data or revealed preferences—that would encourage better decision-making among individuals?

Specific Alternatives to Consider

Consideration of alternatives in the analysis is not only required but can provide valuable insights. One avenue for comparison is between less stringent and more stringent options, as the rigidity with which a regulation is established can significantly impact its overall societal benefits and costs. Exploring alternative regulatory approaches, such as economic incentives, information disclosure requirements, and performance standards, can sharpen regulators' thinking in crafting an effective, appropriately scoped rule.

Economic Incentives

Rather than mandating specific actions through command-and-control regulations, economic incentive policy tools can represent viable alternatives. Command-and-control regulations are direct regulatory tools that *command* a specific action and *control* this action through enforcement. These regulatory solutions are often obvious approaches to meet the policy goal, but they can be expensive and lead to inefficiency or unintended consequences.

Taxes, subsidies, marketable permits, and shifted legal liability can be strategically employed to achieve regulatory goals by influencing market dynamics and decision-making. Taxes and subsidies alter the prices of goods and services, affecting the quantity of goods and services consumed by the market. Marketable permits and shifted legal liability are economic policy tools that can be used to internalize an externality and encourage affected businesses to alter behavior in an efficient manner.

For instance, a hypothetical scenario involving logging permits illustrates how creating an incentive for property owners to enhance safety can be more effective than imposing strict regulations.

Hypothetical A: Logging Permits
Using economic incentives to improve safety
DEM decides to create a regulation making property owners liable for any costs resulting from logging accidents on their property. Without mandating any kind of permit or safety regulation, DEM has created an incentive for owners to take their own safety precautions to reduce the risk of being liable.

Information Disclosure Requirements

A regulatory goal may be achievable by fixing the amount of information revealed in the marketplace instead of directly intervening in the market. One primary cause of market failure is incomplete or asymmetric information: parties involved in a market transaction do not have sufficient information, or one party has more information than the other party. While command-and-control regulations are often an appealing way to deal with these types of market failures, information disclosure requirements can be used to require parties on either side of a transaction to reveal specific information that will help market participants make well-informed, efficient choices. An example involving youth sports concussions demonstrates how information disclosure can enhance safety without mandating paramedics.

Hypothetical B: Youth Sports Concussions
Using information disclosure to improve safety
While the dangers of concussions are becoming more widely known, some parents are still not informed. Instead of mandating paramedics, RIDE decides to require schools to send home a form to be signed by parents outlining the risk of concussions in youth sports. If the most at-risk athletes choose to forgo certain sports as a result of this information, the concussion rate would fall.

Performance Standards

Performance standards set a specific end goal for the regulation and give stakeholders the flexibility to identify their own means of reaching that standard. These are markedly different from design standards, which specify the system parameters through which a stakeholder must meet a regulatory goal. This approach, demonstrated in a hypothetical scenario involving logging permits, fosters social efficiency and allows regulated entities the freedom to innovate in meeting established standards.

Hypothetical A: Logging Permits
Using performance standards to improve safety
Instead of requiring all property owners to apply for a permit, DEM decides to create performance standards for logging companies themselves. Logging companies that incur more than ten safety violations in a year will be required to have consumers of their services sign a form disclosing their safety record. Logging companies will have an incentive to reduce their violations below this standard.

Performance standards are often more socially efficient and allow a regulated entity the freedom to decide how to meet the standard.

Comparing Alternatives

Comparing Net Present Values

If *net present values* are calculated for each alternative, the best method is to choose the alternative with the highest net present value. This choice is complicated if some alternatives impose radically differing burdens on certain groups, or if there are questions of political or legal feasibility. As a whole, comparing net present value is the most analytical rigorous method to choose a policy alternative. For example, the logging permit options comes out on top in the following analysis:

Hypothetical A: Logging Permits	
Comparing net present values	
	Present Value (3% discount rate, four years)
Logging permits	$520,980
Fines for safety violations	$157,282
Regulations requiring safety gear	$20,938
Mandatory disclosure of poor safety records	-$1,204

Benefit/Cost Ratios

Another method to compare benefits and costs is through a *benefit-cost ratio*. This is calculated by discounting the benefits and costs separately, to create a present value for each. Then divide the discounted benefit present value by the discounted cost present value. If the ratio is greater than one, there are more benefits than costs.

How is this useful if we already have a net present value? A benefit-cost ratio can be used when there are limited resources. The alternative with the highest net present value may have very high benefits, but also very high costs – costs which are greater than the available resources. A benefit-cost ratio will tell you how many benefits the state will receive for every dollar invested. For example, the benefit-cost ratio for the logging example is 12.72, which means that for every $1 in costs, $12.72 in benefits is returned. This calculation is shown below:

Present Value Benefits (3% discount rate)	Present Value Costs (3% discount rate)
$$0 + \frac{152{,}117}{1.03} + \frac{152{,}117}{1.03^2} + \frac{152{,}117}{1.03^3} + \frac{152{,}117}{1.03^4}$$	$$11{,}000 + \frac{9{,}000}{1.03} + \frac{9{,}000}{1.03^2} + \frac{9{,}000}{1.03^3} + \frac{9{,}000}{1.03^4}$$
= \$565,433.86	= \$44,453.89
Benefit Cost Ratio: PV Benefits / PV Costs = \$565,433.86 / \$44,453.89 = **app. 12.72**	

If costs are constrained, the alternative with the highest rate of return, rather than the highest net present value, can be chosen. This caveat is important because relying on a benefit-cost ratio (BCR) alone can obscure the true value to society of choosing one alternative over another. A project with a $2 million NPV and a BCR of $2.20 is generally more valuable than – and thus, preferable to – a project with a $20,000 NPV and a BCR of $2.45.

Cost-Effectiveness Analysis

There is another option if all benefits and costs cannot be quantified. Often, it is the case that costs can be quantified, but not benefits. In that case, a *cost-effectiveness ratio* can be calculated. This ratio divides the cost by an expected benefit. This expected benefit can be expressed in non-monetary units, such as "Number of accidents prevented." The lowest cost-effectiveness ratio indicates the alternative that produces the desired option most cheaply. Thus, in the table below, regulations requiring safety gear would be the preferred regulatory action to reduce the occurrence of traumatic brain injuries, because it requires the least amount of money to prevent a single accident:

Hypothetical B: Youth Sports Concussions	
Comparing cost-effectiveness ratios	
	Cost-effectiveness
Fines for safety violations	$879 per accident prevented
Regulations requiring safety gear	$483 per accident prevented
Mandatory presence of paramedics at all school-sanctioned sports events and practices	$5,067 per accident prevented

Appendix A: Demand and Supply Theory

Producing a meaningful and useful benefit-cost analysis requires you to think like an economist for a short time. Even the most seemingly benign regulation can have profound, unexpected impacts on supply and demand. Since the Rhode Island economy is sensitive to the actions undertaken by state agencies, it is up to regulators to identify and weigh the possible negative and positive outcomes.

The Theory of Demand

The *theory of demand* describes the amount of a good or service a consumer is capable and inclined to buy for a particular transaction. This is a combination of consumers' *willingness to pay* and *ability to pay*. With virtually no exceptions, the relationship between the price of a good and demand is inverse. That is, the more something costs, the less of its consumers will purchase. This is known as the *Law of Demand* or *Theory of Demand*.

This is because as consumers attempt to maximize utility, receiving less for more makes consumers worse off.

For example, given the option to spend $5 for one good or $5 for two of the exact same good, most rational people would choose the latter. This is what is referred to as quantity demanded. Quantity demanded is different from demand (although it is a part of it) in that it describes the amount of a good a consumer is willing and able to pay for at a specific price. In other words, quantity demanded is one specific point on the whole curve, or "demand schedule."

The y-axis represents the cost of a good or service. A higher point on the y-axis represents a higher price. The x-axis represents the number of goods or services purchased by a consumer. A point further to the right on the x-axis represents a higher quantity of goods sold. The red line (the demand curve) is high on its left side and low on its right side.

Every person has their own personal level of demand for a good or service – a maximum willingness to pay for a given amount of a good.

Low Price, High Quantity Demanded; High Price, Low Quantity Demanded

The demand curve shown on the graph is the aggregate, or sum, of all the demand curves across every consumer in society. This, as mentioned previously, is merely a representation of how consumers buy more when the price is low and buy less when the price is high.
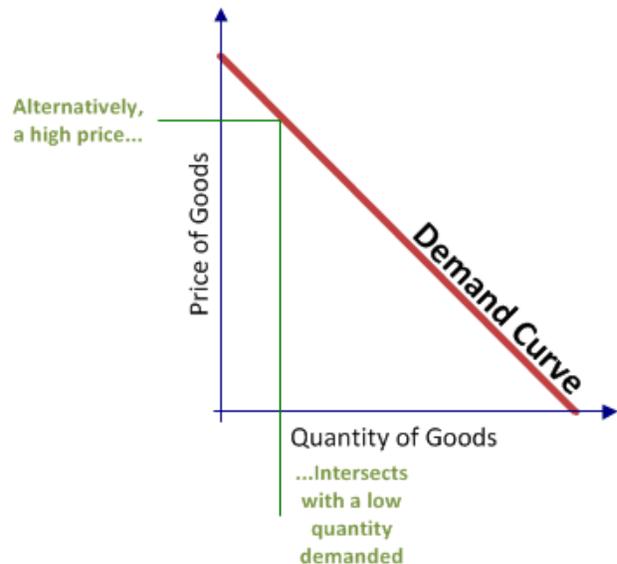
The Theory of Supply

The *theory of supply* describes the amount of a good or service a producer is capable and inclined to sell for a particular transaction.

Typically, the relationship between the price of a good and supply is positive; the higher the sales price, the more the seller will be willing to produce of a good (assuming the market is competitive). For a profit-maximizing firm in a competitive market, the supply curve is the same as the good's marginal cost, that is, the firm's cost of production for each unit of a good. The amount of goods or services provided at a specific price is what is referred to as quantity supplied.

Quantity supplied is distinct from the supply curve in the same way that quantity demanded is distinct from the demand curve. As prices rise, quantity supplied increases, as prices fall, quantity supplied decreases.

Price, Quantity, and Supply

Price of Goods

Supply Curve

As the price rises...

Quantity of Goods

...The number of goods producers supply rises

Supply and Demand Equilibium

Supply Curve

Price of Goods

At this price...

At this point of intersection, consumers and producers agree upon a quantity and price

Demand Curve

Quantity of Goods

...Consumers and producers agree on this quantity

The way in which buyers and sellers reconcile their opposing preferences (upward sloping supply curves and downward sloping demand curves) is what is referred to as a *supply and demand equilibrium*. Simply overlaying the two curves illustrates the relationship between the two.

When the supply curve intersects the demand curve, this represents an agreement between buyers and sellers on how much product to buy/sell and at what price.

This is known as the *market equilibrium* (that small dot in the center of the graph), which is comprised of the *equilibrium quantity* and the *equilibrium price*. You may have heard this point referred to as where the market "clears."

In addition to market equilibrium, another interesting result we can observe from this model is *consumer and producer surplus*. Consumer surplus can be thought of as the total benefit received by consumers who are willing to pay a higher price than what is set by the equilibrium.

To relate to this, imagine you are willing to pay $100 for a good. When you arrive at the store you find the good in question is only $80. Your consumer surplus would be found in the $20 you have left over.

Producer surplus is similar except it refers to an equilibrium selling price being higher than a producer was willing to sell for. A market that has achieved equilibrium also maximizes consumer and producer surplus and is said to be *efficient*. Consumer and producer surplus is different than the more general definition of "surplus" which refers to an amount of excess product.

Supply and Demand Equilibium
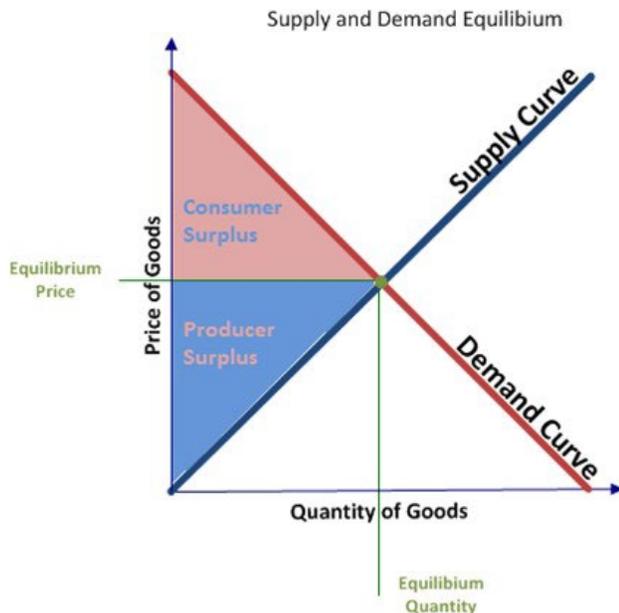
The supply and demand graph represents this outcome visually with shaded areas. Producer surplus can be seen with the triangle-shaped area above the supply curve and below the price. Consumer surplus can be seen with the triangle-shaped area below the demand curve and above the price.

By observing how consumer and producer surpluses change, you can begin recognizing and predicting how a policy change could affect social benefits and costs.

When considering supply and demand, it is important to remember that these curves are not necessarily fixed. While changes in price are demonstrated by movement along a curve (for example, an increase in price going up the supply curve while going down the demand curve), several parameters can shift the entire curves up or down.

IMPORTANT NOTE
For a market to achieve efficient equilibrium, it must be competitive. Competitive markets have four conditions: • Many buyers and sellers, so no one person can set the price. In other words, no one buyer or seller has market power: buyers and sellers are "price-takers" rather than "price-makers"   • Goods that are similar in quality and features (so a consumer actually has a choice)   • Buyers and sellers have the same information about the good or service   • Low barriers to entering and exiting the market, so new sellers can easily choose to enter and leave a market and competition is maintained

Forces That Shift Demand

- Changes in consumer tastes and preferences
  - Should the good become more popular, the demand curve shifts up
  - Should the good become less popular, the demand curve shifts down

- Prices of related goods and services
  - If goods that can replace the good become more expensive, the demand curve shifts up
  - If goods that are used in conjunction with the good become cheaper, the demand curve shifts up
  - If goods that can replace the good become cheaper, the demand curve shifts down
  - If goods that are used in conjunction with the good become more expensive, the demand curve shifts down

- Consumer income
  - If consumer income rises, the demand curve shifts up
  - If consumer income falls, the demand curve shifts down

- Consumer expectations
  - If consumers expect the price of the good to rise, the demand curve shifts up
  - If consumers expect the price of the good to fall, the demand curve shifts down

- Number of consumers
  - If the number of consumers attempting to buy the good rises, the demand curve shifts up
  - If the number of consumers attempting to buy the good falls, the demand curve shifts down

Forces That Shift Supply

- Prices of inputs (Inputs: resources and materials firms need to produce a good or service)
  - If the price of inputs increases, the supply curve shifts up
  - If the price of inputs decreases, the supply curve shifts down

- Number of producers
  - If the number of producers decreases, the supply curve shifts up
  - If the number of producers increases, the supply curve shifts down

- Prices of alternative goods and services
  - If the price for an alternative good (one that a firm is selling other than the original good) decreases, the supply curve shifts up
  - If the price for an alternative good increases, the supply curve shifts down

- Development of technology
  - If technology becomes less efficient, the supply curve shifts up
  - If technology becomes more efficient, the supply curve shifts down

- Producer expectations
  - If the producer expects prices to fall, the supply curve shifts up
  - If the producer expects prices to rise, the supply curve shifts down

Example 1: Removing Logging Permits

Going back to our logging permit example, what if DEM already has logging permits in place, and decides to remove the regulation? This would lower costs for producers of timber. It would also lower what are called *barriers to entry*, which are regulatory or financial burdens that make it hard for new producers to enter the market.

Overall, the lowering of costs and barriers to producers would increase the supply of timber. As the graph shows, the supply curve moves right to indicate this greater supply. The equilibrium price falls, the quantity of goods increases, and the amount of consumer and producer surplus changes.

Demand and Shifted Supply Equilibium
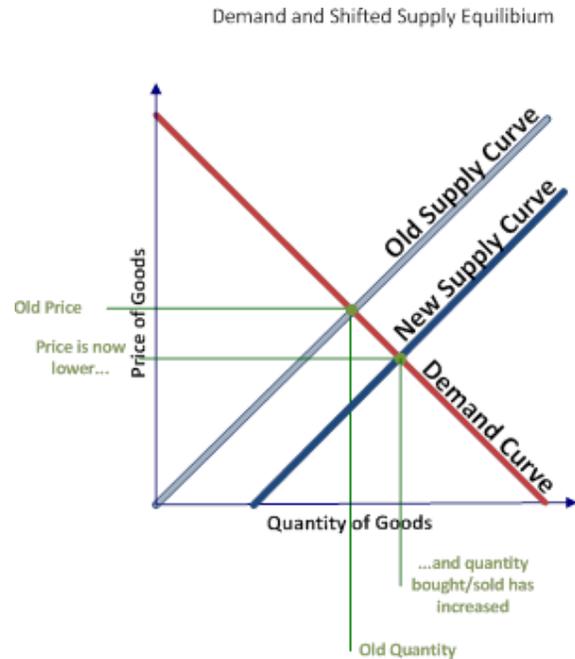
Example 2: Making Timber More Expensive

What if DEM reinstates logging permits, making logging more expensive? If logging is more expensive, then timber is more expensive. As we will see later, if one good becomes more expensive relative to other goods that can substitute for the initial good, the demand for those *substitutes* will rise.

In this example, as wood flooring becomes expensive, the demand for tile flooring would increase (as shown by the demand curve moving to the right). This higher demand creates a higher price, a higher quantity of goods, and changes the amount of surplus for producers and consumers.

Supply and Shifted Demand Equilibium
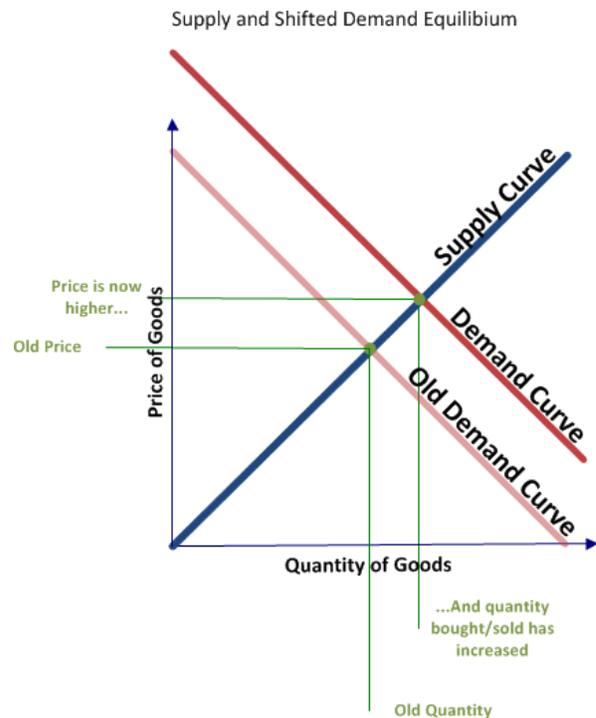
Elasticity

Since we already understand how policies can affect the Rhode Island economy, the question remains: to what extent? *Elasticity* describes sensitivity to changes in a market. While elasticity can be applied to several economic factors, for Rhode Island we really only need to focus on two types to start with:

- Price Elasticity of Demand
- Cross-price Elasticity of Demand

With these types of elasticity, we can begin to measure whether the economic impact of a regulation (which is identified in the long run by using factors that shift supply and demand) is significant or negligible. This is important because were a regulation to affect the price of a good that is not sensitive to changes in price, the economic impact will be better understood as potentially minimal, or alternatively, significant if the good is sensitive to changes in price.

If the supply or demand for a good or service is not sensitive to changes in price, the supply or demand is inelastic. If the supply or demand for a good or service is in fact sensitive to changes in price, the supply or demand is elastic.

Price Elasticity of Demand

Otherwise known as elasticity of demand, this elasticity measures the sensitivity of demand for a good or service to a change in price. Keeping in mind the law of demand (that as price increases, quantity demanded tends to decline), elasticity of demand measures by how much demand changes given changes in price. This is measured as follows:

- Given a 1% *increase* in the price of a good or service, price elasticity of demand is...
    ...elastic if demand for the good or service falls by more than 1%
    ...unit elastic if demand for the good or service falls by exactly 1%
    ...inelastic if demand for the good or service falls by less than 1%

- Given a 1% *decrease* in the price of a good or service, price elasticity of demand is...
    ...elastic if demand for the good or service rises by more than 1%
    ...unit elastic if demand for the good or service rises by exactly 1%
    ...inelastic if demand for the good or service rises by less than 1%

The reason why the quantity demanded may not change significantly given a change in price is primarily due to the nature of the good or service. Products that consumers need, regardless of price, tend to have inelastic demand. Conversely, products that are luxuries or conveniences tend to have more elastic demand. A good way to conceptualize this principle is by remembering examples of elastic and inelastic goods. Typically, a product with elastic demand should be scrutinized very closely if a regulation threatens to affect its price.

Thinking about our previous examples, the demand for paramedic services is probably inelastic. No matter the price, a municipality will need a certain number of paramedics to treat patients in that community. However, the demand for handcrafted wood tables is probably elastic. As the price rises, demand will fall faster because this item is a luxury good that people can do without.

Cross-price Elasticity of Demand

This elasticity is useful in evaluating how a change in the price of a particular good or service affects other goods and services. When beginning to think about this elasticity, consider the relationships between things like paintbrushes and paint, coffee and tea, printers and printer paper. These things are intuitively related; however, the degree to which they are related is the subject of cross-price elasticity.

Complements and Substitutes

There are two different ways in which goods and services can be related. *Complements* are products that are desired by consumers in tandem. When the demand for one rises, the demand for the other tends to rise as well. *Substitutes* are, as the name indicates, goods or services that can be used to replace each other. When the demand for one rises, the demand for the other tends to fall. Cross-price elasticity can be used to determine if goods or services fit into these categories. In addition, cross-price elasticity can also be used to determine if goods and services are unrelated; that is, a change in demand for one has nothing to do with a change in demand for the other.

The factor that influences these changing demands is price. Going back to the above examples, a decrease in the price of paint would increase demand for paintbrushes: they are complementary goods. A decrease in the price of coffee, however, would decrease the demand for tea: they are substitute goods.

Cross-price elasticity of demand is measured as follows:

- Given a 1% *increase* in the price of good or service "A," this means that good or service "B" is...
  - ...a complement if its cross-price elasticity of demand is negative
  - ...a substitute if its cross-price elasticity of demand is positive
  - ...an unrelated good or service if its cross-price elasticity of demand is 0

- Given a 1% *decrease* in the price of good or service "A," this means that good or service "B" is...
  - ...a complement if its cross-price elasticity of demand is positive
  - ...a substitute if its cross-price elasticity of demand is negative
  - ...an unrelated good or service if its cross-price elasticity of demand is 0

Market Failures

One of the most relevant aspects of economics to policy is the idea of market failures. As seen earlier, efficient markets can set an equilibrium price that maximizes both consumer and producer surplus. This efficient market represents the best allocation of resources in that market. Markets, however, can fail. If a market failure exists, there is a strong argument for governmental intervention.

Public Goods and Common Goods

Technically, a *public good* is something that is both non-excludable and non-rivalrous. If something is non-excludable, it is impossible to prevent people from using that good. Non-rivalrous means that one person's consumption does not affect the ability of someone else to use that good.

A good example of a public good is a streetlight. Anyone on a street will benefit from a streetlight, and everyone will benefit equally, no matter how many people are on that street. Having the government provide street lighting makes sense; if buying a street light service was voluntary, some homes might forgo paying while still enjoying the benefits provided by whoever did buy that streetlight. This is known as the free-rider problem, and it is found because public goods are often underprovided by private markets.

A *common good* is also non-excludable but it is rivalrous. This means that everyone can use a good, but one person's use will leave less of that good for the next person. A classic example is fish stocks. There is no way to prevent someone from fishing, especially in a body of water like the ocean. But the more fish one boats catches, the less there will be for the next boat. This is why many governments regulate the kinds and amounts of fish that someone can catch.

	Rival	Non-Rival
Exclusive	Private Goods	Club Goods (e.g., private schools, tolls roads, private beaches, and national parks when not congested)
Non-Exclusive	Common Property Resources	Public Goods (e.g., national parks, lighthouses, national defense)

Externalities

Externalities refer to the effects of a market transaction that extend beyond the immediate parties involved, impacting third parties either positively or negatively.

A notable example of a negative externality is pollution. Consider a town purchasing electricity from a local coal power plant situated downwind in a valley. Despite benefiting from the electricity, the town downwind experiences a decline in its quality of life due to the foul smell emitted by the power plant. If the adverse effects on air quality are not factored into the electricity price, it results in externalities – specifically, a negative externality. Such instances often lead to overconsumption of the good, as the price fails to encompass the complete societal costs of consumption.

Conversely, a positive externality is illustrated by vaccination against diseases. Individuals choose to vaccinate themselves, primarily focusing on the personal decrease in disease risk. However, society benefits by reducing potential transmission points across the population. When the full societal benefit is not considered in individual demand decisions, the good is typically under-consumed from a societal perspective.

Information Asymmetries

Information asymmetry arises when one party possesses more knowledge about the true value of a good than the other in a transaction.

Consider the purchase of a used car as a classic example. If the seller is aware of undisclosed problems with the car, the buyer may end up paying an excessively high price. Conversely, if the buyer knows the car's true value is higher than the asking price, the transaction becomes inefficient. Government disclosure regulations often aim to rectify information asymmetry, ensuring a more equitable exchange of goods and services.

Monopolies

A *monopoly* emerges when a market lacks competition, typically due to high barriers to entry.

In a competitive market, characterized by numerous buyers and sellers offering similar goods with equal information accessibility and low entry barriers, a monopoly stands in contrast. Monopolies result from a single seller controlling the market, allowing them to set prices above the equilibrium and supply quantities below it. Barriers to entry, such as exorbitant startup costs, contribute to monopolistic situations. For instance, utilities often function as monopolies because the extensive infrastructure investment required dissuades new entrants.

While government regulation aims to prevent monopolistic exploitation, there exists a paradox. Excessive regulations can inadvertently create monopolies by acting as barriers to entry. Taxes and regulatory hurdles can favor existing firms over potential new entrants, thereby distorting competition. Striking the right balance in regulation is crucial to maintaining fair market practices.

Appendix B: Additional Resources

US Office of Management and Budget
- Circular A-4 – November 2023

US Environmental Protection Agency
- Guidelines for Preparing Economic Analyses
- Final 2010 Guidelines (Updated 2014)
- EPA FAQ Page on the Guidelines

US Department of Transportation
- Benefit-Cost Analysis Guidance for Discretionary Grant Programs (2023)