The Medical Device Excise Tax: Economic Analysis

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Summary

The 2.3% medical device tax imposed by the Affordable Care Act (ACA; P.L. 111-148) in 2010 was one of a number of additional revenue-raising provisions to finance health reform. This tax, which took effect in January 2013, is projected to collect approximately $38 billion of excise tax revenues over the next 10 years, resulting in $29 billion of net revenues, after accounting for offsets from other taxes.

Some have called for a repeal of the medical device tax since enactment in 2010. Repeal of the tax has become such a high priority for some Members of Congress that it was one of the provisions discussed in the October 2013 negotiations over ending the federal government shutdown and increases in the federal debt ceiling. Repeal, delay, or reform of the tax could be included in future negotiations over the federal budget, debt ceiling, or tax reform.

The major justification offered for the medical device tax is its revenue, which helps offset the cost of the ACA. Although the tax is relatively small, no revenue replacement has been proposed and it may be difficult to find. There is also a concern among some that eliminating the medical device tax would lead to proposals to eliminate similar fees and taxes on other industries, the sum of which, including the device tax, totals $165 billion over 10 years. The tax was justified partly because the medical device industry was among the commercial interests that stood to benefit from unanticipated profits as more individuals enroll in health care insurance, post-ACA.

Viewed from the perspective of traditional economic and tax theory, however, the tax is challenging to justify. In general, tax policy is more efficient when differential excise taxes are not imposed. It is generally more efficient to raise revenue from a broad tax base. Therefore excise taxes are usually based on specific objectives such as discouraging undesirable activities (e.g., tobacco taxes) or funding closely related government spending (e.g., gasoline taxes to finance highway construction). These justifications do not apply, other than weakly, to the medical device case. The tax also imposes administrative and compliance costs that may be disproportionate to revenue.

Opponents of the tax claim that the medical device tax could have significant, negative consequences for the U.S. medical device industry and on jobs. The estimates in this report suggest fairly minor effects, with output and employment in the industry falling by no more than two-tenths of 1%. This limited effect is due to the small tax rate, the exemption of approximately half of output, and the relatively insensitive demand for health services.

The analysis suggests that most of the tax will fall on consumer prices, and not on profits of medical device companies. The effect on the price of health care, however, will most likely be negligible because of the small size of the tax and small share of health care spending attributable to medical devices.

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Introduction

The medical device tax was one of a number of additional revenues proposed to offset the cost of the Affordable Care Act (ACA; P.L. 111-148).[1] This excise tax is projected to collect $38 billion of excise tax revenue over the next 10 years. After offsets due to the deductibility of excise taxes from income and payroll taxes, the medical device tax is estimated to raise net revenues of $29 billion, according to official revenue estimates from the Joint Committee on Taxation (JCT).

While some wish to preserve this revenue source, others have proposed repealing the tax. The industry and some policy institutes have commissioned studies claiming that the excise tax will have significant negative consequences for jobs and innovation in the medical devices industry. Repeal of the tax has become a priority for some Members of Congress. The Senate also voted 79-20 to include repeal of the tax as an amendment to S.Con.Res. 8, the Senate Budget Resolution, on March 21, 2013.[2]

This report reviews the issues surrounding the medical devices tax within the framework of basic principles surrounding the choice of commodities to tax under excise taxes. The next section describes the tax and its legislative origins. After that, the report analyzes the arguments for retaining and repealing the tax.

A Brief Overview of the Medical Device Tax

Since January 1, 2013, manufacturers and importers of final medical devices for sale in the U.S. market have been subject to an excise tax equal to 2.3% of the manufacturer's price.[3] For the purposes of the tax, a "medical device" is defined by the Federal Food, Drug, and Cosmetic Act (21 U.S.C. §321(h)) and pertains to devices "intended for humans."[4]

Congress exempted eyeglasses, contact lenses, and hearing aids from the tax and any other medical device determined by the Secretary of the Treasury to be of the type which is "generally

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[1] The tax was imposed by the Health Care and Education Reconciliation Act of 2010 (HCERA; P.L. 111-152), which modified the ACA.

[2] Bills that have been introduced to repeal the tax include H.R. 532 (Paulsen) and S. 232 (Hatch). H.R. 1259 (Maffei) would eliminate the tax and enact alternative revenue sources. For a discussion of the political background and the lobbying effort by the industry see Michael Hiltzik, "More on the Medical Device Tax: The Lobbying Bonanza," *Los Angeles Times,* October 3, 2013, at http://www.latimes.com/business/hiltzik/la-fi-mh-bonanza-20131003,0,4617480.story#axzz2iewhpfCM; Sarah Kliff, "How Obamacare's Medical Device Tax Became a Top Repeal Target," September 28, *Washington Post's Wonkblog,* at http://www.washingtonpost.com/blogs/wonkblog/wp/2013/09/28/how-obamacares-medical-device-tax-became-a-top-repeal-target/; and "One Industry's Hold on the Senate," Editorial, *New York Times*, April 1, 2013 at http://www.nytimes.com/2013/04/02/opinion/one-industrys-hold-on-the-senate.html?hp&_r=1&.

[3] Excise taxes based on the price of a good are referred to as *ad valorem* tax rates, in contrast to a fixed, per-unit tax rate. For more background on excise taxes, see CRS Report R43189, *Federal Excise Taxes: An Introduction and General Analysis* , by Sean Lowry. The tax is levied on the sales price of the manufacturer, the wholesale price; when manufacturers are also distributors, a price must be constructed. Thus some revenues of medical device manufacturing firms would not be subject to the tax because they reflect the revenues the firms is making is its role as wholesaler.

[4] For more information on regulations relating to the medical devices excise tax, see CRS Report R42971, *The Medical Device Excise Tax: A Legal Overview*, by Andrew Nolan and Internal Revenue Service, "Medical Device Excise Tax: Frequently Asked Questions," at http://www.irs.gov/uac/Medical-Device-Excise-Tax:-Frequently-Asked-Questions.

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purchased by the general public at retail for individual use." The internal revenue code prohibits a tax from being imposed on the sale by a manufacturer of an article for export, or for resale by the purchaser to a second purchaser for export. Thus, medical devices manufactured in the United States and exported abroad are also exempted from tax.

The excise tax is deductible as an ordinary cost of business for firms subject to income tax.[5] If the tax falls on profits this effect reduces the tax, for profitable firms, to about 1.4%.[6] If the tax is passed forward, raising prices, the deduction would offset the firm's revenue gain from the price increase, leaving income tax revenues unchanged (absent effects on quantity) because the tax reduces the amount of income subject to federal income taxes.

Legislative Origins

The medical device tax was enacted by the Health Care and Education Reconciliation Act of 2010 (HCERA; P.L. 111-152), which modified the Patient Protection and Affordable Care Act of 2010 (ACA; P.L. 111-148). Like other revenue-raising measures enacted in ACA, the excise tax on medical devices was meant to help offset the expenditures associated with health care reform (e.g., subsidies for low-income households and small businesses to purchase health care, and funding for programs to promote efficiencies in the market for health care). Additionally, the medical device industry was among one of the commercial interests (as well as health insurance providers and pharmaceutical firms) that stood to benefit from unanticipated profits as more people enrolled in health care, post-ACA.[7] These industries are subject to fees.

This objective of the tax can be inferred from the original Senate proposal. During the early stages of the health care reform debate in 2009, the House and the Senate had different proposals to raise revenue from the medical device industry. The Senate proposed an industry-wide fee based on a firm's gross receipts, similar to the fees that were eventually imposed on drug manufacturers and health insurance providers. In contrast, the House proposed a flat excise tax across all medical device manufacturers; this framework eventually was adopted during the reconciliation process for HCERA/ACA. Even though the intent of the Senate bill might have been to impose the tax on profits, a fixed dollar fee allocated by market share closely approaches an excise tax.[8]

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[5] Firms report their excise tax payments by filing a Form 720 Quarterly Federal Excise Tax Return to the Internal Revenue Service (IRS).

[6] The top federal corporate tax rate of 35% would reduce the tax to 1.5% because federal income taxes would fall by 0.8% of revenues (0.35 times 2.3%) and a small additional reduction would result from the savings in state income taxes.

[7] Sen. Richard Durbin, Remarks on the Floor of the U.S. Senate, *Congressional Record*, vol. 155, part 188 (December 13, 2009), p. S13134; Rachel Bade and Kim Dixon, "Talking About the Medical Device Tax," *Politico*, October 15, 2013; and Paul N. Van de Water, *Excise Tax on Medical Devices Should Not Be Repealed*, Center on Budget and Policy Priorities, October 2, 2013, at http://www.cbpp.org/cms/?fa=view&id=3684.

[8] See CRS Report R40648, *Tax Options for Financing Health Care Reform*, by Jane G. Gravelle, which traces the revenue choices in the legislative history and discusses them.

Revenue Effects

According to the Joint Committee on Taxation (JCT), the medical device tax was estimated to raise $29 billion in revenue over the FY2013 to FY2022 budget window.[9] JCT estimates that the tax raised $1.7 billion in FY2013, which would amount to approximately 1.4% of the sales of medical devices in the United States.[10] This number is for a fiscal year, with the last quarter of calendar year 2013 appearing in FY2014 receipts. The calendar year liability is estimated at $2.4 billion.[11]

The excise tax collections are larger than JCT's net revenue estimates for budgetary purposes.[12] Overall, excise taxes enter as a wedge between aggregate output and income. Because these taxes reduce income, they also reduce income and payroll taxes. JCT uses an offset to estimate net collections, the offset being 24.3% for FY2013.[13] Consequently, the actual revenue collected from the excise tax is estimated at $38 billion over 10 years and $3.1 billion in 2013.[14] Based on these figures, CRS calculates that JCT's revenue estimate projects a taxable base of $135 billion of manufacturers' sales in 2013.[15]

Issues Surrounding the Medical Device Excise Tax

In general, tax policy is considered more efficient when differential excise taxes are not imposed. It is generally more efficient to raise revenue from a broad tax base. Therefore excise taxes are usually justified on specific grounds.

Before discussing these justifications, it should be noted that the medical device tax tends to be a small share of the price of the taxed product, relative to other excise taxes. Most federal excise taxes are levied on a per unit basis, although a few are ad valorem (based on value, not quantity).[16] Fishing and hunting equipment is taxed at either 10% or 11% (except for tackle boxes

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[9] Joint Committee on Taxation, *Description of H.R .436, The Protect Medical Innovation Act of 2011*, JCX-45-12, May 29, 2012, at https://www.jct.gov/publications.html?func=startdown&id=4431.

[10] This calculation is based on the market forecast of $127 billion in sales. Espicom Business Intelligence, *The Medical Device Market: USA*, September 30, 2013, at http://www.espicom.com/usa-medical-device-market.

[11] This number was calculated by taking one-third of the estimate of $1.742 billion for FY2013 and one-fourth of the estimate of $2.562 billion for FY2014, averaging them and adding the result back to the FY2013 total for a $2.352 billion.

[12] In estimating the effect of an excise tax, the JCT assumes the tax is passed on in price to the taxed sector. Because revenue estimating conventions keep output and prices constant, prices fall by the same amount (although typically as negligible as a percent) in other sectors.

[13] See U.S. Congress, Joint Committee on Taxation, *New Income and Payroll Tax Offsets to Changes in Excise Tax Revenues for 2013-2013*, committee print, 113th Cong., 1st sess., February 12, 2013, JCX-5-13 (Washington: GPO, 2013).

[14] These figures represent sales to hospitals, doctors, the federal government, etc., *not* individual consumers. If the markup to consumers is used for the basis for comparison, revenue estimates would compose a smaller share of the purchases of medical devices in the United States.

[15] To adjust from net to gross collections, divide by (1-0.243); thus $29 billion divided by 0.243 is $38 billion. The base of the tax for 2013 is determined by dividing $3.1 by 0.023.

[16] Most excise tax rates can be found on the Internal Revenue Service Form 720. Taxes on alcohol, tobacco and firearms are collected by the Alcohol and Tobacco Tax and Trade Bureau and rates can be found at http://www.ttb.gov/tax_audit/atftaxes.shtml Many excise taxes are levied on a per unit basis, but some are ad valorem (a percentage of price).

taxed at 3%), transportation by air is taxed at 7.5% for persons and 6.5% for property. Large cigars are taxed at 52.75% (with a maximum of slightly over 40 cents). The unit taxes as an estimated share of value vary. Federal cigarette taxes are estimated to be around 16% of the retail price, but if measured on the same basis as the medical device and other taxes (before state and local taxes and on price net of the tax) the tax is more than 36%.[17] Although federal alcohol taxes vary considerably across brands, they are about 4% for wine and beer, and 8% for distilled spirits as a percent of retail price and would be higher on a comparable (net of tax and markups by distributors and retailers) basis.[18] A relatively small tax on medical devices means that economic effects are likely to be small, but also that administration costs relative to revenue are larger.

Arguments for Retaining the Tax

Revenue Needs

Taxes, among other justifications, are primarily for the purpose of raising revenues. One issue with respect to the medical device tax, and considerations of its repeal, is how the revenue loss might be offset, given current concerns about the deficit. The tax is relatively small, but, for political reasons, it may be difficult to find an alternative revenue source.

Perhaps more importantly, the medical device tax is one of a suite of taxes on particular industries adopted to finance the Affordable Care Act including fees on drug manufacturers and importers (estimated to raise $34.2 billion over 10 years), and fees on providers of health insurance (estimated to raise $101.7 billion over 10 years). These fees tend to have similar effects as excise taxes.[19] The "Cadillac" tax on insurers of high cost policies (estimated to raise $111.0 billion over 10 years) is also in the form of an excise tax.[20] The Cadillac tax becomes even more important in the future as it was delayed in taking effect. If there are justifications for eliminating the medical device tax, there may be arguments for eliminating these remaining taxes and fees. Those losses would present a more significant challenge in finding alternative revenue sources.

Taxing Industries that Benefit from Health Reform

A second argument offered for this tax (as well as the fees on other industries) is that the industry will benefit from the increased demand for their product due to the expansion of health insurance coverage in the health reform legislation. The tax might be seen as a way of reducing profits to

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[17] The federal tax is $1.01 per pack. According to the Campaign for Tobacco Free Kids the average price of a pack of cigarettes is $6.03, with $1.82 in state taxes, see http://www.tobaccofreekids.org/research/factsheets/pdf/0202.pdf. The tobacco settlement payment which is the same as a tax is about 43 cents per pack as reported in CRS Report RS22681, *The Cigarette Tax Increase to Finance SCHIP*, by Jane G. Gravelle. When all of these taxes are removed the net of tax price is $2.77, and even this price is too high since it includes wholesale and retail mark up. So the tax as a percent of manufacturers' price is higher.

[18] Sales data were from Standard and Poor's Industry Surveys: Alcoholic Beverages and Tobacco, May, 2013. Data on federal tax revenues were from Alcohol and Tobacco Tax and Trade Bureau, Cumulative Summary, Fourth Quarter FY2012.

[19] See CRS Report R40648, *Tax Options for Financing Health Care Reform*, by Jane G. Gravelle.

[20] See Letter from Thomas A. Barthold, Chief of Staff of the Joint Committee on Taxation, June 15, 2012, at http://waysandmeans.house.gov/uploadedfiles/jct_june_2012_partial_re-estimate_of_tax_provisions_in_aca.pdf; and Senate Finance Committee, "The Affordable Care Act: More than $800 Billion in Tax Cuts," press release, June 29, 2012, at http://www.finance.senate.gov/newsroom/chairman/download/?id=ac4aec3b-1110-4311-9db5-5f9539797a33.

the industry, as well as offsetting any negative effects of the tax on demand. The estimates of the economic effects of the tax, presented further in the report, suggest that the tax will probably not reduce profits, but will likely be passed on in price. It also suggests small effects on output and jobs, which probably would be more than offset by the expansion in demand.

Concerns About the Tax

Is the Tax Justified by General Rationales for Selective Excise Taxes?

Excise taxes have traditionally been collected for distributional effects, as benefit taxes (gasoline taxes which are used for highway construction and maintenance), and to discourage consumption (such as taxes on alcohol and tobacco).[21] Some of these arguments might be applied to justify the medical device excise tax. It is not the first tax to be imposed for purposes of reducing a one-time profit, as the windfall profits tax of the 1980s was in the form of an excise tax on oil.[22]

Some version of the benefit principle (that is, impose taxes on those who benefit from the spending financed by the taxes, as is the case with the gasoline tax) might apply as well. Almost all of the revenue sources in the Affordable Care Act were related to health. As a package, then, an argument may be made that taxes collected overall from consumers of health care might be appropriate to offset new as well as existing health insurance subsidies. Almost all individuals benefit from health care-related subsidies including existing benefits (from not taxing the value of employer provided insurance and Medicare, along with existing subsidies for Medicare and Medicaid) plus new benefits in the health law. The connection between the taxes and benefits, however, is very loose compared to the link between gasoline taxes and highway construction or taxes on firearms and ammunition and wildlife preservation. Some parts of the provision of health care services are not facing new taxes. It is difficult to explain the rationale for the tax based on the benefit principle.

Health care may be over consumed by individuals with health insurance who may face little or no cost of treatment, and often rely on doctors (who recognize there is little cost) to make these decisions. A tax might reduce this effect. The difficulty with this last argument is that the evidence suggests such taxes will be ineffective; they are not likely to alter the weak price signals that occur because consumers rely in part on decisions about their medical care and treatment made by physicians and other health professionals, and because that most of the cost is paid by insurance. This argument may be applied with the most justification to the "Cadillac" tax on excessive health insurance coverage.[23] There are also cases where more health care might be desirable, for example in lower income families where even a deductible or copayment might be unaffordable given competing demands on the budget. Thus the efficiency case for the tax appears weak and the tax may increase inefficiency.

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[21] See J. Fred Giertz, Excise Taxes, *Encyclopedia of Taxation and Tax Policy*, Ed, Joseph J. Cordes, Robert E. Ebel, and Jane G, Gravelle, Washington, DC, 2005, pp. 125-127.

[22] See CRS Report RL34689, *Oil Industry Financial Performance and the Windfall Profits Tax*, by Robert Pirog and Molly F. Sherlock.

[23] See CRS Report R40548, *Legal Issues Relating to the Disposal of Dispensed Controlled Substances*, by Brian T. Yeh, for a discussion of the Cadillac tax.

In general, it appears that some justification for the medical device excise tax could be provided based on traditional economic principles, but the justifications, in most cases, are weak.

Administrative and Compliance Costs

One argument against the tax is that it imposes potentially significant administrative costs. While an extensive analysis of these costs is beyond the scope of this report, this section presents a brief overview.[24]

The medical device tax faces some of the same administrative costs as any other excise tax. Firms must: 1) determine whether they are liable for the tax; 2) determine that the product is the final manufactured good (i.e., no further manufacture will occur), and thus taxable; and 3) trace the supply chain and account for exempt purchasers.

In some ways, compliance with the medical device tax should be easier than compliance with other taxes. The only exempt purchasers involve exports (state and local governments and nonprofits are exempt purchasers of most other products subject to excise taxes).

Compliance may be more difficult than with other excise taxes in other ways. Because the tax is ad valorem (based on value) and some firms are vertically integrated (distribute as well as produce) or sell to related parties, those firms must construct a wholesale price, as that is the price on which the tax is levied. Most excise taxes are unit rather than ad valorem. In addition, although the medical devices tax falls on products already regulated and firms registered with the FDA (which can also share data with the IRS), there are exempt products. Aside from specific exempt products, a complication of the medical device tax is the retail exemption, which is open-ended and arguably unclear. This lack of clarity introduces a different type of complication compared to most other products subject to excise taxes.[25] On occasion, because of the heterogeneous nature of the goods, the final point of manufacture may not be clear (for example, in the assembly of kits, which is addressed in the regulations).

Very little has been written about the cost of excise tax compliance and administration. There is general agreement that taxing manufacturers rather than retailers or households is less costly and limits abuse.[26] One 1989 study in the United Kingdom found very small compliance and administrative costs, of about one-half of 1% of revenues.[27] This relationship would depend on the concentration of the industry (large firms can spread the administrative costs over more

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[24] Some idea of the specific issues associated with the medical device tax can be found in the final regulations, at http://www.gpo.gov/fdsys/pkg/FR-2012-12-07/pdf/2012-29628.pdf. An extensive discussion of the tax and regulations including the retail exemption, see CRS Report R42971, *The Medical Device Excise Tax: A Legal Overview*, by Andrew Nolan. Some of this issues briefly reviewed here are based on Sean W. Rutter, Understanding the Medical Device Excise Tax (MDET), Slideshow, PriceWaterhouseCoopers. May 9, 2012, at http://medsupplychain.org/pdfs/SeanRutter.pdf, and John Monahan and Gary Purpura, Medical Device Excise Tax: Minimization and Compliance, Slideshow, Tax OPs, May 11, 2012.

[25] This issue is discussed in detail in CRS Report R42971, *The Medical Device Excise Tax: A Legal Overview*, by Andrew Nolan.

[26] See Government of Canada, *Excise Act Review*, February 1997, at http://www.fin.gc.ca/earev/eareve.pdf.

[27] Cedric Sanford, Michael Godwin and Peter Hardwick; Administrative and Compliance Costs of Fiscal Publications, Bath,1989. Some discussion and evidence from that study are available on line in Jonathan Haughton Measuring the Compliance Costs of Excise Taxes, Discussion paper 14, African Economic Policy, Funded by the U United States Agency for International Development, 1998, at http://pdf.usaid.gov/pdf_docs/PNACF305.pdf.

products) and the size of the effective tax rate. As discussed earlier, the tax rate for medical devices as a percent of manufacturer's sales is low, and the lower the tax rate, the lower the revenues relative to the value of industry output. Therefore, administrative costs may be higher as a percent of the tax for that reason.

Harmful Economic Effects on the Industry

One argument against the tax is the potentially harmful effects on the medical device industry, including a loss of jobs, a reduction in research and development, and harmful effects on smaller businesses. Some studies have estimated large negative effects from the tax (these are discussed in the **Appendix**). The remainder of this report estimates the likely effects of the tax on prices and output in the medical device industry. This analysis uses estimates of supply and demand response, along with the size of the tax rate itself and the exempt share to project effects on prices and quantity.

This analysis begins with an overview of the medical device industry. That analysis indicates that the industry faces different types of competition depending on product, and that about half of output is exempt from the tax (20% because of exemptions in the domestic market and 38% because exports are exempt).[28]

The next section of the report presents an analysis of the expected economic effects of the medical device excise tax. The analysis suggests the following:

- The tax is likely to be passed forward in prices, falling on consumers, not profits.

- The drop in U.S. output and jobs for medical device producers due to the tax is relatively small, probably no more than 0.2%. These small effects occur in part because the tax is small, in part because demand is estimated to be relatively insensitive to price, and in part because approximately half of production is exempt from the tax.

- With relatively small effects on the U.S. medical device industry, it is unlikely that there will be significant consequences for innovation and for small and mid-sized firms.

- To the extent that the tax does fall on profits, economic theory indicates that there would be no effect on output or jobs. Stockholders, however, would lose money, but that loss would be reduced because of device exemptions and income tax offsets. The tax on U.S. producers would be $1.2 billion in 2013 if the entire tax fell on profits.[29] The tax as a percentage of industry revenues would be 0.9%.[30]

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[28] The exemptions in the domestic market include the specific exemptions for eyeglasses, contact lenses, and hearing aids along with other goods ordinarily sold to customers at retail. Some exemptions might reflect markups in distribution. The 50% calculation assumes that some portion of the exports would have been exempt anyway, so the share taxed is 50%, based on 0.8 times (1-.038).

[29] Calculated as $3.1 billion times (1-0.39) times (1-0.38). The first multiplier accounts for income taxes and the second accounts for exports. This calculation assumes: a) that these firms had taxable income and allowing for the income tax offset, and b) that 38% of U.S. production is exported abroad (thereby exempt from the tax).

[30] Calculated as 2.3% times (1-0.39) times (1-0.38) times (1-0.2). The last term accounts for tax-exempt products.

Some of the technical detail of the analysis is in the **Appendix** which also contains a section assessing the estimates in other studies of economic impact that tend to project larger effects on jobs and output than the analysis in this report.

The Medical Device Industry

The medical device industry produces a wide range of products. Some products have long been in existence and some are relatively new and are technologically advanced. Although there are a number of firms, output is concentrated in larger firms. Most large firms, both in the United States and abroad, operate on a global basis, and there are significant U.S. exports and imports. As a result, a significant fraction of the tax is projected to be paid on imports from foreign manufacturers (although some of those imports could be from foreign operations of U.S. firms, and some domestic production could be by subsidiaries of foreign firms).

Types of Products

The industry produces a broad range of conventional instruments and supplies such as syringes, needles, catheters, intravenous (IV) pumps, and surgical dressings. It also produces many advanced devices. An S&P Capital IQ ("S&P") survey identifies some specific areas where technologically advanced products have appeared.[31]

- In-vitro diagnostics accounts for about 14% of the global medical devices market and involves systems to test blood, urine, tissue and other bodily fluids. Most of the market is relatively developed although there are new advances in cardiac, HIV, molecular, and companion diagnostics (protein or genetic tests).

- Orthopedics accounts for about 13% of the global medical devices market, where joint replacements (mainly hip and knee) and spinal products are the main products sold.

- Cardiology accounts for about 12% of the global medical devices market, and includes rhythm management devices (such as pacemakers), implantable defibrillators (and similar items), ventricular assist devices, advanced stents, and heart valves.

- Diagnostic imaging accounts for about 8% of the global medical devices market, and includes X-ray equipment, ultrasound computed tomography (CT), positron emission tomography (PET), single photon emission computed tomography (SPECT), magnetic resonance imaging (MRI), nuclear medicine, mammography, and fluoroscopy.

Market Structure

The market for conventional products (such as catheters and needles), according to S&P, is characterized by close competition, with limited profit margins. Many large firms produce conventional items in addition to more sophisticated devices. Products with more advanced

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[31] Phillip Seligman, *Industry Surveys: Healthcare Products & Supplies*, S&P Capital IQ, August 2013.

technology may face less competition and provide larger profits. While production tends to be by large firms, there are niches for smaller and mid-sized firms.

The top five global firms account for 28% of global medical device sales.[32] They include, in order, Johnson and Johnson, GE Healthcare, Siemens, Medtronic, and Philips Healthcare. Siemens is a German company and Philips Healthcare is a Dutch firm. The next five firms accounted for 13% of global sales: Abbott Labs, Covidien, Boston Scientific, Becton Dickinson, and Stryker. Covidien is an Irish firm (but was originally a spin-off from Tyco, a U.S. firm). The next five firms account for 7% of global sales: St. Jude, Baxter, Zimmer, Smith and Nephew, and Biomet. Smith and Nephew is a British firm.

Table 1 shows the distribution of U.S. firms whose principal activity is manufacturing medical supplies and equipment, based on analysis of corporate tax data collected by the Internal Revenue Service (IRS).[33] As seen in **Table 1**, while most firms are relatively small, most output is concentrated in the highest asset classes. The top 1% of firms (by asset size) accounted for approximately 80% of receipts in the industry in 2010.

Table 1. Distribution of Firms and Receipts for Manufacturers of Medical Supplies and Equipment from Tax Returns, 2010

Assets ($millions)	Share of Firms	Cumulative Share of Firms	Share of Receipts	Cumulative Share of Receipts
$0	18.4%	18.4%	1.4%	1.4%
$<0.5	59.0%	77.4%	1.2%	2.6%
$0.5-$1	4.8%	83.1%	0.4%	3.0%
$1-$5	10.4%	93.6%	3.6%	6.6%
$5-$10	1.7%	95.0%	0.8%	7.4%
$10-$25	2.0%	97.0%	2.1%	9.5%
$25-$50	0.9%	97.8%	2.3%	11.8%
$50-$100	0.7%	98.6%	2.8%	14.6%
$100-$250	0.5%	99.0%	3.7%	18.3%
$250-$500	0.3%	99.4%	4.2%	22.5%
$500-$2,500	0.4%	99.8%	21.6%	44.1%
$>2,500	0.2%	100.0%	55.9%	100.0%
Total	100.0%	100.0%	100.0%	100.0%

Source: CRS analysis of data from Internal Revenue Service, Corporate Sourcebook, 2010, Chapter 2, at http://www.irs.gov/uac/SOI-Tax-Stats-Corporation-Tax-Statistics.

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[32] These data are taken from Phillip Seligman, *Industry Surveys: Healthcare Products & Supplies*, S&P Capital IQ, August 2013. In a different list, Baxter was in the top five, moving Philips to sixth place. See Medical Product Outsourcing, *The Top Thirty Global Medical Device Companies*, July 30, 2013, at http://www.mpo-mag.com/issues/2013-07/view_features/the-top-30-global-medical-device-companies-564773/.

[33] **Table 1** does not include firms whose major activity is the manufacture of diagnostic imaging or in-vitro testing devices.

Notes: Data from the firm size category of $0.5 to $1 million should be considered with caution according to the table because of small sample problems. There were 17 firms in the highest assets category, 41 in the next highest category, and over 9,000 firms in total.

Table 2 provides 2011 Census data on U.S. medical device production, exports, and imports, which can be used to derive domestic consumption.[34] As shown in **Table 2**, 38.5% of medical devices produced in the United States were exported abroad, and approximately 37.0% of U.S. consumption of medical devices was composed of foreign imports in 2011. In other words, it could be expected that 37% of excise revenues will be paid on products imported from foreign firms.[35] Note, however, that some imports could come from foreign operations of U.S. firms, and some U.S. production could be from operations of foreign firms in the United States.

Table 2. U.S. Production, Exports, Imports, and Domestic Consumption, 2011

Industry	U.S. Production	Exports	Imports	Net U.S. Consumption	Share of Tax Paid on Foreign Production	Share of Production Exported
	($ billions)					
In-Vitro Diagnostics	$11.5	NA	NA	NA	NA	NA
Electro-Medical, Electrotherapeutic Apparatus	$23.9	$10.3	$8.6	$22.2	38.7%	43.1%
Irradiation Apparatus	$5.7	$4.2	$3.8	$5.3	71.7%	73.7%
Surgical and Medical Instruments	$36.0	$15.0	$10.6	$31.6	33.5%	41.7%
Surgical Appliances and Supplies	$34.7	$9.5	$11.4	$36.9	31.0%	27.3%
Dental Equipment and Supplies	$4.6	$1.4	$1.6	$4.8	33.3%	30.4%
Ophthalmic Goods	$5.3	$2.0	$3.8	$7.1	53.5%	37.8%
Total	$121.7	$46.8	$43.9	$118.8	37.0%	38.5%

Source: CRS analysis of data from U.S. Census Bureau, International Trade Statistics and 2011 Annual Survey of Manufactures.

Notes: Data are by establishment. No data were available for exports and imports in-vitro diagnostics; it was assigned the average export and import share in the totals. Pacemakers and diagnostic imaging devices are included in "electro-medical, electrotherapeutic apparatus" categories. Diagnostic imaging devices could also be included in the "irradiation apparatus" category, depending on the type of imaging device. The North American Industry Classification System (NAICs) categories included in the order of rows in the table are 325413, 334510, 334517, and 339112 through 339115. These categories are also included in *Effects of the Medical Device Excise Tax on the Federal Tax Liability of the Medical Device Industry*, Ernst and Young (Prepared on Behalf of the Advanced Medical Technology Association), November 2012, at http://advamed.org/res.download/14. Exports would be somewhat smaller (33% rather than 38%) if data on exports from trade statistics from the U.S. Department of Commerce and the U.S. International Trade Commission (at http://dataweb.usitc.gov/) were used Exports and imports may also reflect markups from distributors in the supply chain.

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[34] Data in **Table 2** are by establishment whereas data in **Table 1** are by firm. A firm may have many establishments with different activities. For example major oil companies are classified in petroleum refining, but they also extract oil. Establishments are generally engaged in the activities described.

[35] This share assumes that the share of otherwise tax exempt income is similar between imports, exports, and domestic production for domestic consumption.

Some production is also exempt due to the retail and specific exemptions (eyeglasses, contacts and hearing aids), as well as a mark-up for distribution. Assuming a domestic market of $169 billion in 2013, this suggests that JCT's revenue estimate assumes that approximately 20% of the value of medical devices sold in the U.S. market will be exempt from the excise tax.[36]

As noted earlier, based on the data in **Table 2** showing the export share (which is exempt) and the analysis indicating 20% of sales are exempt through the retail exemptions, approximately half of U.S. production is subject to the tax.

Economic Effects

The price and quantity effects of an excise tax as well as how the burden of the tax is potentially divided between above normal profits and consumers is driven by supply and demand in the market and represented in the slopes of those demand and supply curves.[37] Economists normally speak of *elasticities*, or the percentage change in quantity divided by the percentage change in price, when deriving demand and supply curves. In other words, elasticities measure the responsiveness of producers and consumers to changes in price. Any study of the effects of the tax contains explicit or implicit assumptions about these curves.[38]

Figure 1 depicts the market supply and demand curves assumed in this report's analysis, based on theoretical and empirical evidence. (For simplicity of exposition, the demand curve is presented as a straight line.) When a curve is relatively flat (nearly horizontal) it has a very high elasticity. When a curve is relatively steep (nearly vertical) it has a very low elasticity. In **Figure 1**, the market begins at an equilibrium price (P*) and quantity (Q*). The supply curve is horizontal. Making the supply curve very elastic makes output effects in the economy larger because it leads to the full pass through of the price. However, the market is also characterized by a relatively inelastic demand which causes a small effect on output. The demand curve is almost vertical. (These supply and demand relationships are discussed in the **Appendix**). The relationship in **Figure 1** would occur after adjustment to the tax has taken place, and would represent the steady state.

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[36] The medical device industry is not precisely defined. The 20% exemption and the job effects calculated subsequently are based on a study by Battelle, Battelle Technology Partnership Practice, *The Economic Impact of the U.S. Advanced Medical Technology Industry*, Advanced Medical Technology Association (AdvaMed), March 2012, at http://www.chi.org/uploadedFiles/Industry_at_a_glance/BattelleFinalAdvaMedEconomicImpactReportMarch2012.pdf. That study measured the industry at $150 billion in 2009, and assuming a growth rate of 3% would be $169 billion in 2013. There are a number of other estimates of the domestic market size, some that appear smaller such as the $127 billion in Espicom Business Intelligence, *The Medical Device Market: USA*, September 30, 2013, at http://www.espicom.com/usa-medical-device-market.This number is consistent with data in **Table 2** adjusted for two years of growth. Epsicom appears to estimate lower numbers, at least for the global market, than other sources. Their global estimate was about 85% of the estimate of Johnson and Johnson, reported in Phillip Seligman, *Industry Surveys: Healthcare Products & Supplies*, S&P Capital IQ, August 2013. Business receipts from the firms in **Table 1**were $155 billion in 2010, and did not include in vitro diagnostics of at least $10 billion, based on **Table 2**. These data suggest larger numbers.

[37] Economists define "normal profit" as the profit necessary to attract equity capital. A high rate of return (in the form of accounting profits) in the industry does not necessarily imply profits above normal returns because normal profit must compensate for risk.

[38] The change in price as a share of the change in tax is the elasticity of supply divided by the sum of the elasticity of supply and the absolute value of the elasticity of demand. (Demand elasticities are negative.) The change in quantity as a share of the tax is the change in price times the elasticity of demand. (All of these effects are percentages.)

Figure 1. Potential Effect of a Tax on the Medical Devices Market
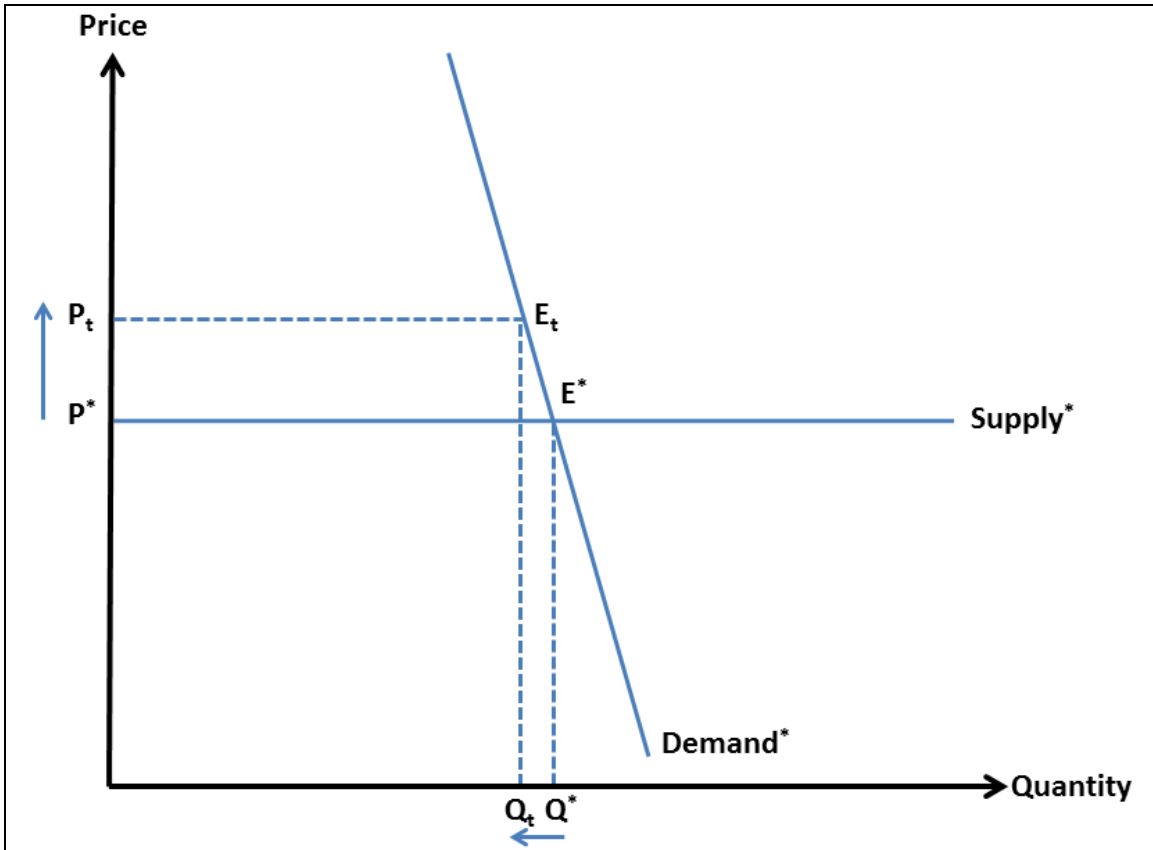
Source: CRS.

Notes: Q is quantity, P is price, and E is the equilibrium price and quantity point. Original values are marked with an asterisk. A t subscript indicates price and quantity after the tax.

The following subsections discuss the evidence supporting a highly elastic supply curve and an inelastic demand curve.

Supply Responses to Price

The medical device market has not previously been subject to an excise tax, thus there are no previous studies that indicate how the firms in the industry react to a tax. Nevertheless, there is reason to believe that the supply curve for this industry is infinitely elastic or close to it in the long run, and therefore that the tax is passed forward into the price. There are several reasons to support this view.

First, as discussed earlier, much of the market, producing ordinary items such as needles and catheters, is described as competitive by the S&P analysis.[39] In the S&P report, which focuses on large publicly traded firms, there are 37 manufacturers of medical devices along with 11 additional firms that produce supplies, along with two other large firms that have a division producing these goods. IRS tax return data show over 9,000 firms producing medical supplies and

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[39] Phillip Seligman, *Industry Surveys: Healthcare Products & Supplies*, S&P Capital IQ, August 2013.

equipment.[40] As shown in **Table 1**, even though production is concentrated at the top, there are still 17 firms in the top asset category and 41 in the second (see Note). In a competitive market, firms earn no profit above the normal return necessary to attract capital (if they did, other firms would enter to exploit it). Economic theory indicates that the market supply curve is perfectly elastic. Since these firms are price-takers, and are not influential enough to affect prices prevailing in the market, they will initially see their normal profits fall, and firms will begin to leave the industry. As quantity contracts, the price will rise (and rise relatively quickly if demand is relatively inelastic) restoring normal profits and stemming the exit of firms.

Second, to the extent that firms have market power, which may be the case for the production of more technologically advanced products, there is not a supply curve *per se* but an optimization of profits by firms that lead to some or all of the tax being passed on in price. As discussed in the **Appendix**, there are theoretical reasons that 100% of the tax could be passed on in price. The adjustment process could begin with raising prices or reducing quantity.

There is also a large body of empirical research on tobacco and, to a lesser extent on alcohol and fuel excise taxes that, while the findings are mixed, tends to indicate these taxes are passed forward in price and, in some cases, with more than 100% of the tax passed forward.[41] These taxes are per unit taxes, rather than ad valorem taxes (taxes as a percent of price), which could explain why more than 100% of the tax is passed forward (see the **Appendix**). Manufacture of cigarettes, in particular, is largely concentrated in a few firms.

There is one caveat to this standard analysis of supply. In the health market there are large purchasers such as hospitals, the federal government, and insurance companies that can exert

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[40] Internal Revenue Service, Corporate Sourcebook, 2010, Chapter 2, at http://www.irs.gov/uac/SOI-Tax-Stats-Corporation-Tax-Statistics.

[41] Some of these studies use differences in state taxes to estimate the pass through and generally, in the cases where they find the producer absorbing part of the tax, it is near the borders where customers from high tax states could purchase in neighboring lower tax states. While these state taxes are collected at retail, most retail businesses operate in a competitive environment which suggests that when part of the tax is not passed on, it is most likely ultimately absorbed by the manufacturer. For recent studies and literature reviews that indicate the tax is largely passed forward in price, see Matthew Harding, Ephraim Leibtag, and Michael F. Lovenheim, The Heterogeneous Geographic and Socioeconomic Incidence of Cigarette Taxes: Evidence from Nielsen Homescan Data, *American Economic Journal: Economic Policy* 2012, 4(4): 169–198, at http://www.stanford.edu/~mch/resources/Harding_CigaretteTaxes.pdf and *The Heterogeneous Geographic and Socioeconomic Incidence of Cigarette and Beer Taxes: Evidence from Nielsen Homescan Data*, March 2010, at http://www.cemmap.ac.uk/resources/scanner_data/sd10_harding.pdf; Douglas J. Young and Agnieszka Bieli´nska–Kwapisz, "The Incidence of Tobacco Taxation: Evidence from Geographic Micro-Level Data," *National Tax Journal*, vol. LV, no. 1, March 2002. Other empirical work finds the federal excise tax more likely to be passed on than state taxes, see P.G. Barnett, T.E. Keeler, and T. Hu, T., 1995, in "Oligopoly Structure and the Incidence of Cigarette Excise Taxes," *Journal of Public Economics,* vol. 57, 1995, 457-470. For gasoline taxes, the literature is more sparse, but one study finds half the federal tax and all of the state tax passed forward. Hayley Chouinard and Jeffrey M Perloff, "Incidence of Federal and State Gasoline Taxes*." Economics Letters*, Volume 83, Issue 1, April 2004, Pages 55-60, at http://are.berkeley.edu/~jperloff/PDF/gastax.pdf. For studies that find that the gasoline excise tax passed forward, see James Alm, Edward Sennoga and Mark Skidmore, *Perfect Competition, Spatial Competition and Tax Incidence in the Retail Gasoline Market*, Fiscal Research Center Report No. 112, September 2005, at http://aysps.gsu.edu/sites/default/files/documents/frc/report112.pdf. Other studies generally find gasoline and diesel fuel taxes passed forward, but diesel fuel tax pass through is sensitive to supply conditions, see Justin Marion and Erich Muehlegger, *Fuel Tax Incidence and Supply Conditions*, National Bureau of Economic Research Working Paper No. 16863, March 2011, at http://www.nber.org/papers/w16863. A recent study suggests that diesel fuel taxes are largely passed forward, with greater passthrough the higher up the tax is in the supply chain. See Wojciech Kopczuk, Justin Marion, Erich Muehlegger, and Joel Slemrod, "Do the Laws of Tax Incidence Hold? Point of Collection and the Pass-through of State Diesel Taxes," National Bureau of Economic Research Working Paper 29410, September, 2013.

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market power. These buyers with market power could resist the pass through of price. However, even if these buyers have been successful in limiting the profits of medical device manufacturers, it does not mean the tax would not be passed on. For example, suppose the market power of large buyers is so great that all higher than normal profits that might be earned by medical device manufacturers are eliminated. Then these medical device firms are in the same circumstance as firms in a competitive market and must pass forward the tax in higher prices (which is a cost, just as wages are a cost) to stay in business. Or if there is market power but still some profits above the normal profit, the effect would be a more elastic individual firm demand curve which, as shown in the **Appendix**, should not affect price pass through.

There are some anecdotal stories to suggest that the tax is being passed forward.[42] In addition, S&P reported on a survey of firms in January 2013 that indicated 42% of firms (presumably large firms that S&P covers) were planning to increase prices, and the remainder had some type of cost cutting procedures in place.[43] Both of these activities are consistent with passing the tax forward in price (where producers can move first on either price or quantity).

Demand Responses to Price

In general the effect on output depends on both supply and demand. If the tax is passed forward in price because the supply curve is perfectly elastic, the effect on output and jobs in the industry depends on the slope (or elasticity) of the demand curve. The smaller the elasticity, the smaller are the effects on output. There is reason to expect that the demand curve for medical devices is relatively inelastic.

Medical devices are generally not final consumer goods, but are rather inputs into delivering health care services to individuals. An individual typically does not purchase a new hip joint directly from the manufacturer; he or she purchases a hip replacement procedure, which involves the joint, the services of doctors in diagnosing and operating, anesthesia, perhaps physical therapy, and other medical devices used in doctors' offices and surgery (e.g., needles, scalpels, and sutures).

The demand for a good that is an input into the provision of the final consumer service depends, in part, on the degree to which that input can be substituted for other inputs. (The derivation of the input demand curve is shown in the **Appendix**.) It is necessary to estimate how the firm using the good as an input (e.g., the hospital or physician) will change its demand as price changes. If all of the components (physicians' services, medical devices, drugs, etc.) must be used in fixed proportions, then the price of any one of them simply raises the price of the final good (e.g., the

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[42] Christopher Weaver, "Device Makers Add Fees to Cover Health Tax," *Wall Street Journal*, January 25, 2013, at http://online.wsj.com/news/articles/SB10001424127887323854904578264170779696696; Cathi Kulat, "Some Medical Device Manufacturers Not Paying Their Share of Health Reform," *The Hill*, October 19, 2012, at http://thehill.com/blogs/congress-blog/healthcare/301887-some-medical-device-manufacturers-not-paying-their-share-of-health-reform#ixzz2j9GfBNzI. Note that in the latter article that the author refers taxes on wheelchairs and canes as an example, but these items are *not* subject to tax under the retail exemption. Anecdotes also indicate that there is some resistance to passing the cost of the tax on to consumers. The "Medical Device Tax Watch" (http://www.devicetaxwatch.com/) is a website created by health care supply firms and other large purchasers of devices that publicly lists companies that are allegedly shifting the tax on to consumers. Note also that these instances are where firms have explicitly stated they are adding on the tax; firms may also simply raise prices without separately stating the tax. The Wall Street Journal article, cited above, suggests that the tax may be "baked in" to new contracts.

[43] Phillip Seligman, *Industry Surveys: Healthcare Products & Supplies*, S&P Capital IQ, August 2013.

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hip replacement service) by the tax rate times the share of the price that reflects the cost of the input. Thus, if 10% of the cost of the hip replacement is the cost of the joint itself, a 2.3% tax on the joint would raise the overall price by 0.23%. If expressing this effect in a demand elasticity, the sensitivity of the final consumer to price would be multiplied by the share of the medical devices in total health costs to get the firm's demand. For example if the demand elasticity for health were -0.5 and the share of devices in total sales were 10%, then the demand elasticity would be -0.5 times 10%, or -0.05. Elasticities can become very small for small inputs.

If other inputs can be substituted for the medical device, then demand for devices will respond to prices through this effect as well and demand for the medical device will be more elastic. The term for measuring this substitution of inputs in response to price is a factor substitution elasticity (percentage change in ratio of inputs divided by the percentage change in the ratio of input prices). As shown in the **Appendix**, the elasticity of demand for an input is the factor substitution elasticity times the share of other inputs plus the consumer demand elasticity for the final consumer product times the share of the input.[44] That is, the overall input demand will be the sum of the final consumer demand elasticity weighted by the share of the input in cost and the factor substitution elasticity weighted by the share of all other inputs in cost.

Factor substitution in the aggregate economy (between capital and labor) has been studied extensively. Although economists often use an elasticity of one (in absolute value) in simulation studies of the aggregate economy, empirical evidence has pointed to a lower value. One review of empirical studies places that aggregate elasticity at -0.5. Thus even the aggregate factor substitution in the economy is probably inelastic. The elasticity would be expected to be smaller in magnitude at the individual firm or industry level.[45]

Demand is less elastic for products with fewer substitutes. Thus, it is likely that the substitution elasticity between medical devices and other inputs into health procedures is extremely small, perhaps approaching zero. For a hip replacement, a joint is necessary, so the only response might be to choose a different type of joint. All joints, however, will be subject to the tax so their relative prices would not change. In addition, for many procedures there is likely little ability to economize on medical devices (for example, sutures), and also little incentive, where economizing is possible, when costs are charged to insurance and are less likely to affect doctors, who largely make these decisions.[46]

The overall demand elasticity for medical devices, therefore, requires an estimate of the consumer demand elasticity, an estimate of the factor substitution elasticity, and the share of medical devices in overall health services. One review of numerous econometric studies found the price elasticity of demand for health services, in general, to be -0.2.[47] If the factor substitution elasticity

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[44] The absolute value of elasticity is $(1-\alpha)S + \alpha Ed$, where α is the share of the medical device in output, S is the absolute value of the factor substitution elasticity and Ed is the absolute value of the demand elasticity.

[45] Jennifer Gravelle, "Corporate Tax Incidence: Review of General Equilibrium Estimates and Analysis*," National Tax Journal*, Vol. 66, March 2013, pp. 185-214.A Congressional Budget Office working paper version can be found at http://cbo.gov/sites/default/files/cbofiles/ftpdocs/115xx/doc11519/05-2010-working_paper-corp_tax_incidence-review_of_gen_eq_estimates.pdf.

[46] Confidentiality clauses may also prevent physicians' knowledge of relative costs. Media reports indicate that some large purchasers are taking steps to help contain rising medical device costs. See Jaimy Lee, "Losing Preferential Treatment," Modern Healthcare, vol. 43, no.7, Feb 18, 2013, pp. 28-30. The more successful this change is, however, the less scope for responding to the tax by using a cheaper device.

[47] Su Liu and Deborah Chollet, *Price and Income Elasticity of the Demand for Health Insurance and Health Care Services: A Critical Review of the Literature*, Mathematica Policy Research, Inc., March 24, 2006, at (continued...)

for medical devices is zero, the demand elasticity for medical devices would be -0.008, based on estimates that medical devices account of 4% of health costs (0.04 times -0.2 is -0.008).[48] It is likely to be smaller as more individuals become covered through health insurance since individuals with health insurance do not face the full price. (Note, however, that the share would vary by procedure. A higher share of the cost of medical devices would likely occur for a hip replacement than for hospitalization for an infection.)

Potential Effects on Output, Jobs, and Innovation

This section of the report analyzes the economic effects of the medical device tax under three sets of assumptions that provide sensitivity to elasticity estimates. First, the analysis considers both no pass through and full pass through of the price, which are the measures that define the possible values of the supply curve elasticity (zero and infinity). If there is no pass through of the tax, there is no effect on consumers and no change in quantity. As noted above the evidence does not appear to support this case. If some of the tax is absorbed by the firm, the firm must have above normal profits, and these profits above the amount required to attract capital will fall.

In the case of full pass through, which appears more likely and where the demand response is relevant, two elasticity assumptions are considered. Both assume that final consumer demand is -0.2. In one, inputs into health services are assumed to be in fixed proportions, the factor substitution elasticity is zero and the demand elasticity is very small, -0.008. In the second case, the factor substitution elasticity is set at the same level as the consumer demand elasticity for health services, -0.2, inelastic and below the economy-wide average, but above the fixed input assumption. This assumption produces a demand elasticity of -0.2 and the demand elasticity set at -0.2. When this last assumption is made, the share of the cost attributable to medical devices is not relevant since both elasticities are the same. The demand may be more elastic for these technologically advanced products which may be a larger part of cost in the lower elasticity case, but there is somewhat more of a possibility that all of the price will not be passed forward, which has overall offsetting effects.

The range of effects from these cases is shown in **Table 3**. With no pass through of the tax in price, there are no effects on output, employment or innovation, since the tax presumably falls on profits. (As noted above, this outcome does not appear realistic.) The effect on profit as a percentage of revenue is reduced because only half of devices are taxed and because of savings in income taxes due to deductions for excise taxes paid. With pass through and inputs fixed and an overall 0.008 demand elasticity the factor substitution elasticity set at zero, the percentage reduction in output for U.S. medical device firms is estimated at 1/100 of 1%.[49] With the factor substitution and overall demand elasticity set at -0.2, the effect is estimated at two-tenths of 1%.[50] The results in **Table 3** when the tax is passed on in profit indicate a range of effects on jobs of almost zero to about 1,200.

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http://www.mathematica-mpr.com/publications/pdfs/priceincome.pdf.

[48] Phillip Seligman, *Industry Surveys: Healthcare Products & Supplies*, S&P Capital IQ, August 2013.

[49] This is the elasticity of 0.008 times 0.80 (to reflect the share taxable) times 0.62 (to reflect the share exported) times 2.3%, the tax rate.

[50] This number repeats the previous calculation using the -0.2 factor substitution elasticity.

**Table 3. Projected Effects of the Medical Device Tax on Profits, Output, and Jobs
in the U.S. Medical Device Industry**

Possible Scenario	Effects on Profits	Effects on Output	Effects on Jobs
Case 1: Medical Device Companies Bear the Entire Burden of the Tax[a]	Profits fall by 0.9% of revenues	No effect	No effect
Case 2: Consumers Bear Burden of the Tax, and are Less Responsive to Price Increases[b]	No effect	Decline of 1/100 of 1%	Job loss of 47 workers (0.01% of industry jobs)
Case 3: Consumers Bear Burden of the Tax, and are More Responsive to Price Increases[c]	No effect	Decline of 2/10 of 1%	Job loss of 1,200 (0.2% of industry jobs)

Source: CRS estimates.

a. Case 1 assumes no price pass through to consumers due to the tax.

b. Case 2 assumes full price pass though, factor substitution elasticity is set at zero, and product demand elasticity is set at -0.2.

c. Case 3 assumes full price pass though, factor substitution elasticity is set at -0.2, and product demand elasticity is set at -0.2.

These elasticities would determine effects on jobs (since there are no changes in relative factor prices for the medical device industry). For the factor substitution elasticity of zero, the job loss is 47, 1/100 of a percent of industry jobs. The effects for the -0.2 elasticity are 1,200 jobs or two-tenths of 1%. These relatively modest effects occur partly because the tax is relatively small, partly because half of output is exempt, and partly because demand is inelastic.[51]

Additionally, some have claimed that the medical device tax will lead companies to offshore operations and reduce employment in the United States as a means to avoid the tax.[52] The tax

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[51] It is also important to note, however, that these changes in jobs and output in the industry, even though they are small, do not reflect a reduction in output or jobs for the economy but rather a shift to some other sector. In the short run, economic analysis suggests that the economy would not likely be affected in the aggregate if the medical device tax were repealed and replaced by another source of revenue; rather, the location of employment would be affected. In the long run, economic theory suggests that there is no reason to view general job creation as an objective of government policies. Even if the workforce in the industry is reduced because of the tax, it is more likely that hiring slowed rather than firing took place. According to industry analysis conducted by S&P, demand for medical devices has been negatively affected due to slow economic growth and higher levels of unemployment in recent years. However, S&P forecasts that an aging population and higher health insurance enrollment (due to health care reform) will expand the industry's customer base in the United States.

[52] For example, see George Will, "Taxing Jobs Out of Existence," *Washington Post*, May 9, 2012, at http://articles.washingtonpost.com/2012-05-09/opinions/35454641_1_medical-devices-state-and-local-taxes-stryker; and Sen. Kelly Ayotte, Remarks on the Floor of the U.S. Senate, *Congressional Record*, vol. 159, part 42 (March 21, 2013), p. S2128, at http://www.gpo.gov/fdsys/pkg/CREC-2013-03-21/pdf/CREC-2013-03-21-pt1-PgS2053-7.pdf. However, media reports indicate that Covidien claimed that the decision was made on the basis of improving the efficiency of its operations rather than the medical device tax. See Zeba Siddiqui, "Covidien to shutter South Carolina plant, lay off 595," *Reuters*, September 13, 2012, at http://www.reuters.com/article/2012/09/13/covidien-plantclosure-idUSnWNAB119720120913; and Rick Foster, "Covidien denies layoffs report," *The Sun Chronicle*, May 11, 2012, at http://www.thesunchronicle.com/mansfield/covidien-denies-layoffs-report/article_a55f54db-b925-5b86-b246-(continued...)

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should have no effect on production location decisions, since both domestically manufactured and imported medical devices are subject to the excise tax.

A number of concerns have been raised about the effects of the tax on research and innovation in the medical device industry. The relatively small effects on the industry suggest that innovation and research would be minimally affected.

Claims have also been made that the small firms in the medical device industry will be disproportionately affected by the excise tax. Particularly, critics of the tax argue that small firms will reduce innovation as cuts to thin profit margins will lead them to reduce investment in research. These critics often note the large share of firms that are small, arguing that smaller firms have greater expenditures on research. They also indicate that smaller firms' profit margins tend to be small.[53] The analysis in this report suggests the effects on small as well as large firms will likely be minimal because the tax is expected to be passed on in price and the decrease in demand would be negligible. As in the case of virtually all industries, the share of firms is concentrated in smaller firms but output and research are concentrated in large ones. As measured by research and experimentation (R&E) credits (reflected in the general business credit)[54] most of the research and development is performed by large firms. The 17 firms with assets of more than $2.5 billion reported in **Table 1** are responsible for 56% of the revenues as well as 56% of the general business credit. Combining these firms with the 41 firms in the next category, firms with over $500 million of assets account for 77% of output and 80% of the R&E credit. While it is true that smaller firms (in part because they are new) have smaller profit margins, in most asset categories, firms tend to have net profits (even for tax purposes) that are larger than net deficits.[55]

In discussing innovation in the medical device industry, it is important to note that innovation for innovation's sake does not always lead to the most efficient economic growth path in the health care industry. Some have argued that the rapid adoption for high-technology equipment and medical procedures has been a significant contributor to rising health care costs in the past.[56]

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136f2178e487.html.

[53] Katie Peralta "Small Device Companies May Bear Biggest Brunt of Controversial Tax," Wall Street Journal Market Watch Blog, October 10, 2013, at http://blogs.marketwatch.com/health-exchange/2013/10/10/small-medical-device-companies-may-bear-biggest-brunt-of-controversial-tax/; and Henry I. Miller, "ObamaCare's Medical Device Tax Will Cost Innovation and Jobs," Forbes, December 17, 2012, at http://www.forbes.com/sites/henrymiller/2012/12/17/obamacares-medical-device-tax-will-cost-innovation-and-jobs/.

[54] Only the general business credit is reported in tax statistics for minor industries, but it is dominated by the R&E credit and R&E is the only credit likely to be claimed by medical device manufacturers.

[55] Calculated from data in Internal Revenue Service Statistics of Income, Corporate Sourcebook, Chapter 2, http://www.irs.gov/uac/SOI-Tax-Stats-Corporation-Source-Book:-U.S.-Total-and-Sectors-Listing. Taxable income tends to be smaller than financial profits before tax because of tax deductions, such as depreciation, that exceed economic depreciation.

[56] Although health care expenditures had been increasing at a rate greater than the growth of GDP for some years, recent data indicate that health care expenditures have been increasing at approximately the same rate as GDP growth in 2011. Explanations for decline in the growth of health care expenditures vary, and coverage of this issue can be found at Sarah Kliff, "Health care costs are growing really slowly. Americans haven't noticed.," *The Washington Post's Wonkblog*, August 20, 2013, at http://www.washingtonpost.com/blogs/wonkblog/wp/2013/08/20/health-costs-are-growing-really-slowly-americans-havent-noticed/; and "The Health Spending Decline," *The Wall Street Journal*, May 12, 2013, at http://online.wsj.com/news/articles/SB10001424127887323744604578470752468155518. For more general discussion on the role of technological innovation on health care costs, and possible policy options, see the "Changing Incentives for Technological Innovation" section in CRS Report RL33759, *Health Care and Markets*, by D. Andrew Austin.

While these technologies could offer absolute gains, in terms of quality-of-life and life expectancy, it is likely that the marginal cost of these new technologies begins to grow at a faster rate than the marginal benefits—resulting in higher costs for smaller gains.

In summary, the analysis in this section suggests that the effects of the current tax on the medical device industry should be relatively small because of the inelastic demand, probably no more than 1,200 employees should lose their jobs in that industry, and industry output and employment should likely decline by no more than two-tenths of a percent. While such losses directly impact the employees and employers, they are negligible for the economy (about 1/1,000 of a percent of the total labor force).

At the same time, one of the popular arguments for retaining the tax (that it will fall on profits of manufacturers), while still possible, appears unlikely. The nature of the industry, profit optimization, and some empirical evidence together suggest that most of the tax will be passed on to consumers in price. Some of this tax will fall on the federal government, which provides financing for some medical care. Even though there may be an expansion in demand that produces additional profits, a tax may be only partly able to offset it.

Appendix. Technical Explanations and Study Reviews

This appendix provides a more technical discussion and a derivation of the relationships used to capture supply and demand in this report. It is intended for the reader who is knowledgeable about economics. Three topics are addressed. The first is an exposition of the supply and demand relationships and how they can be expressed as relationships between the tax, price and quantity. The second presents a discussion of profit maximization with monopoly power (assuming the firm is in an industry characterized by market power). The final section discusses the derivation of the demand function for an intermediate good.

In this appendix, the following notation is used: P (price), Q (quantity), Ed (absolute value of the demand elasticity), Es (supply elasticity) t (tax), c (marginal cost), and S (absolute value of the factor substitution elasticity). A percentage change in x is dx/x. A change in the tax is dt, equal to the tax rate.

Supply and Demand Relationships

Figure A-1 presents the basic supply and demand relationship, showing the shift in price (from P^* to P_t) with a unit tax of t, and the shift in quantity from Q^* to Q_t. The net producer price, after the tax is imposed, is indicated by P_t - t. To simplify, linear demand and supply curves are provided and a per unit rather than an ad valorem tax (imposed as a percentage of price) tax are presented, although in the derivations an ad valorem tax is assumed. For this purpose there is no difference between the two.

To determine the formulas for price and quantity:

The demand relationship is:

(1) dQ/Q = -Ed (dP/P)

The supply relationship where tax is imposed on P, and the net price is P(1-t):

(2) dQ/Q = Es (dP/P- dt/(1-t))

To solve for dP/P, equate (1) and (2) (since the change in supply and demand must be equal) and assume the initial value of t is zero, to obtain:
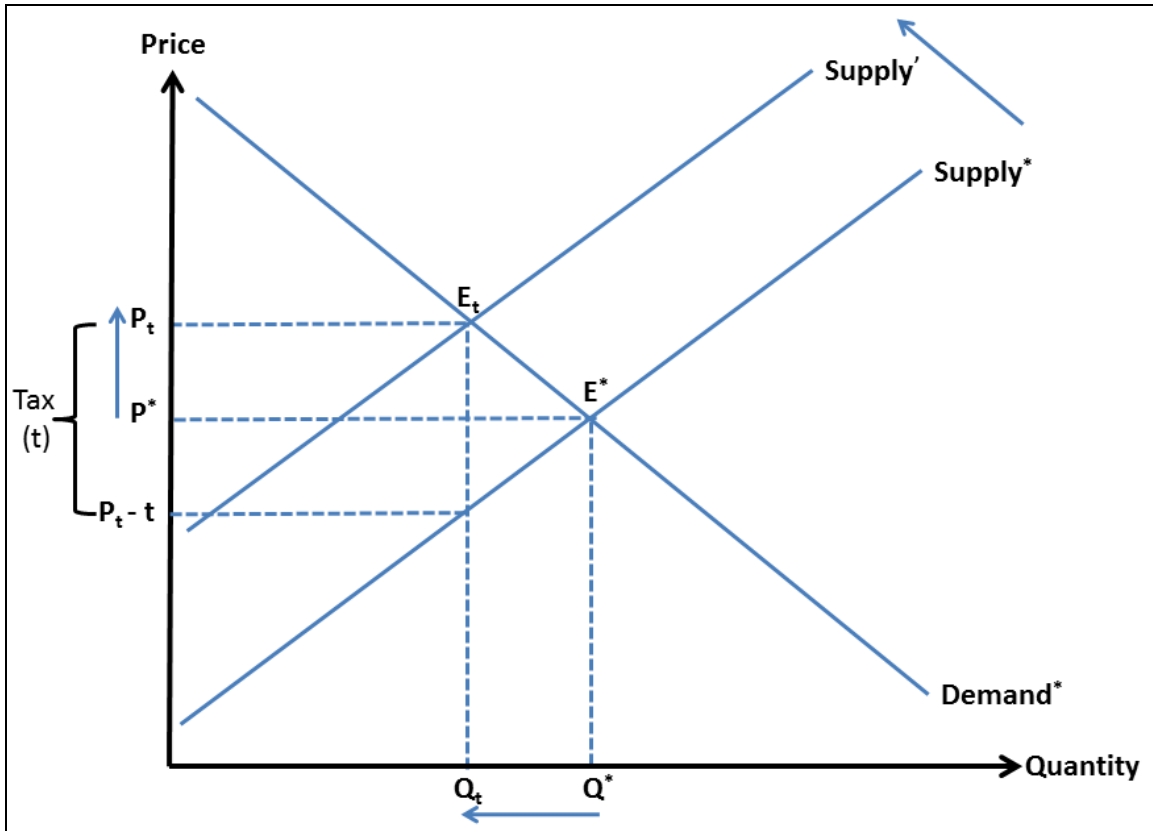
(3) dP/P = (Es/(Es+Ed)) dt

To derive the change in output, substitute (3) into (1) to obtain:

(4) dQ/Q = -(EdEs/(Ed+Es)) dt

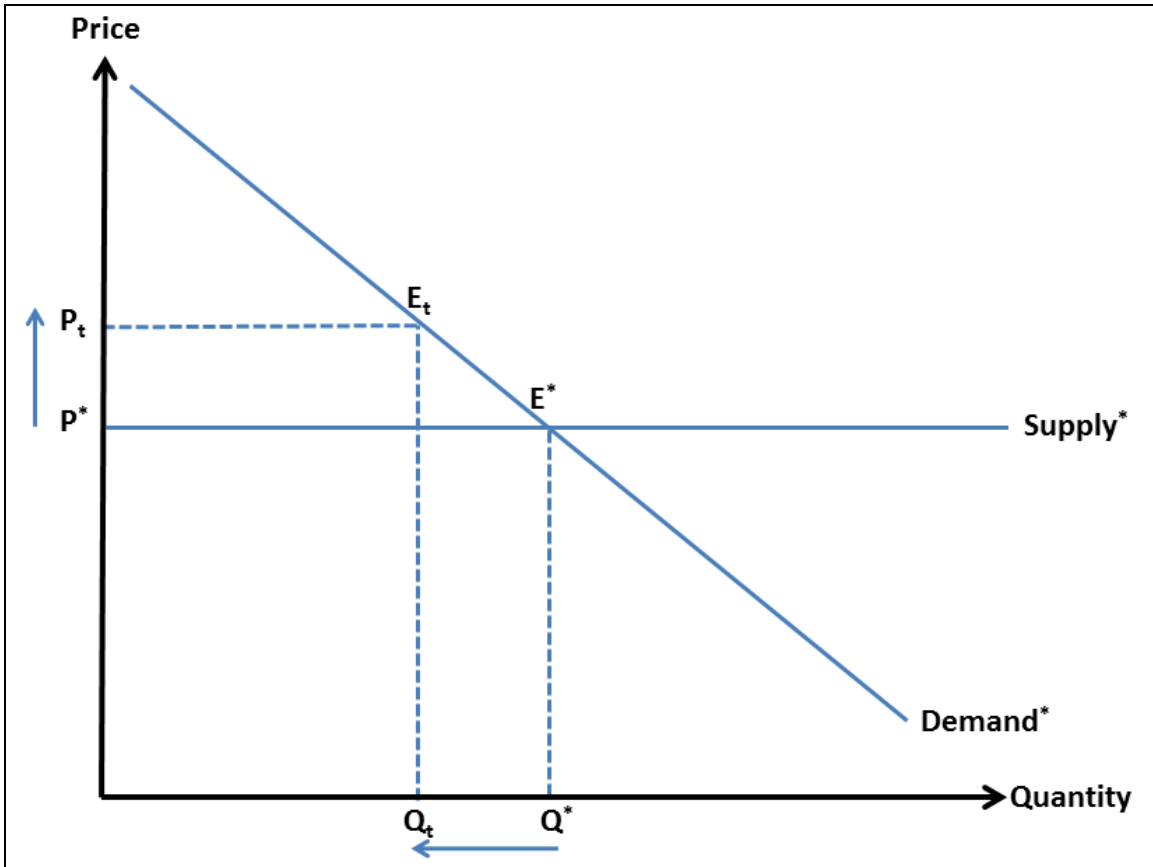**Figure A-1. Tax Adjustment in the Market**

If Es is infinitely large the value Es/(Es+Ed) becomes one, the supply curve is horizontal, and the entire tax is passed on in price, as shown in **Figure A-2**, on the next page.

Figure A-2. Market Equilibrium with an Infinitely Elastic Supply Curve
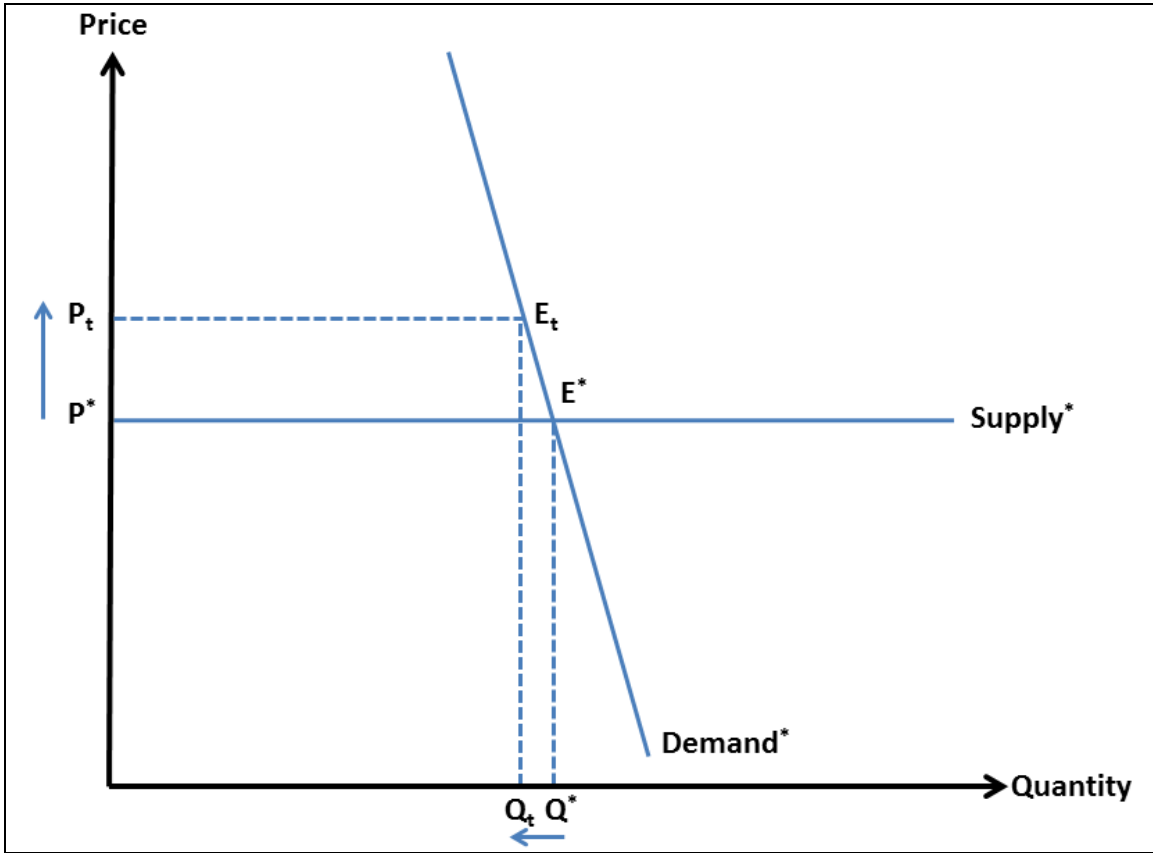

Source: CRS.

With an infinitely elastic supply curve, output change is determined by the slope of the demand curve.

Contrast the effect on quantity change in **Figure A-3**, which has a much more inelastic demand curve.

Figure A-3. Market Equilibrium with an Infinitely Elastic Supply Curve and a Relatively Inelastic Demand Curve

Figure A-3 is the basic type of relationship that analysis and empirical evidence suggest may characterize the medical device market.

Price Pass Through for a Firm with Market Power and Above-Normal Profits

The two extremes of market structure are perfect competition and monopoly. Most market structures lie somewhere in between. In perfect competition, the supply curve is perfectly elastic as increases in output are achieved by new firms entering the industry. Firms have no profits and are price takers (i.e., cannot influence price) and ultimately must pass on any excise tax in cost. Even market structures where there is imperfect competition will still not have profits above the normal return as long as there is entry.

Monopolies rarely exist and they are typically regulated. However, firms may have market power if there are barriers to entry. In this case, an individual firm can be depicted as having a downward sloping demand curve as in the case of a monopolist selling a similar or a differentiated good. Each firm assumes its market conditions are not affected by others, although a contraction in output by one firm, with aggregate demand fixed in the overall market, will

expand demand for other firms. This analysis examines the optimization process for an ad valorem tax in a firm facing a downward sloping demand curve. For a firm with market power, it is reasonable to assume a constant marginal cost (whereas a natural monopoly, such a cable company, tends to have a downward sloping marginal cost curve). A constant marginal cost assumes that firms have constant returns to scale and can produce additional amounts at the same cost. A rising marginal cost curve could also be considered, but it would not change the outcome for passing through the tax.

The firm's profits (Π):

(5) $\Pi = P(Q)Q(1-t) - cQ$

To totally differentiate this equation and obtain the maximum profit, given t:

(6) $(PdQ + QdP)(1-t) - cdQ = 0$

This analysis considers a constant elasticity of demand function:

(7) $Q = AP^{-Ed}$

For this function,

(8) $dQ/Q = -Ed (dP/P)$, or

(9) $dP = -(1/Ed)(P/Q)dQ$.

Substitute (9) into (6) and solve for P:

(10) $P = (Ed/(Ed-1))c/(1-t)$

Compare (10) with and without the tax and the result is that P_t, the price after the tax is compared to the price without the tax, or:

(11) $P_t - P = tP/(1-t)$.

Because the tax is an ad valorem tax, the price rises by slightly more than P_t; for a 2.3% tax, it rises by 2.35%.[57]

Textbooks sometimes teach that a monopolist passes on half of the cost of an excise tax to the consumer and the same analysis would apply to a monopolistic competitor facing a downward sloping demand curve. This outcome, however, is an artifact of a linear demand curve which must intersect the x and y axis.

To solve for the effect with a linear demand curve, the demand function is:

(12) $P = a - bQ$

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[57] Note that had the tax been a unit tax, a fixed tax τ, so that in equation (5) the tax would be added to c rather than subtracted from revenues. In that case the price would go up more than the tax: $P = (Ed/(Ed-1))*(c+\tau)$.

This function can be solved by substituting (16) directly into the profit function:

(13) $\Pi = (a-bQ)*(Q(1-t)) - cQ$

Differentiating (13), holding t constant, and finding the profit maximum,

(14) $(a-2bQ)(1-t) = c$

Solving (14) for Q and substituting it into (12) leads to the price equation:

(15) $P = a/2 + c/(2(1-t))$

With an ad valorem tax the pass through is equal to $(1/2)(t(1-t))*c$ which passes through ½ of the portion of tax on c and thus less than half of the total tax appears in price.

Although the use of a linear demand function is commonly taught in discussing the pass through of taxes (perhaps because it requires simpler mathematics or can be expressed graphically), it is an unlikely demand function. It results in a quantity equal to zero at a finite price, and a quantity equal to a finite amount at a zero price. It is difficult to imagine any utility function that produces a linear demand function. A criticism of the use of this linear demand and its special attributes was made forty-five years ago by Bishop (1968), and Mixon (1986) also criticized textbook writers for continuing to use the linear examples.[58]

There are also demand curves of the log-linear type, such as:

(16) $Q = Ae^{-bP}$

which is a log-linear function (when expressed in logs it is $\ln(Q) = \ln(A) - bP$).

Without repeating the estimates, this function passes through the amount of the tax on c. Although this function is a curve, it still crosses the y axis. If the log linear relationship is reversed, all of the tax is passed forward but the quantity becomes zero at a finite price; it crosses the x axis.

Given the findings with respect to the more appropriate curved demand curve used earlier, it seems more likely that the tax is passed forward in full.

The individual firms' demand curves are more elastic than the aggregate market demand curve. As all firms begin to raise prices, their individual demand curves will shift out due to the actions of other firms, so they will not have to cut production as much and will reach the smaller quantity reductions consistent with a less elastic aggregate market demand. Alternatively, if they begin to adjust by reducing output, the actions of many other firms also reducing output will contribute to pushing up prices (shifting the demand curve out) leading to the appropriate market response.

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[58] Robert L. Bishop, "The Effects of Specific and Ad Valorem Taxes," *The Quarterly Journal of Economics*, Vol. 82, No. 2 (May, 1968), pp. 198-218; and J. Wilson Mixon, Jr., "On the Incidence of Excise Taxes on a Monopolist's Price: A Pedagogical Note," *The Journal of Economic Education*, Vol. 17, No. 3 (Summer, 1986), pp. 201-203.

Derived Demand Elasticities

When a product is an input into further production for a final consumer product, as in the case of medical devices, the demand elasticity in the market must account for that.

For a constant returns to scale, constant elasticity of substitution production function, the first order conditions for choice of a given input Qi, as it relates to its price Pi and the price and quantity for the final product, P and Q, is, denoting S as the absolute value of the factor substitution elasticity's and A as a constant:

(17) $Q_i/Q = A (P_i/P)^{-S}$

Taking logs and differentiating:

(18) $dQ_i/Q_i - dQ/Q = -S(dP_i/P_i - dP/P)$

To substitute for dQ/Q, note that $dQ/Q = -E_d \, dP/P$

Note also that the percentage change in output price is a weighted value of the percentage change in input prices. Since other input prices are held constant, $(dP/P = \alpha \, dP_i/P_i)$, where α is the share of revenue paid to the Qi input. Substituting those values into (21) results in:

(19) $dQ_i/Q_i = -[S(1-\alpha) + \alpha E_d]$.

Discussion of Other Studies of Economic Effects

Several studies have been used to support claims that the tax would reduce employment, reduce incentives for innovation in the U.S. industry, and reduce overall economic output. One study also claimed, in addition to direct effects on the U.S. market, the tax could encourage offshoring of production. As suggested by the analysis in this report, any negative effects on supply and demand are likely to be small. Additionally, assertions that the medical device tax will encourage offshoring of production appear to have no basis in economic theory. These individual studies are reviewed in this section.

Three empirical studies of job effects have been widely-cited by opponents of the medical device tax:

- Furchtgott-Roth and Furchtgott-Roth (hereafter "F-R") in 2011,[59]

- Battelle Technology Partnership Practice in 2012,[60] and

- Ramlet, Book, and Zhong in 2012.[61]

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[59] Diana Furchtgott-Roth and Harold Furchtgott-Roth, Employment Effects of the New Excise Tax on the Medical Device Industry, September 2011, at http://www.chi.org/uploadedFiles/Industry_at_a_glance/ 090711EmploymentEffectofTaxonMedicalDeviceIndustryFINAL.pdf.

[60] Battelle Technology Partnership Practice, *The Economic Impact of the U.S. Advanced Medical Technology Industry*, Advanced Medical Technology Association (AdvaMed), March 2012, at http://www.chi.org/uploadedFiles/ Industry_at_a_glance/BattelleFinalAdvaMedEconomicImpactReportMarch2012.pdf

[61] Michael Ramlet, Robert Book, and Han Zhong ,The Economic Impact of the Medical Device Excise Tax, American (continued...)

The F-R study projects job losses of around 43,000. They begin with estimates of job effects using supply and demand analysis. A range of elasticities were considered: 0.5, 1 and 5 for supply, and -0.5, -1, -3, and -5 for demand. The result is a range of job loss from 2,300 to 23,000. They choose an absolute value of 1 for each, which is the equivalent of passing half the tax on in price and reducing output by on half of the tax change (thus output falls by 50% of the tax or 1.15%). The projected job loss from this analysis is 4,700. Their estimate is based on a lower work force size than the estimate derived above, but because of the larger elasticity and not recognizing that half of output is exempt, is four times the highest job loss estimated in this report. Their job loss of 43,000 is much higher because of an assumption that 10% of the industry's production would move abroad which accounts for almost 90% of the job loss. There appears to be no reason, however, to expect the industry to relocate because of the tax. This tax, as is the case with other excise taxes, is imposed based on consumption in the United States. As long as production serves the U.S. market, firms will be liable for the tax regardless of location. Based on their calculations, only with respect to the output effect from the supply and demand analysis, the domestic market would contract by 1%.

Overall, this study has significant methodological drawbacks because its demand elasticity appears too high in absolute value (although its supply elasticity is too low) and because there is no adjustment for tax-exempt sales. However, the impact of unsupported elasticities is minor compared to the assumption that production will move abroad.

The Battelle study doesn't mention the tax, but rather estimates the effects of a $3 billion loss of revenue from a hypothetical event. It is interpreted, however, as a study of the effects of the tax. They estimate a job loss of 38,000. This number includes the job losses of suppliers of the industry through an input-output analysis, and general economic effects on the economy through spending. For the direct analysis of the industry, they project a loss of 12,947 jobs.

To translate the value of the tax to a change in quantity implies an implicit composite effect of supply and demand elasticity of at least one (in absolute value). This combined effect in implicit elasticities is larger than the -0.5 in the F-R study and five times the largest elasticity calculated above, -0.2). In addition to the large elasticities, this approach implicitly fails to reduce the tax by exports, which account for 38% of output. The extension of the job loss in the industry to jobs of suppliers and the economy in general is not considered an appropriate way to analyze a tax change that would be offset by an alternate revenue source, or to analyze longer run effects of a tax.

It is important to note that this study does not claim to estimate the effect of the tax. Using the study to show the effects of the tax overstates the effect because its implicit elasticities are too large in absolute value, its measurement of the effect does not account for exports, and it is not appropriate to include multiplier effects.

The Ramlet, Book, and Zhong study is very similar to the Battelle approach except that they explicitly attribute effects to the tax. They project 14,700 job losses for the medical device industry in 2022 (10,500 in 2014), and 47,100 for the economy based on estimates of suppliers. They use regression analysis to relate the change in output to the change in jobs. They have the

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(...continued)

Action Forum, June 4, 2012 at http://americanactionforum.org/sites/default/files/
The_Economic_Impact_of_the_Medical_Device_Excise_Tax.pdf.

large implicit elasticity of at least one. Their measurement of the tax using revenue projections understates the tax because it is not grossed up by income and payroll tax offset used to project the revenue loss. Their measurement overstates the tax because it does not exclude the effect of exports; these partially offsetting effects overstate the tax effect by 20%. The same criticisms of the Battelle study (if used as an indication of the effects of the tax) can be applied to the Ramlet, Book and Zhong study.

In the end, based on CRS analysis, the job loss related to the tax is far less than the range projected in these studies. It is more likely to be in the range of negligible, or zero, to a high of about 1,200.

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