



HEALTH CARE AND HUMAN SERVICES POLICY, RESEARCH, AND CONSULTING—WITH REAL-WORLD PERSPECTIVE.

# State Economic Impact of the Medical Technology Industry

Prepared for: AdvaMed

Submitted by: The Lewin Group

Date: June 7, 2010



**AdvaMed**

Advanced Medical Technology Association

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## Executive Summary

This report presents updated estimates of the medical technology industry's (MTI) economic contributions from the previous industry analysis, which was released in 2007. The industry encompasses the manufacturing of everyday medical devices, such as contact lenses and thermometers, to high-tech equipment, such as implantable pacemakers, neurostimulators and state-of-the-art imaging systems. Each of the 50 States and the District of Columbia are benefitted by MTI establishments; nearly all have seen this industry grow since the 2007 report.

The medical technology industry is a strong and vibrant part of the U.S. economy and plays a critical role in our health economy. In 2008, the industry had the following direct benefits to the national economy:

- Employed 422,778 workers;
- Paid \$24.6 billion in earnings; and
- Shipped \$135.9 billion worth of products.

These figures show an increase of 12.5%, 11.4% and 11.6%, respectively, over 2005 data.<sup>1</sup>

MTI establishments can be found in every state as well as the District of Columbia. Large states generally had the highest MTI employment in 2007: California had nearly 84,000 MTI workers, followed by disproportionately high Minnesota, then Massachusetts, Pennsylvania, and Florida with between 21,700 and 26,900 workers each.

A number of smaller states had high concentrations of MTI jobs. Minnesota and Utah had the highest concentration of MTI jobs relative to total employment – over 3 times the national average. Delaware, Massachusetts and Indiana followed, with over 2 times the national average.

In the great majority of states, earnings for individual MTI jobs were above state average earnings for all private jobs – primarily because the industry requires a highly skilled and educated workforce that can command higher than average earnings. In Arizona, Wisconsin and South Dakota, medical technology jobs paid more than 50% above the average state earnings. In the median state, Michigan, medical technology paid 22.2% more than the average earnings. The average MTI earnings were less than the state average earnings in only seven states, and, of these, MTI average earnings were still above the national average earnings in four of those states.

The recent economic downturn affected MTI employment through 2008, but at a fraction of the impact on U.S. manufacturing<sup>2</sup> overall. Total manufacturing employment decreased by 4.8% from 2007 to 2008, while MTI employment decreased by only 1.1%. Over the same time period, payroll and shipments also performed better than general manufacturing: total manufacturing

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<sup>1</sup> The previous industry report (released in 2007) analyzed Economic Census data from 2005, trended forward from 2002. This report analyzes actual 2005 data.

<sup>2</sup> Manufacturing here is classified as an industry rather than a type of employment; i.e., there are blue- and white-collar jobs within the total employment numbers.

earnings decreased by 1.4%, but total shipments increased by 2.8%. Within MTI, both measures increased: 3.2% in earnings and 6.9% in shipments.

MTI jobs, earnings and sales have strong and positive effects on the economies of the individual states and the nation on whole beyond its direct economic benefits. The total economic impact in each state includes effects on related industries as well as the benefit of MTI employee earnings put into the regional economies. In the median state:

- Each medical technology job generates an additional 1.5 jobs in that state;
- Each medical technology payroll dollar generates an additional \$0.90 in earnings in that state; and
- Each dollar of medical technology sales generates an additional \$0.90 in sales in that state.

The additional impact of MTI establishments on additional employment and additional payroll in the states has decreased since the previous industry analysis, but the additional sales benefit has remained constant. Given the notable increases in all three measures of direct benefits listed above – employment, earnings and shipments – the additional benefits from the medical technology industry remain impressive. Still, the state-level multipliers may understate the total benefits from the MTI industry, as establishments employ and make purchases across state borders and employees spend their incomes on goods and services made out-of-state as well as in-state.<sup>3</sup>

The analyses in this report are based on the most current and comprehensive data available from the U.S. Census Bureau. National MTI data are based on the 2008 Annual Survey of Manufacturers. The distribution of MTI jobs across the 50 states and District of Columbia are based on the 2007 Economic Census, augmented by the 2007 County Business Patterns. Earnings comparisons are based on 2007 census data. Multipliers are from RIMS II (Regional Input-output Modeling System, version II), which is operated by the Bureau of Economic Analysis of the U.S. Department of Commerce (released May 2010).<sup>4</sup>

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<sup>3</sup> National multipliers are no longer produced by the Bureau of Labor Statistics as of March 2009.

<sup>4</sup> The 2010-released multipliers are based on the 2002 Benchmark Input-Output Table for the Nation and 2007 regional data.

## I. Introduction

The Medical Technology Industry (MTI) is recognized for major contributions of its products to the health and well-being of the nation. Medical technology products range from the everyday to the extraordinary. Familiar products include vision products (eyeglasses and contact lenses), stethoscopes, thermometers and blood pressure monitors. More complex products include heart pacemakers, kidney dialysis machines, artificial limbs and joints, imaging machines, and *in vitro* diagnostic tests for infections and genetic tests. Most of the equipment and furnishings in hospitals, physicians' and dentists' offices and medical laboratories are products of the medical technology industry. Note that pharmaceutical products are an equally valuable but distinct industry, and are not included in this report.<sup>5</sup> Together with public health initiatives (e.g., sanitation and safety) and pharmaceuticals, medical technology has greatly improved life expectancy and the quality of life over the past centuries.

There is less appreciation that this industry has strong and positive impacts on the economy of every state and community in which it operates. This report presents data on and estimates of the economic impacts of the MTI in the fifty states and the District of Columbia. The analysis explicitly focuses on contributions to local economies that are made through job creation, payrolls and sales of products. These are both the traditional first line of "direct" impacts assessed in studies of regional economies, as well as "indirect" impacts generated when establishments purchase inputs for production (various goods and services) in the state or local area and these enterprises in turn hire and pay staff. These purchases generate further purchases from other businesses (that again undertake further hires). In addition, a cycle of "induced" beneficial impacts arises as employees and families spend their incomes on consumer goods and services (which generates yet further hiring and payrolls primarily in the retail sector).

The data for this report comes from the U.S. Census Bureau. Estimates of economic impacts of the medical technology industry (jobs, payroll and value of shipments) are based on data from the 2008 Annual Survey of Manufacturers, the 2007 Economic Census and the 2007 County Business Patterns Survey. Detail on data sources and the methodology is in Appendix A.

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<sup>5</sup> Note that the data in this report pertains only to the employment, payroll and value of shipments of establishments engaged in the manufacture of medical technology products.

## II. Direct Value of the Medical Technology Industry

The medical technology industry employed 422,778 workers across the nation in 2008. Workers earned \$24.6 billion, or an average of over \$58,000 per year.<sup>6</sup> The total value of industry shipments was \$135.9 billion. This constituted about 6 percent of the total health industry, which had total revenue of \$2.2 trillion in 2007 according to the Centers for Medicare & Medicaid Services (CMS).

As noted above, a vast array of products have been developed and are manufactured by the industry. Eight different sectors of the medical technology industry are tracked by the Census Bureau (Exhibit 1). Over fifty percent of the sales and employment are in the first two sectors listed: “surgical appliance and supplies manufacturing” and “surgical and medical instrument manufacturing”. The supplies sector includes the manufacture of orthopedic devices, surgical sutures and dressings (\$35.3 billion, 114,523 employees); the instrument sector includes the manufacture of scalpels, clamps, and syringes (\$33.6 billion in sales and 109,321 employees). The next largest sector, electromedical and electrotherapeutic apparatus manufacturing, includes such diverse electrical devices as pacemakers, hearing aids, heart monitors, endoscopes, ultrasound equipment and magnetic resonance imagers.

Exhibit 1: Medical Technology Industry Components and Basic Statistics, 2008<sup>7</sup>

Industry Sector	Employees (1,000s)	Payroll (\$ billions)	Sales (\$ billions)
Medical Technology Industry	422.8	24.6	136.1
Surgical appliance and supplies manufacturing	114.5	6.4	35.3
Surgical and medical instrument manufacturing	109.3	6.2	33.6
Electromedical and electrotherapeutic apparatus manufacturing	65.3	4.8	27.6
Dental laboratories	50.0	1.8	4.7
<i>In vitro</i> diagnostic substance manufacturing	27.0	2.2	12.7
Ophthalmic goods manufacturing	23.5	1.0	5.8
Irradiation apparatus manufacturing	16.8	1.5	11.6
Dental equipment and supplies manufacturing	16.3	0.8	4.7

State-level MTI employment, payroll and sales (i.e., shipments) are presented in Exhibit 2.

<sup>6</sup> “Earnings” in the context of the Annual Survey of Manufacturers includes all forms of compensation, such as salaries, wages, commissions, dismissal pay, bonuses, vacation and sick leave pay, and compensation in kind, prior to such deductions as employees’ social security contributions, withholding taxes, group insurance, union dues, and savings bonds. The total includes salaries of officers of corporations; it excludes payments to proprietors or partners of unincorporated concerns. (Data item description, 2008 Annual Survey of Manufacturers.) For the Economic Census, the term “payroll” is used, defined as “all forms of compensation, such as salaries, wages, commissions, dismissal pay, bonuses, vacation allowances, sick-leave pay, and employee contributions to qualified pension plans paid during the year to all employees...Payroll is reported before deductions for social security, income tax, insurance, union dues, etc.” (Data item description, 2007, American Factfinder, Economic Census Glossary.) In impact analysis with RIMS II, “earnings” is defined as the earnings that are received by households from the production of regional goods and services and that are available for spending on these goods and services. Thus, earnings is calculated as the sum of wages and salaries, proprietors’ income, directors’ fees, and employer contributions for health insurance less personal contributions for social insurance. (U.S. Department of Commerce, “Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II)”. Ed 3. March 1997.) For clarity, “earnings” is used throughout this report.

<sup>7</sup> For further definition of each industry sector, see Appendix A.

Exhibit 2: MTI Employment, Payroll and Sales by State, 2007

State	Employment	Payroll (\$1,000's)	Sales (\$1,000's)	State	Employment	Payroll (\$1,000's)	Sales (\$1,000's)
United States *	422,778	24,600,669	135,921,967	Missouri	5,701	244,027	1,204,223
Alabama	2,287	86,943	446,929	Montana	400	15,025	55,547
Alaska	147	5,871	42,310	Nebraska	4,784	208,237	1,762,178
Arizona	7,168	422,221	1,688,431	Nevada	1,097	46,241	180,247
Arkansas	2,610	89,995	499,128	New Hampshire	3,795	197,896	759,789
California	83,999	5,253,891	26,341,566	New Jersey	20,496	1,415,234	5,772,560
Colorado	9,169	531,684	2,988,536	New Mexico	1,152	42,409	331,425
Connecticut	7,576	391,394	2,055,630	New York	19,645	913,622	3,930,731
Delaware	3,136	160,414	872,502	North Carolina	8,407	425,685	2,208,625
District of Columbia	60	3,315	17,125	North Dakota	211	6,566	60,730
Florida	21,668	1,154,620	6,476,288	Ohio	12,383	528,614	2,819,114
Georgia	6,741	310,661	1,474,067	Oklahoma	1,430	55,974	285,948
Hawaii	320	11,383	91,958	Oregon	4,746	232,454	1,039,897
Idaho	735	23,043	122,422	Pennsylvania	22,233	1,116,384	5,709,405
Illinois	11,919	594,072	2,389,507	Rhode Island	1,933	82,668	401,542
Indiana	19,950	1,011,723	6,916,813	South Carolina	4,281	174,385	1,508,643
Iowa	1,953	75,672	350,547	South Dakota	1,064	59,289	306,240
Kansas	2,466	95,992	437,894	Tennessee	8,349	428,035	2,455,967
Kentucky	2,007	75,045	304,806	Texas	16,560	798,758	4,797,315
Louisiana	798	26,719	84,943	Utah	10,272	517,715	2,357,175
Maine	1,724	73,039	375,544	Vermont	397	14,880	100,675
Maryland	4,900	288,333	1,336,590	Virginia	4,700	197,783	831,219
Massachusetts	23,907	1,596,668	8,288,236	Washington	8,718	526,098	2,021,086
Michigan	9,355	467,927	2,422,388	West Virginia	1,104	43,662	317,609
Minnesota	26,862	1,707,508	6,775,042	Wisconsin	14,381	897,127	4,442,630
Mississippi	921	41,776	103,726	Wyoming	69	3,845	19,860

\* National data is from the 2008 Annual Survey of Manufacturers; state data is from the 2007 Economic Census.

The medical technology industry employed 375,961 workers; paid \$20.0 billion in salaries; and shipped \$110.5 billion worth of products in 2005, the year analyzed in the previous industry analysis.<sup>8</sup> Current data (2008) show that there has been a 12.5% growth in employment, over 11.4% growth in earnings, and 11.6% growth in shipments.

## A. Employment

Ten states accounted for over 60% of MTI employment in the nation in 2007. California had the largest number of MTI jobs, with just fewer than 84,000 jobs (Exhibit 3). Similar to California, the other states in the top ten are all highly populated states.

Exhibit 3: Ten States with Largest MTI Employment

State	Employees (1000s)
California	84.0
Minnesota	26.9
Massachusetts	23.9
Pennsylvania	22.2
Florida	21.7
New Jersey	20.5
Indiana	19.9
New York	19.6
Texas	16.6
Wisconsin	14.4

Exhibit 4: Ten States with Highest Percentage MTI Employment

State	Percent State Employment
Minnesota	1.06%
Utah	0.93%
Delaware	0.79%
Massachusetts	0.78%
Indiana	0.75%
New Hampshire	0.66%
California	0.61%
Nebraska	0.60%
Wisconsin	0.58%
New Jersey	0.56%

The MTI industry constitutes a large share of the employment in several less populated states. Exhibit 4 presents the states with the highest percentage of MTI employees of all state private employees. The median state's percentage MTI employment is 0.25% (Arkansas) (i.e., 25 of 1,000 private employees work in the industry). The national percentage of MTI employees from all private employment is just over 0.35%. Four states – Utah, Delaware, New Hampshire, and Nebraska – have a high percentage of MTI employment despite having total private employment less than the median total state private employment (1.6 million). Each of these states has at least several thousand jobs in the MTI, and in a small state this can constitute a material contribution to the total economy.

### Growth

National MTI employment increased by over 20% from 2005 to 2007, but declined from 2007 to 2008 to make the total growth from 2005 just under 12.5%. Exhibit 5 lists states with the highest percentage increases from 2005 to 2007.<sup>9</sup> Of these, Kansas and Wisconsin also had significant

<sup>8</sup> The 2005 figures do not align with the 2007 report's estimates: data presented here are actual; the data presented in the 2007 report were trended forward from 2002.

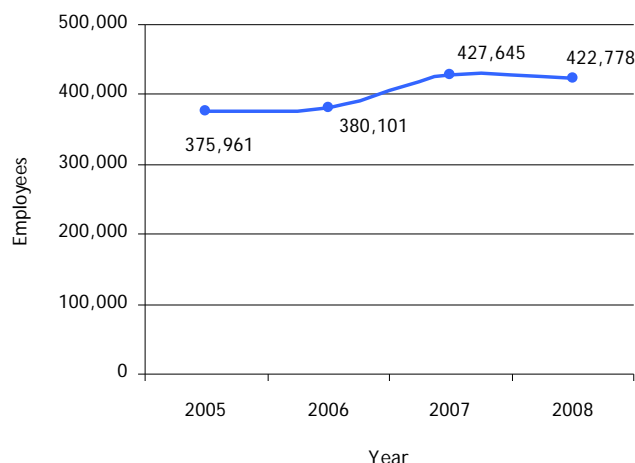
<sup>9</sup> State-level data are unavailable through 2008; only national data is available for this year. The data in Exhibit 5 do not show the MTI decline in employment from 2007 through 2008.

absolute growth, with increases of 1,200 and 5,500 positions, respectively. Other states with large absolute growth include California (11,514 jobs), Minnesota (8,290), Pennsylvania (4,751), and Indiana (4,401). (Appendix B presents additional growth data.)

**Exhibit 5: States with the Largest Increases in MTI Employment, 2005 to 2007**

State	Change in Employment (%)
Sum of States	20.4%
Hawaii	320.9%
Nevada	272.4%
Alaska	242.0%
Louisiana	114.5%
Vermont	99.5%
Kansas	96.6%
North Dakota	94.9%
Iowa	76.3%
District of Columbia	73.7%
Wisconsin	63.3%

**Exhibit 6: MTI Employment, 2005-2008**



The national MTI employment decline from 2007 to 2008 is small compared to that experienced by the overall manufacturing industry: total manufacturing employment decreased by 4.8% from 2007 to 2008, a decline of nearly 640,000 jobs. Total MTI employment decreased by only 1.1% in the same year, down from 427,645 to 422,778 (a loss of 4,867 jobs). This one-year downturn in employment can likely be attributed to the larger economic environment.

## B. Earnings<sup>10</sup>

One of the outstanding characteristics of the medical technology industry is the strong pay scale. Nationally, medical technology jobs produced individual average earnings of over \$58,000 in 2008, compared to the national earnings average of less than \$42,000. This is almost a 40 percent premium for jobs in the medical technology industry. Medical technology also pays a healthy premium relative to the average manufacturing job.<sup>11</sup> The average U.S. manufacturing job earnings totaled \$47,500 in 2007, higher than the national average for all private employment, but approximately 22 percent less than the average MTI job.

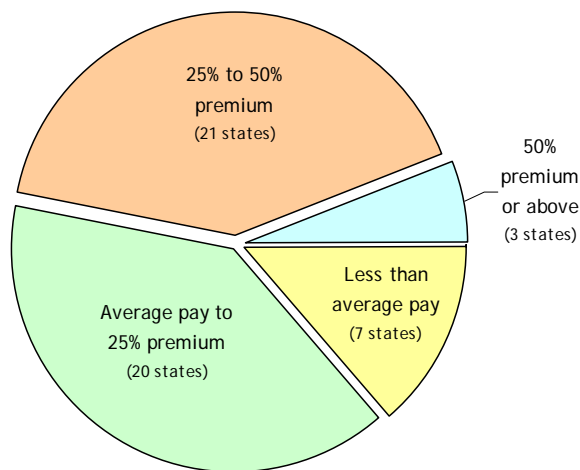
There was an appreciable level of variation in payroll per MTI employee across states in 2007. New York was the median state, at \$46,500 per year. Average annual earnings per medical technology employee were \$60,000 or greater in six states: New Jersey, Massachusetts, Minnesota, California, Wisconsin, and Washington. In contrast, four states had average MTI earnings of less than \$35,000.

<sup>10</sup> See footnote 6 for definitions of "earnings".

<sup>11</sup> Industry codes 31-33.

Exhibit 7: Premiums on MTI Average Earnings over State Average Earnings, 2007

In the context of state average earnings for all private employment, most states' medical technology earnings per employee offer a notable premium (Exhibit 7). The median premium of MTI earnings relative to average state private earnings was 22% (Michigan). In Arizona, Wisconsin and South Dakota, medical technology jobs paid more than 50 percent above the average state earnings. The average of MTI earnings was less than the state average earnings in only seven states.



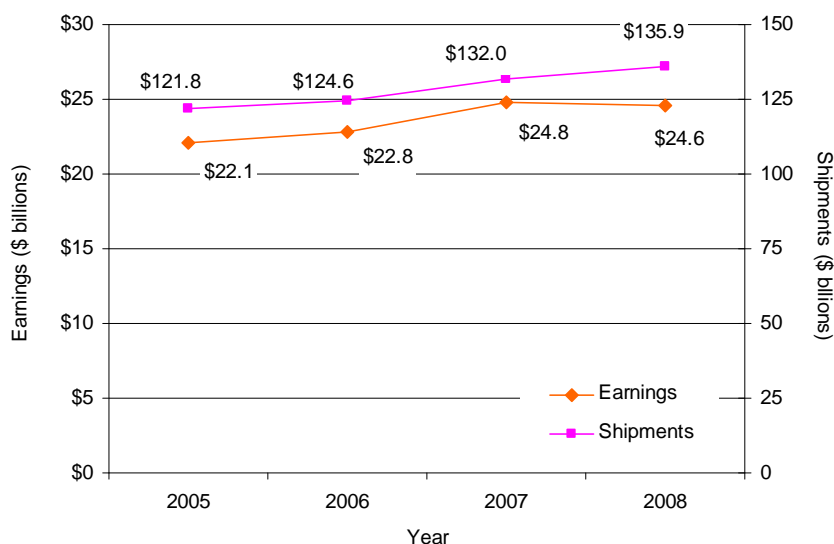
State by state comparisons of medical technology earnings and the state average are presented in Exhibit 9.

### Growth

National MTI earnings and shipments increased by 11.4% and 11.6%, respectively, from 2005 to 2008. Similar to employment trends, MTI aggregate earnings decreased from 2007 to 2008 (by 0.7%), but MTI shipments fared better with an increase of 3.0% (Exhibit 8). General manufacturing experienced a similar trend from 2007 to 2008, but with a larger decline in earnings (1.4%) and a slightly smaller increase in shipments (2.8%, not shown).

Exhibit 8: MTI Aggregate Earnings and Shipments, 2005-2008 (2008 dollars)

The current 40% national MTI earnings premium relative to overall average earnings is 19 percentage points higher than the premium in 2005 (21%)..<sup>12</sup> The increase in the premium of MTI earnings over general manufacturing earnings may signify increased skill level requirements as the industry moves toward more technologically advanced outputs.



<sup>12</sup> The 2005 average private sector earnings were over \$48,600 (2008 dollars) compared to the average MTI wage of over \$58,000 (2008 dollars).

Exhibit 9: Average Employee Earnings and MTI Average Employee Earnings by State, 2007 <sup>13</sup>

State	Average Earnings	MTI Average Earnings	Percent Premium	State	Average Earnings	MTI Average Earnings	Percent Premium
United States	\$ 41,680	\$ 58,188	39.6%	Missouri	37,141	42,804	15.2%
Alabama	33,818	38,016	12.4%	Montana	30,091	37,610	25.0%
Alaska	46,605	39,937	-14.3%	Nebraska	34,214	43,528	27.2%
Arizona	37,768	58,908	56.0%	Nevada	37,149	42,152	13.5%
Arkansas	32,332	34,481	6.6%	New Hampshire	39,760	52,153	31.2%
California	47,481	62,547	31.7%	New Jersey	50,295	69,051	37.3%
Colorado	42,295	57,990	37.1%	New Mexico	34,086	36,829	8.0%
Connecticut	52,922	51,666	-2.4%	New York	56,983	46,507	-18.4%
DC	63,369	55,723	-12.1%	North Carolina	36,793	50,638	37.6%
Delaware	46,951	51,152	8.9%	North Dakota	31,112	31,118	0.0%
Florida	36,029	53,287	47.9%	Ohio	37,848	42,689	12.8%
Georgia	38,953	46,089	18.3%	Oklahoma	34,107	39,143	14.8%
Hawaii	35,268	35,629	1.0%	Oregon	37,923	48,984	29.2%
Idaho	32,216	31,373	-2.6%	Pennsylvania	40,041	50,213	25.4%
Illinois	45,061	49,842	10.6%	Rhode Island	38,464	42,778	11.2%
Indiana	35,800	50,714	41.7%	South Carolina	32,683	40,739	24.7%
Iowa	33,310	38,756	16.4%	South Dakota	30,726	55,723	81.4%
Kansas	35,945	38,934	8.3%	Tennessee	36,391	51,271	40.9%
Kentucky	33,801	37,391	10.6%	Texas	41,260	48,234	16.9%
Louisiana	35,956	33,482	-6.9%	Utah	35,119	50,403	43.5%
Maine	33,842	42,379	25.2%	Vermont	32,906	37,528	14.0%
Maryland	44,421	58,843	32.5%	Virginia	42,639	42,081	-1.3%
Massachusetts	51,151	66,787	30.6%	Washington	44,893	60,346	34.4%
Michigan	40,935	50,022	22.2%	West Virginia	31,081	39,567	27.3%
Minnesota	42,428	63,567	49.8%	Wisconsin	37,293	62,383	67.3%
Mississippi	30,353	45,384	49.5%	Wyoming	37,855	55,723	47.2%

<sup>13</sup> Data shown is the average annual earnings per employee of MTI establishments relative to the average annual earnings of all private establishments in each state (as reported in the 2007 County Business Patterns Survey).

### III. Indirect Value of the Medical Technology Industry

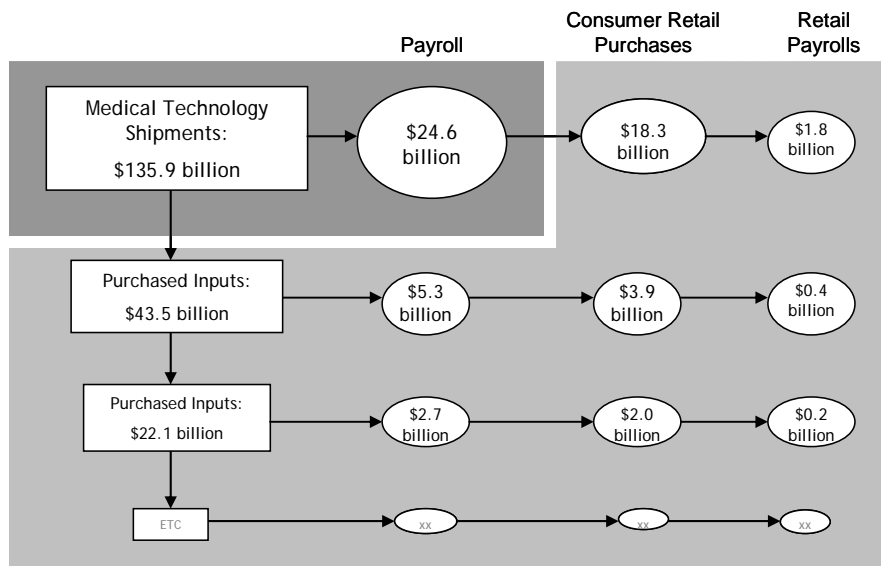
Beyond the direct benefits of MTI earnings, the industry generates indirect benefits to local communities. Higher income/education households have a greater level of disposable income, and high demand for consumer durables (e.g., houses, cars, personal electronic equipment) and consumables (e.g., food, clothes, dining out, entertainment), which creates further jobs. There is also business-to-business benefit, as raw materials are bought and sold.

“Input-output” analyses can help quantify the indirect benefits of an industry – capturing the value of increased buying power and impacts on other businesses. This section explains such calculations and presents the sum of direct and indirect impact of MTI jobs by state.

#### A. How Industry Impacts are Multiplied

The direct employment and earnings impacts of an MTI establishment are the foundation of economic benefits. Additional benefits accrue through several mechanisms, which are schematically portrayed in Exhibit 10. These are consumer spending by the MTI workforce, purchases of goods and services as “inputs” to the medical technology production, marketing and sales processes, and subsequent consumer spending by the input industry workforce. These effects are repeated, although at a fraction of the original impact.

Exhibit 10: Graphical Exposition of the “Multiplication” of Direct Economic Benefits



The value of this “multiple” of economic benefits can be estimated by input-output analysis. Input-output analyzes the amount and value of inputs (labor, other “purchased inputs” including raw and finished materials, energy, etc.) that an establishment of a particular industry uses to produce its output – such as manufactured goods (e.g., a cardiac pacemaker) or a service (automobile repairs), or retail sales (by a gasoline station or a clothing store). Different types of industries and businesses have different types and degrees of impacts, or “multipliers.” The amount of the impact or multiplier tends to be greater in larger geographic areas (the nation, regions) than in smaller areas, and larger states generally have greater multipliers than the very smallest states. In larger areas, it is likely that a greater proportion of inputs could be purchased

in that area than in a smaller area because it is more likely that a business that provides required goods or services would be in the area.

The immediate employment, payroll and sales of an industry are considered the “direct” impacts of an industry. Direct impacts are often public information. Direct impacts become multiplied due to (a) purchase of inputs to support production (termed “indirect” impacts); and (b) spending of employees for consumer goods (“induced” impacts). The indirect and induced impact cycles are represented by the lighter shaded region of Exhibit 10 that is separated from the primary MTI direct benefits.

MTI establishments purchase inputs, including components and parts, raw materials (e.g., metals, plastics, and chemicals), office supplies, and utilities (e.g., communications, energy, and water). The enterprises that sold the inputs generate their own cycles of impacts from further purchases of inputs as well as their payrolls (i.e., payments for earnings). In a “typical” or median establishment, purchased inputs constitute about 50 percent of the value of sales and about 12 percent of payrolls. The enterprises that sold the inputs generate cycles of impacts from their payrolls and purchases of inputs.

Induced impacts are generated when employees spend their incomes on consumer goods and services. The MTI workers spent about \$18 billion of the 24 billion they earned on consumer goods and services (the rest goes to tax payments and savings/investments). Firms that sell consumer goods (primarily retail establishments) have payrolls roughly equal to 10 percent of their sales (most of their costs are for the goods they sell), and these incomes (approximately 1.8 billion) are in turn spent. The goods (re)sold at retail also generate impacts from their workforce payrolls and purchase of inputs, but these are progressively smaller.

As is evident from Exhibit 10, there are leakages at each subsequent step as incomes are saved, invested or spent outside the geographic area. The impact multiplier chain is materially smaller in successive steps, so the cycle of economic impacts progressively diminishes. After a limited number of steps the impact of the next step is negligibly small (so the economic impact is “finite” rather than indefinitely large).

State economic impact multipliers for manufacturing establishments are often in the range of about 2.0 – these numbers estimate the total impact of all the cells represented in Exhibit 10. Multipliers are unique to geography and to each particular industry, due to local differences in manufacturing processes, staffing patterns and use of purchased inputs. Multiplier impacts within a state or local area will be smaller than for the nation as a whole, as establishments in smaller areas generally need to look outside of their local area in order to find economical or high quality inputs of certain types. Purchasing inputs outside of the local area then diminishes the contribution to the local economy, although it produces employment impacts in the other areas. These extra-area impacts are obviously important to assess the national contributions of MTI, but state officials will be more concerned about the state area impacts.

The detailed state by state estimates of the economic impact of MTI are presented in Appendix D. The table presents estimates of MTI direct impacts (employment, earnings, and shipments/sales) and total economic impact, which is the sum of the direct impacts and the indirect impacts (via purchases of input supplies) plus the induced impacts (largely consumer purchases of retail goods).

The respective state impact estimates and multipliers are the sum of the eight distinct MTI sector impacts. Each sector impact was estimated separately for each state based on state sector employment, earnings and sales/shipments and the respective impact multipliers obtained from the Bureau of Economic Analysis's Regional Input-output Modeling System.

The multipliers used in this study are specific to each industry sector in each respective state. The Economic Census performed by the U.S. Census Bureau collects data for each establishment in the country every five years; the 2010 release included 2002 national I-O data and 2007 regional data. This data is analyzed for each industry in the area(s) of interest (in this analysis, states) to identify the purchasing patterns and extant supply networks. Multipliers for employment/jobs, payrolls and sales/value of shipments are developed directly from the data for each area. The resulting multipliers, therefore, reflect both the requirements of particular industries and the robustness of the supply networks in each state.

### *Example: California*

Using the State of California as an example, the MTI multiplier can be demonstrated with state data listed in Exhibit 2 and multipliers presented in Appendix C. Per Exhibit 2, California's medical technology industry had the following statistics in 2007:

- Nearly 84,000 employees;
- An aggregate payroll of \$5.3 billion; and
- Total sales worth \$26.3 billion.

Per Appendix D, the job multiplier for the state is 3.5, the payroll multiplier is 2.3, and the shipment (sales) multiplier is 2.2. From this data, it can be calculated that California's MTI businesses support:

- Nearly 210,000 additional jobs ( $83,999 \times 2.5$ );
- \$6.9 billion in additional payroll ( $\$5.3 \text{ billion} \times 1.3$ ); and
- \$31.6 billion in total additional sales ( $\$26.3 \text{ billion} \times 1.2$ ).<sup>14</sup>

## **B. MTI Impacts on State Employment**

The medical technology industry has significant impacts on the economy of the United States and on the respective states in which MTI establishments operate. These impacts are measured by the economic value of jobs and the value of shipments. The employment multipliers represent additional jobs created by the jobs in MTI establishments.<sup>15</sup>

The median state employment multiplier is 2.48 (Oklahoma), meaning each MTI job creates an additional 1.48 positions in the state. The middle 50% of state employment multipliers are between

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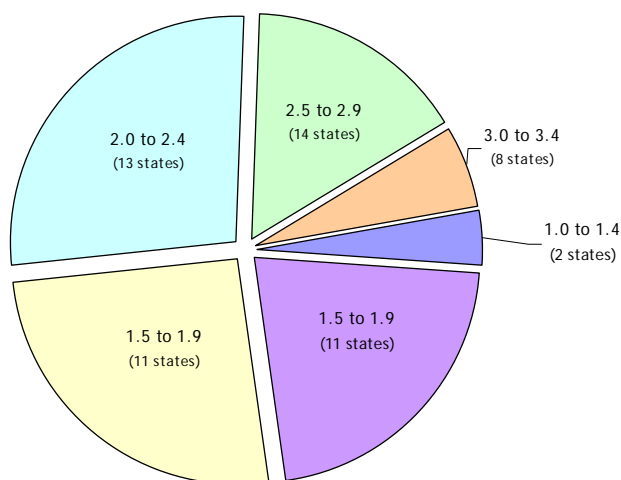
<sup>14</sup> Multipliers are reduced by 1.0, which represents the direct MTI economic benefits; by reducing the multiplier the number calculated is the *additional* value.

<sup>15</sup> This methodology is for RIMS "direct effect" multipliers, as opposed to "final demand" multipliers, which are based on shipments/sales.

2.02 and 2.98 (see Exhibit 11). There are three states with job multipliers smaller than 1.7 (District of Columbia, Wyoming, Alaska), and 3 with values above 3.5 (Michigan, California, Pennsylvania). State-by-state estimates of economic impacts are presented in Appendix D.

The states with the highest job multipliers are identified in Exhibit 12. Pennsylvania has the highest multiplier, 3.57, followed closely by California, Michigan, and Massachusetts. The primary characteristic of this set of high multiplier states is that they are highly populated states and they have large MTI sectors (see Exhibit 2). A large state economy increases the chances that input suppliers can be found in-state. Another factor that may positively affect the size of a state multiplier is that an industry concentration is likely to attract suppliers to locate facilities in close proximity. The areas in which an industry first develops are likely to gain a long lasting advantage.

**Exhibit 11: State MTI Job Multiplier Distribution, 2007**



**Exhibit 12: The Ten States with the Highest MTI Job Multipliers, 2007**

State	Job Multiplier
Pennsylvania	3.57
California	3.52
Michigan	3.51
Massachusetts	3.43
Illinois	3.42
Georgia	3.34
Texas	3.31
Utah	3.22
Minnesota	3.09
New Jersey	3.09

Not all states with high job multipliers fit these characteristics, however. Utah, for example, had total private employment of 1.1 million (compared to the state median of 1.6 million) and MTI employment of 10,300 (0.94%) in 2007. The state's MTI job multiplier is pulled upward by two component industries with high job multipliers (over 4.0) and relative share of employment: electro-medical/therapeutic apparatus manufacturing and irradiation apparatus manufacturing.

Illustrating the impact of the employment multiplier, Exhibit 13 lists the top ten states by MTI-related employment in 2007. These top-ten states have high MTI direct employment (see Exhibit 3), but a high multiplier can bring states with moderate direct employment to a high-ranking amount of total (i.e., indirect and direct) employment. Each state's multiplier and MTI-related employment estimate is presented in Appendix D.

There is considerable variation in MTI employment multipliers across MTI sectors, as shown in Exhibit 14. At median state values of 2.99 and 2.95, the electromedical and electrotherapeutic

Exhibit 13: States with the Largest MTI-Related Employment

apparatus and the *in vitro* diagnostic multipliers are greater than any of the other sectors. These values are notably higher than the median for dental laboratories or ophthalmic goods, demonstrating that the mix of medical technology industries in a state can have an impact on the ultimate MTI multiplier.

There are also lessons from low state multipliers. Multipliers in this range could reflect the fact that there has been little presence of an industry in the state (or that it has only come into the state recently), and that there has been little incentive to attract a network of specialized suppliers. Alternately, such industries could rely on a supplier across a state border.

State	MTI Employment (1000s)	Job Multiplier	MTI-Related Employment (1000s)
California	84.0	3.5	295.3
Minnesota	26.9	3.1	83.1
Massachusetts	23.9	3.4	82.0
Pennsylvania	22.2	3.6	79.3
New Jersey	20.5	3.1	63.4
Florida	21.7	2.8	60.8
Texas	16.6	3.3	54.8
Indiana	19.9	2.7	54.8
New York	19.6	2.4	47.0
Wisconsin	14.4	2.9	41.4

Exhibit 14: Employment Multipliers for the MTI Component Industries, Medians and Interquartile Ranges<sup>16</sup>

Component Industry	Median	Interquartile Range
Surgical and medical instrument manufacturing	2.53	2.02 - 3.06
Surgical appliance and supplies manufacturing	2.46	2.10 - 2.87
Dental equipment and supplies manufacturing	2.23	1.90 - 2.59
Ophthalmic goods manufacturing	2.02	1.72 - 2.33
Dental laboratories	1.77	1.58 - 1.89
Electro-medical/therapeutic apparatus manufacturing	2.99	2.08 - 3.73
Irradiation apparatus manufacturing	2.50	2.04 - 3.49
In-vitro diagnostic substance manufacturing	2.95	2.19 - 3.74

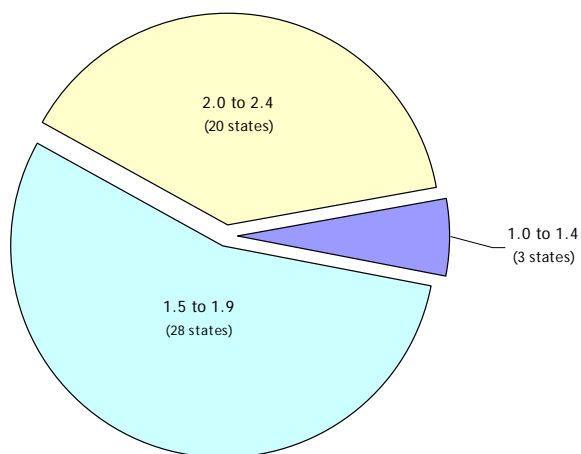
In the 2007 report, the median state's job multiplier was higher: MTI jobs supported an additional 2.0 jobs. The decline to an additional 1.5 jobs in the current analysis may indicate increased efficiencies and industry concentration, or it may simply reflect general tightening of the economy.

### C. MTI Impacts on State-level Earnings and Output

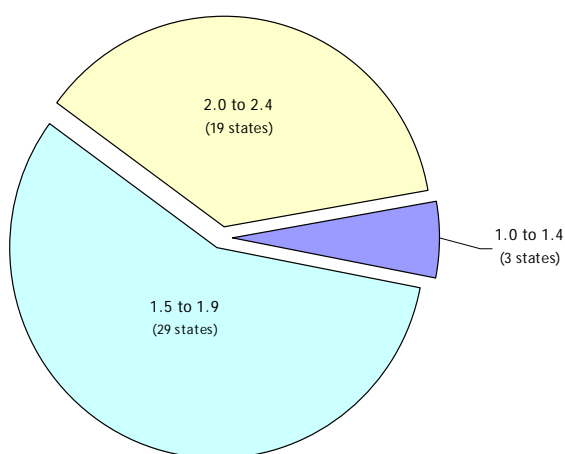
The MTI makes significant, large contributions to states in which it operates, both directly in terms of earnings and output produced by the industry and indirectly in terms of the multiplier effects of the MTI on other industries.

<sup>16</sup> The interquartile range presents the range of the middle 50% of the job multipliers. For example, 50% of the state's job multipliers for the surgical and medical instrument manufacturing are between 2.02 and 3.06.

**Exhibit 15: State MTI Earnings Multiplier Distribution**



**Exhibit 16: State MTI Output Multiplier Distribution**



Exhibits 15 and 16 present state-level earnings and output multipliers for the overall MTI industry. The distributions of the state-level earnings and output multipliers are very similar; again, the state values are smaller than the national multipliers. Both measures had a median state value of 1.9. This indicates that in the median state, each dollar of MTI earnings generated an additional \$0.90 in earnings elsewhere in the state economy. The majority of the states' earnings multipliers and output multipliers were between 1.5 and 1.9: 28 states and 29 states, respectively (Exhibits 17 and 18). Earnings multipliers for MTI are smaller than employment multipliers because, ultimately, much of earnings is spent in the retail sector and for "low tech" inputs, where pay scales are much lower than in MTI. A similar hypothesis could be made for the output multiplier.

**Exhibit 17: Top MTI-Related Earnings, 2007**

State	MTI		MTI-Related
	Earnings (\$ millions)	Earnings Multiplier	Earnings (\$ millions)
Arizona	5,253.9	2.3	12,073.6
Massachusetts	1,707.5	2.2	3,731.5
Maine	1,596.7	2.3	3,660.8
Nevada	1,415.2	2.3	3,221.1
Oklahoma	1,116.4	2.4	2,630.9
Delaware	1,154.6	2.0	2,286.3
Idaho	1,011.7	2.0	2,016.4
Washington	897.1	2.1	1,853.1
Wisconsin	897.1	2.1	1,853.1
South Dakota	798.8	2.2	1,766.7

**Exhibit 18: Top MTI-Related Shipments, 2007**

State	MTI		MTI-Related
	Shipments (\$ millions)	Output Multiplier	Shipments (\$ millions)
Arizona	26,341.6	2.2	58,932.7
Maine	8,288.2	2.1	17,665.2
Massachusetts	6,775.0	2.1	14,391.6
Idaho	6,916.8	2.0	13,837.7
Oklahoma	5,709.4	2.3	13,133.5
Nevada	5,772.6	2.2	12,621.0
Delaware	6,476.3	1.9	12,520.9
South Dakota	4,797.3	2.2	10,520.9
Washington	4,442.6	2.0	8,902.5
Wisconsin	4,442.6	2.0	8,902.5

Exhibits 17 and 18 present states with the largest MTI-related employee earnings and MTI-related shipments, respectively. Many states appear on both lists, led by Arizona with the highest values in both measures. As with MTI-related employment, both a high *direct* value and a high multiplier may yield a large total economic impact. Appendix D lists data for all states.

In the 2007 report, the median state's earnings multiplier was higher than in the current analysis: each dollar of MTI earnings supported an additional \$1.12 in earnings in that state, as

opposed to \$0.90. The additional sales generated by each dollar of MTI sales, however, has remained constant across the reports, showing continued use of other industries' materials and other general stimulation of additional outputs.

## IV. Conclusion

This report presents updated estimates of the economic contributions of the medical technology industry. Beyond the medical value of the industry, the direct and indirect benefits of the employment, earnings and shipments sum to a significant contribution to the national economy.

MTI employment plays an important role in large states – like California – as well as smaller states with high concentrations of MTI employment – like Utah. In nearly all states, earnings in the industry are above state averages for the private marketplace; the industry requires a skilled and educated workforce that can command such earnings. In some states – Arizona, Wisconsin and South Dakota – MTI jobs paid more than 50% above the average state earnings.

Use of RIMS II multipliers allows for the estimation of indirect and induced economic benefits from the medical technology industry in addition to the direct benefits. In the median state, each MTI job generates an additional 1.5 jobs; each dollar in MTI earnings generates an additional \$0.90 in earnings; and each dollar in output generates an additional \$0.90 in output. Although the multiplier amounts have decreased for employment and earnings since the previous industry analysis, the increases in absolute measures of the industry's economic benefits are strong relative to the manufacturing industry overall. As mentioned previously, these multiplier amounts understate regional and national benefits, as only within-state benefits are considered.

As the economy continues to recover from the current climate, the medical technology industry's economic impacts to the states should be revisited to document future growth.

## **Data Sources**

2007 Economic Census: Manufacturing. U.S. Census Bureau, Economics and Statistics Administration, U.S. Department of Commerce.

Annual Survey of Manufactures, Statistics for Industry Groups and Industries: 2008. U.S. Census Bureau, Economics and Statistics Administration, U.S. Department of Commerce, November, 2010.

County Business Patterns, United States 2007. U.S. Census Bureau, Economics and Statistics Administration, U.S. Department of Commerce, July 2009.

2002/2007 Regional Input-Output Modeling System (RIMS II), Regional Economic Analysis Division, Bureau of Economic Analysis, U.S. Department of Commerce. National I-O Data Year 2002, Regional Data Year 2007. Multipliers for the Medical Technology Industry in the 50 States and DC were purchased from RIMS II. Released 2010.

Data from the 2007 Economic Census, Annual Survey of Manufactures and County Business Patterns were accessed May 2010 through "American FactFinder," the US Census Bureau Web Portal.

## Appendix A: Industry Definition, Data Sources and Methodology

The medical technology industry is analyzed and reported on by the U.S. Census Bureau in several relatively distinct sectors. Each sector is defined to include relatively distinct product types and associated manufacturing processes. Within each of the eight industry sectors selected for this report, there are several different product types, as exemplified in Exhibit A.

Exhibit A: Medical Technology Industry Sub-Industry Contents

NAICS Code*	Industry Sector	Examples of Manufactured Items
325413	<i>In vitro</i> diagnostic substance manufacturing	<i>in vitro</i> (i.e., not taken internally) diagnostic substances, such as chemical, biological, or radioactive substances (used for diagnostic tests that are performed in test tubes, petri dishes, machines, and other diagnostic test-type devices)
334510	Electromedical and electrotherapeutic apparatus manufacturing	magnetic resonance imaging equipment, medical ultrasound equipment, pacemakers, hearing aids, electrocardiographs, electromedical endoscopic equipment
334517	Irradiation apparatus manufacturing	irradiation apparatus and tubes for applications, such as medical diagnostic, medical therapeutic, industrial, research and scientific evaluation
339112	Surgical and medical instrument manufacturing	syringes, hypodermic needles, anesthesia apparatus, blood transfusion equipment, catheters, surgical clamps, medical thermometers
339113	Surgical appliance and supplies manufacturing	orthopedic devices, prosthetic appliances, surgical dressings, crutches, surgical sutures, personal industrial safety devices (except protective eyewear), hospital beds, operating room tables
339114	Dental equipment and supplies manufacturing	dental chairs, dental instrument delivery systems, dental hand instruments, dental impression material, dental cements
339115	Ophthalmic goods manufacturing	prescription eyeglasses (except manufactured in a retail setting), contact lenses, sunglasses, eyeglass frames, reading glasses made to standard powers, protective eyewear
339116	Dental laboratories	dentures, crowns, bridges, orthodontic appliances (customized for individual application)

\* North American Industry Classification System codes

Available data was obtained for each of the eight sectors (specified above) for each state and the District of Columbia. This included data about state-level employment, earnings (i.e., payroll) and value of shipments, as well as RIMS II economic impact multipliers.

All of the data for this report has been acquired from the Bureau of Economic Analysis, US Department of Commerce. This includes both data about size and location of the medical technology industry as well as the economic impact multipliers.

The primary source of economic size and location data for this report is the 2007 Economic Census from the Bureau of Economic Analysis (BEA), US Economics and Statistics Administration. The Economic Census has high quality information about detailed industries, including the data fundamental to this economic impact analysis: the value of shipments, number of employees, and value of earnings, each by state. The Economic Census is performed every 5 years, and entails a comprehensive enumeration and characterization of all operating “establishments” that have employees, excluding agriculture-related and government entities.

Data is requested from each identified establishment, and is cross-checked and completed with sources such as the Internal Revenue Service and private business data services. “Missing” data is logically or statistically imputed, providing a rigorous, comprehensive profile of economic activity in the nation, and is the premier source of economic data about industrial sectors of the nation.

The Economic Census has two main limitations. First, the medical technology industry has likely changed since 2007 – balancing the economic downturn with the possible beginnings of a recovery. There are some reports that manufacturing is leading the economic recovery,<sup>17</sup> but further analyses would be necessary for a reliable conclusion to this point. Second, Economic Census data on an industry for states with few establishments or fewer than 100 employees is suppressed in order to protect confidentiality.

Change over time in the medical technology industries is tracked with the Annual Survey of Manufactures (ASM). The ASM tracks national trends in economic activity of detailed industries (including each of the industries of focus) on an annual basis and published 2008 data in March 2010. Unfortunately, the ASM does not produce *state* level estimates for the detailed industries under examination, but only for more broadly defined groupings of manufacturing industries (for example, for “pharmaceutical and medicine manufacturing,” but not for the detailed sub-industry “*in vitro* diagnostic substance manufacturing”).

### *Imputed Data*

Data suppression was a minor issue. The data on employment, earnings and values of shipments that was suppressed represented approximately 10 percent of the respective national totals across the 8 medical technology sectors. For purposes of attempting to be as complete as possible the study made imputations for suppressed data on a state-by-state and industry sector-by-sector basis. The methods used to “fill in” the suppressed 10 percent of jobs, earnings and shipments are described in the paragraphs below.

While the Economic Census reports a wealth of data, state specific values were suppressed in instances where there were very few industry establishments, as well as where total industry employment in a state was less than 100 workers. In these instances the Economic Census indicated the size range of employment (e.g., 100-249, 250-499, 500-999, 1000-2499), but not the earnings or value of shipments. In these instances a state’s employment was estimated at the mid-point of the indicated range (for 100-249 a value of 175 was used) and the earnings and value of shipments were estimated based on the national average MTI earnings and shipments per employee, respectively.

Data for states with fewer than 100 workers in an industry sector were entirely suppressed in the Economic Census. In this situation, substitute data were obtained from the BEA’s “County Business Patterns” (CBP). The CBP is derived from periodic establishment reports of payroll taxes to the IRS. Because the CBP has less data (only employees and value of payroll) it does report the number of establishments and the size range for number of employees (0-19 and 20-99) even when there are fewer than 100 workers in an industry sector. This fills a small, but meaningful, gap in coverage of the Economic Census. Again, the mid-range value of

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<sup>17</sup> Institute for Supply Management, “April 2010 Manufacturing ISM *Report on Business*”. May 3, 2010. URL: <http://www.ism.ws/ismreport/mfgrob.cfm>, accessed 5/10/10.

employment was used, and multiplied by the industry sector national average for earnings and value of shipments per employee.

The economic impact multipliers were obtained from the BEA's RIMS II service (Regional Input-output Modeling System, version II). RIMS can generate multipliers for over 400 industry sectors, for the nation, states or local areas. Multipliers were available for seven out of the eight MTI sectors and for the last sector (*in vitro* diagnostics) multipliers were obtained for the higher level "pharmaceutical and medicine manufacturing" sector, of which *in vitro* diagnostics is a part. The most recent multipliers were released in May 2010, and are based on 2002 national benchmark input-output data and 2007 regional data.

There were a small number of industry sectors in smaller states where RIMS was unable to estimate multipliers due to insufficient data. Missing multipliers were imputed with the median value for medical technology industry sectors for the same state. This was judged preferable to replacement with the median or mean for other states because review of the multipliers showed that multipliers across sectors for a state were usually quite similar. This primarily has to do with the size and location of a state with respect to economic markets. Specifically, smaller states (based on total employment) tend to have smaller than average multipliers across all industry sectors. Since missing multipliers were generally in small states the indicated replacement strategy seemed most reasonable.

Comparisons of earnings per employee were based on values reported by BEA, and did not include any imputed data. The reported values covered 91.9 percent of jobs as well as earnings for the medical technology sectors.

Appendix B: Change in Employment by State, 2005 to 2007<sup>18</sup>

State	Employment			State	Employment		
	2005	2007	% Growth		2005	2007	% Growth
Sum of States	357,670	430,673	20.4%	Missouri	4,043	5,701	41.0%
Alabama	2,328	2,287	-1.8%	Montana	266	400	50.4%
Alaska	43	147	242.0%	Nebraska	4,651	4,784	2.8%
Arizona	4,506	7,168	59.1%	Nevada	295	1,097	272.4%
Arkansas	2,236	2,610	16.7%	New Hampshire	3,298	3,795	15.1%
California	72,485	83,999	15.9%	New Jersey	17,953	20,496	14.2%
Colorado	7,969	9,169	15.0%	New Mexico	989	1,152	16.5%
Connecticut	7,638	7,576	-0.8%	New York	16,607	19,645	18.3%
Delaware	3,067	3,136	2.2%	North Carolina	7,804	8,407	7.7%
District of Columbia	34	60	73.7%	North Dakota	108	211	94.9%
Florida	19,949	21,668	8.6%	Ohio	12,820	12,383	-3.4%
Georgia	6,801	6,741	-0.9%	Oklahoma	983	1,430	45.4%
Hawaii	76	320	320.9%	Oregon	3,927	4,746	20.9%
Idaho	451	735	62.9%	Pennsylvania	17,482	22,233	27.2%
Illinois	9,967	11,919	19.6%	Rhode Island	1,358	1,933	42.3%
Indiana	15,548	19,950	28.3%	South Carolina	3,702	4,281	15.6%
Iowa	1,107	1,953	76.3%	South Dakota	1,767	1,064	-39.8%
Kansas	1,254	2,466	96.6%	Tennessee	5,820	8,349	43.4%
Kentucky	1,516	2,007	32.4%	Texas	14,253	16,560	16.2%
Louisiana	372	798	114.5%	Utah	8,894	10,272	15.5%
Maine	2,048	1,724	-15.8%	Vermont	199	397	99.5%
Maryland	3,867	4,900	26.7%	Virginia	2,934	4,700	60.2%
Massachusetts	21,847	23,907	9.4%	Washington	7,131	8,718	22.3%
Michigan	6,089	9,355	53.6%	West Virginia	806	1,104	36.9%
Minnesota	18,571	26,862	44.6%	Wisconsin	8,805	14,381	63.3%
Mississippi	771	921	19.4%	Wyoming	236	69	-70.7%

<sup>18</sup> The comparison years are those presented in the 2007 and current (2010) economic analyses performed by the Lewin Group.

Appendix C: Job, Earnings/Payroll and Output Multipliers

State	Job	Earnings	Output	State	Job	Earnings	Output
Median of States	2.5	1.9	1.9	Missouri	2.9	2.1	2.1
Alabama	2.6	1.9	1.9	Montana	1.7	1.5	1.6
Alaska	1.7	1.5	1.5	Nebraska	1.8	1.7	1.7
Arizona	2.4	1.9	1.7	Nevada	1.9	1.6	1.7
Arkansas	2.2	1.7	1.8	New Hampshire	2.1	2.0	1.9
California	3.5	2.3	2.2	New Jersey	3.1	2.3	2.2
Colorado	2.9	2.2	2.2	New Mexico	2.4	1.7	1.6
Connecticut	2.7	2.1	2.0	New York	2.4	1.9	1.9
Delaware	2.6	1.8	1.7	North Carolina	2.9	2.2	2.1
District of Columbia	1.1	1.1	1.3	North Dakota	1.7	1.5	1.6
Florida	2.8	2.0	1.9	Ohio	2.9	2.2	2.2
Georgia	3.3	2.2	2.2	Oklahoma	2.5	1.8	1.8
Hawaii	1.9	1.7	1.7	Oregon	2.6	2.0	2.0
Idaho	2.1	1.6	1.6	Pennsylvania	3.6	2.4	2.3
Illinois	3.4	2.4	2.3	Rhode Island	2.2	2.0	1.9
Indiana	2.7	2.0	2.0	South Carolina	2.5	1.9	2.0
Iowa	1.9	1.7	1.7	South Dakota	1.8	1.5	1.6
Kansas	2.1	1.7	1.7	Tennessee	3.1	2.1	2.1
Kentucky	2.5	1.9	2.0	Texas	3.3	2.2	2.2
Louisiana	2.5	1.8	1.8	Utah	3.2	2.2	2.2
Maine	2.2	1.9	1.8	Vermont	1.9	1.6	1.6
Maryland	2.9	1.9	1.8	Virginia	2.4	2.0	2.0
Massachusetts	3.4	2.3	2.1	Washington	2.5	2.0	2.0
Michigan	3.5	2.2	2.1	West Virginia	1.9	1.7	1.6
Minnesota	3.1	2.2	2.1	Wisconsin	2.9	2.1	2.0
Mississippi	1.9	1.6	1.7	Wyoming	1.5	1.4	1.5

**Appendix D: Impact Estimates and Multipliers for Jobs, Earnings/Payroll and Output, by State**

State	Employment (thousands)	Job Multiplier	Effect of MTI Jobs on Jobs in State	Payroll (\$ millions)	Earnings Multiplier	Effect of MTI Payroll on State Payroll	Shipping (\$ millions)	Output Multiplier	Effect of MTI Output on Output in State
Alabama	2.3	2.6	5.9	86.9	1.9	163.3	446.9	1.9	850.3
Alaska	0.1	1.7	0.2	5.9	1.5	8.9	42.3	1.5	63.0
Arizona	7.2	2.4	17.0	422.2	1.9	795.2	1,688.4	1.7	2,954.3
Arkansas	2.6	2.2	5.7	90.0	1.7	157.4	499.1	1.8	908.2
California	84.0	3.5	295.3	5,253.9	2.3	12,073.6	26,341.6	2.2	58,932.7
Colorado	9.2	2.9	26.3	531.7	2.2	1,194.3	2,988.5	2.2	6,468.5
Connecticut	7.6	2.7	20.5	391.4	2.1	814.9	2,055.6	2.0	4,105.2
Delaware	3.1	2.6	8.2	160.4	1.8	285.4	872.5	1.7	1,521.6
District of Columbia	0.1	1.1	0.1	3.3	1.1	3.7	17.1	1.3	21.4
Florida	21.7	2.8	60.8	1,154.6	2.0	2,286.3	6,476.3	1.9	12,520.9
Georgia	6.7	3.3	22.5	310.7	2.2	685.8	1,474.1	2.2	3,180.0
Hawaii	0.3	1.9	0.6	11.4	1.7	19.3	92.0	1.7	156.3
Idaho	0.7	2.1	1.5	23.0	1.6	36.9	122.4	1.6	198.9
Illinois	11.9	3.4	40.8	594.1	2.4	1,425.5	2,389.5	2.3	5,533.8
Indiana	19.9	2.7	54.8	1,011.7	2.0	2,016.4	6,916.8	2.0	13,837.7
Iowa	2.0	1.9	3.7	75.7	1.7	126.2	350.5	1.7	587.1
Kansas	2.5	2.1	5.3	96.0	1.7	166.0	437.9	1.7	743.8
Kentucky	2.0	2.5	5.0	75.0	1.9	143.9	304.8	2.0	594.6
Louisiana	0.8	2.5	2.0	26.7	1.8	47.3	84.9	1.8	149.3
Maine	1.7	2.2	3.8	73.0	1.9	135.8	375.5	1.8	693.9
Maryland	4.9	2.9	14.1	288.3	1.9	556.9	1,336.6	1.8	2,467.7
Massachusetts	23.9	3.4	82.0	1,596.7	2.3	3,660.8	8,288.2	2.1	17,665.2
Michigan	9.4	3.5	32.8	467.9	2.2	1,032.7	2,422.4	2.1	5,164.8
Minnesota	26.9	3.1	83.1	1,707.5	2.2	3,731.5	6,775.0	2.1	14,391.6
Mississippi	0.9	1.9	1.7	41.8	1.6	67.5	103.7	1.7	178.5

State	Employment (thousands)	Job Multiplier	Effect of MTI Jobs on Jobs in State	Payroll (\$ millions)	Earnings Multiplier	Effect of MTI Payroll on State Payroll	Shipping (\$ millions)	Output Multiplier	Effect of MTI Output on Output in State
Missouri	5.7	2.9	16.7	244.0	2.1	523.3	1,204.2	2.1	2,538.8
Montana	0.4	1.7	0.7	15.0	1.5	22.9	55.5	1.6	90.1
Nebraska	4.8	1.8	8.8	208.2	1.7	346.8	1,762.2	1.7	3,011.3
Nevada	1.1	1.9	2.1	46.2	1.6	75.7	180.2	1.7	310.5
New Hampshire	3.8	2.1	8.1	197.9	2.0	390.3	759.8	1.9	1,470.9
New Jersey	20.5	3.1	63.4	1,415.2	2.3	3,221.1	5,772.6	2.2	12,621.0
New Mexico	1.2	2.4	2.7	42.4	1.7	71.4	331.4	1.6	544.5
New York	19.6	2.4	47.0	913.6	1.9	1,756.8	3,930.7	1.9	7,498.4
North Carolina	8.4	2.9	24.5	425.7	2.2	927.8	2,208.6	2.1	4,684.4
North Dakota	0.2	1.7	0.4	6.6	1.5	9.7	60.7	1.6	96.1
Ohio	12.4	2.9	35.3	528.6	2.2	1,180.1	2,819.1	2.2	6,168.1
Oklahoma	1.4	2.5	3.5	56.0	1.8	102.9	285.9	1.8	521.3
Oregon	4.7	2.6	12.1	232.5	2.0	472.1	1,039.9	2.0	2,061.5
Pennsylvania	22.2	3.6	79.3	1,116.4	2.4	2,630.9	5,709.4	2.3	13,133.5
Rhode Island	1.9	2.2	4.2	82.7	2.0	161.7	401.5	1.9	759.2
South Carolina	4.3	2.5	10.5	174.4	1.9	331.4	1,508.6	2.0	2,984.8
South Dakota	1.1	1.8	1.9	59.3	1.5	91.2	306.2	1.6	478.6
Tennessee	8.3	3.1	25.6	428.0	2.1	903.2	2,456.0	2.1	5,157.2
Texas	16.6	3.3	54.8	798.8	2.2	1,766.7	4,797.3	2.2	10,520.9
Utah	10.3	3.2	33.1	517.7	2.2	1,147.2	2,357.2	2.2	5,088.8
Vermont	0.4	1.9	0.8	14.9	1.6	24.4	100.7	1.6	163.7
Virginia	4.7	2.4	11.2	197.8	2.0	397.0	831.2	2.0	1,677.6
Washington	8.7	2.5	21.9	526.1	2.0	1,065.4	2,021.1	2.0	3,995.7
West Virginia	1.1	1.9	2.1	43.7	1.7	73.5	317.6	1.6	514.0
Wisconsin	14.4	2.9	41.4	897.1	2.1	1,853.1	4,442.6	2.0	8,902.5
Wyoming	0.1	1.5	0.1	3.8	1.4	5.2	19.9	1.5	28.9