



Bringing Innovation to Patient Care Worldwide

State Impacts of the Medical Technology Industry

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I. Executive Summary

The medical technology industry (MTI) has a strong and very positive impact on the economies of states through employment, payrolls and sales. The total economic benefits are a multiple of the direct impacts. In the “median” state (half of the states have larger and smaller impacts, respectively):

- Each medical technology job generates an additional 2.0 jobs in that state;
- Each medical technology payroll dollar generates an additional \$1.12 in payroll in that state; and
- Each dollar of medical technology sales generates an additional \$0.90 in sales in that state.

This report presents estimates of the economic contributions of the MTI to each of the 50 states and the District of Columbia. This includes 2006 estimates for each state of MTI employment, payrolls, and sales/shipments and of the multiplier economic effects on these same measures. “Multipliers” are higher and lower in various states.

The MTI is a strong and vibrant part of the U.S. economy and plays a critical role in our health economy. In 2006, the industry:

- Employed 357,700 workers;
- Paid \$21.5 billion in salaries; and
- Shipped \$123 billion worth of products.

The national multiplier impacts are a little more than twice as large as the “median” state multipliers:

- An additional MTI job generates 4.5 additional jobs across the nation;
- An additional \$1 of MTI payroll induces \$2.30 in added payroll across the nation; and
- Each dollar of additional MTI sales spurs \$1.90 in additional sales nationwide.

The national multipliers are larger than the state multipliers because a little more than half of the MTI stimulus spills across state lines. While MTI establishments purchase on average almost half of their parts and other supplies in state (in some states more, in others less), certain specialized inputs may need to be purchased from out-of-state suppliers. Similarly, the employees at an MTI establishment spend their incomes on goods and services made out of state as well as in state. Consequently, the national MTI impacts exceed state impacts.

MTI establishments can be found in every state as well as in the District of Columbia. As might be expected, large states had the highest MTI employment in 2006: California had the largest number of MTI jobs with 72,500 workers, followed by Massachusetts, Florida, Minnesota, New Jersey and Pennsylvania which had between 17,500 and 22,000 workers each.

Still, a number of smaller states had high concentrations of MTI jobs. Utah and Delaware actually had the highest concentration of MTI jobs relative to total employment – almost three times the national average – and Nebraska, New Hampshire and South Dakota were also in the top ten states with respect to share of MTI jobs relative to total employment.

In the large majority of states wage rates for MTI jobs were above the state average salary – largely because the industry requires a highly skilled and educated workforce that can command higher than average salaries. In the median state (Colorado) medical technology paid 24.4 percent more than the average job. In Mississippi, Arizona, Arkansas and Wisconsin, medical technology jobs paid more than 50 percent above the average job in that state. New York is the only state in which the MTI salary was less (about seven percent) than the state average salary, although MTI pay in N.Y. was still above the median state.

The analyses in this report are based on the most current and comprehensive data available from the U.S. Census Bureau. National estimates on the employment and size of the MTI are based on the 2005 Annual Survey of Manufactures, trended forward to 2006. The distribution of MTI jobs across the 50 states and the District of Columbia is based on the 2002 Economic Census, augmented by the 2002-2004 County Business Patterns. Salary comparisons are based on 2002 Census data, the most recent year with reliable and comprehensive 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.

II. Introduction

The medical technology industry (MTI) is recognized for the major contributions of its products to the health and well-being of the nation. However, there is less appreciation that this industry has additional 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 50 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 the traditional first line of “direct” impacts assessed in studies of regional economies.

Enterprises have been shown to have much greater aggregate impacts on local economies than just their own jobs, payrolls and sales. “Indirect” impacts are 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). 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 cascade of total benefits is generally several times larger than the value of the direct impacts, depending on the nature of the initial enterprise and the particular geographic area.

Economists have developed measures and tools to estimate the size of the indirect and induced impacts in an area, or the nation. The analyses rely on detailed data from the U.S. Economic Census about the types and numbers of enterprises that operate in the area of interest, and data about the input purchasing patterns of various types of businesses. This report uses multipliers from the RIMS II model of the U.S. Bureau of Economic Analysis. RIMS II is one of the most widely used models for this purpose.

The data for this report comes from the U.S. Census Bureau. Estimates of economic impacts of the MTI (jobs, payroll and value of shipments) are presented for 2006. The initial source of data for states was the 2002 Economic Census and the 2002-2004 County Business Patterns Survey. Values were projected to 2006 based on national trends from the Annual Survey of Manufactures. More detail on data sources and the methodology is in the Appendix.

III. The Medical Technology Industry (MTI)

Medical technology products range from the everyday to the extraordinary. Familiar items include vision products (eyeglasses and contact lenses), stethoscopes, thermometers and blood pressure monitors. More complex products include heart pacemakers, kidney dialysis machines, replacement joints, irradiation and imaging systems, diagnostics for diseases and genetic tests. Most of the equipment and furnishings in hospitals, physicians' and dentists' offices and medical laboratories are products of the MTI. Note that pharmaceutical products are an equally valuable, but distinct industry, and are not included in this report. Medical technology is fundamental to modern medicine.

Medical technology has directly contributed to the improvement of life expectancy and quality of life over the past two centuries. Life expectancy in the U.S. at birth increased from 47 years in 1900 to 77 years in 2000. Medical technology was a major element in this improvement, together with public health (e.g., sanitation, safety) and pharmaceuticals. The fruits of these endeavors are ubiquitous, are constantly improving and growing, and are essential to virtually all of medicine.

Medical technologies are generally used by, and are inputs to, the services delivered by the front-line providers of medical care (e.g., hospitals, clinics, medical labs). 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.

A. Direct Impacts on States

The MTI employed 357,700 workers across the nation in 2006. Workers earned about \$21.5 billion, or an average of \$60,000 per year. The total value of industry shipments was \$123 billion. This constituted about 5.5 percent of the total health industry, which had total revenue of almost \$2 trillion in 2005, 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 MTI are tracked by the Census Bureau (**Exhibit 1**). Over 50 percent of the sales and employment are in the two sectors that produce (a) orthopedic devices, surgical sutures and dressings (\$33.2 billion in sales; 101,000 employees); and (b) surgical and medical instruments, supplies and appliance, such as scalpels, clamps, and syringes (\$33 billion in sales; 100,000 employees). The next largest sector (\$22 billion in sales; 51,000 employees) manufactures such diverse electrical devices such as pace makers, hearing aids, heart monitors, endoscopes, ultrasound equipment and magnetic resonance imagers. The other five sectors are much smaller, and their names are descriptive of the indicated products.

Exhibit 1

Vital Statistics of the Medical Technology Industry

Industry Sector	Employees (in 000s)	Payroll (in billions)	Sales (in billions)
Medical Technology Industry	357.7	\$21.53	\$123.0
In vitro diagnostic substances	25.4	\$1.93	\$11.3
Electromedical/therapeutic devices	51.3	\$4.13	\$22.0
Irradiation apparatuses	18.8	\$1.48	\$9.2
Laboratory apparatus and furniture	23.1	\$1.24	\$6.1
Surgical and medical instruments	100.1	\$5.47	\$31.2
Surgical supplies and appliances	101.3	\$5.55	\$33.2
Dental equipment and supplies	19.2	\$0.78	\$4.3
Ophthalmic goods	18.4	\$0.95	\$5.7

Most economic developers and public officials concerned with economic development would consider MTI establishments to be very desirable businesses. This is reflected in several characteristics. The foremost reason is that the MTI is among the highest paying industries (more on this later). This reflects the MTI's requirements for a highly skilled and educated workforce. High income/education households have a significant level of disposable income, and high demand for consumer durables (houses, cars, personal electronic equipment) and consumables (e.g., food, clothes, dining out, entertainment), which creates further jobs.

Second, a medical technology business provides attractive employment opportunities for local citizens – particularly more educated, young people at the beginning of a career – and attracts highly skilled and educated persons into the local area. This more educated population tends to have a strong interest in education both for their children and continuing education for themselves, and is supportive of the local educational system.

State by state estimates of primary or direct economic impacts are presented in the **Appendix in Exhibit A**. Estimates are for 2006, and include data on employment, total payrolls and sales (value of shipments).

California, with 72,500 jobs out of the national total of 357,700 has the largest amount of MTI employment (**Exhibit 2**). The other states in the top ten are each “large” population states.

Exhibit 2
Ten States with Largest MTI Employment

State	Employment	State	Employment
California	72,485	Pennsylvania	17,482
Massachusetts	21,847	New York	16,607
Florida	19,949	Indiana	15,548
Minnesota	18,571	Texas	14,253
New Jersey	17,953	Ohio	12,820

Still, a certain number of “smaller” states get a sizeable impact from the MTI when we examine the share of state employment (**Exhibit 3**). Utah and Delaware have the highest concentrations of medical technology employment, as measured by the MTI’s share of total state employment. For example, Utah has 8,900 MTI jobs, out of state private employment of 935,000 (thus about 0.95 percent of private employment). Nationally the MTI makes up 0.31 percent of private employment. The concentration index is the ratio of the Utah’s share of MTI employment to Utah’s share of total private employment. So Utah has over three times as many MTI jobs as might be expected. A state with an index greater than “1.0” has a higher concentration of MTI jobs, while an index below 1.0 means there are fewer MTI jobs than the national average.

**Exhibit 3
Ten States with Highest MTI Share of State Employment**

State	Concentration Index	State	Concentration Index
Utah	3.06	Nebraska	1.93
Delaware	2.52	New Hampshire	1.93
Minnesota	2.50	South Dakota	1.85
Massachusetts	2.36	California	1.76
Indiana	1.93	New Jersey	1.60

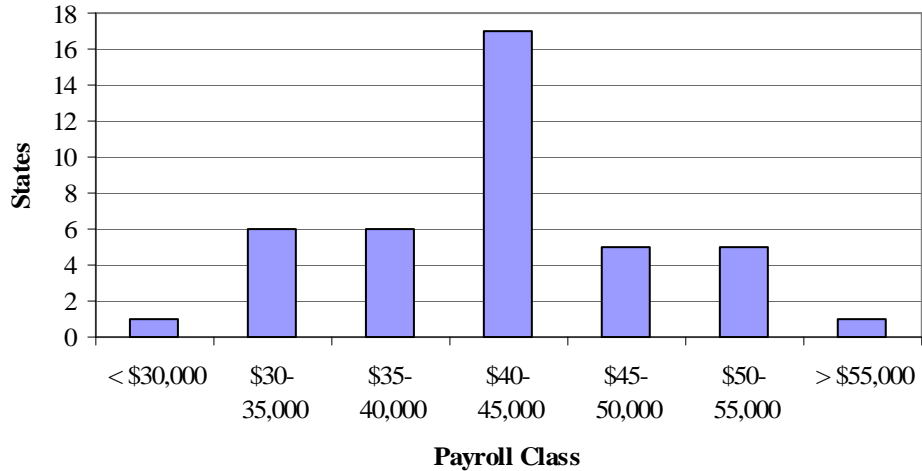
Besides Utah, there are four other states in the top ten that are “smaller” states (total private employment of fewer than one million workers): Delaware, Nebraska, New Hampshire and South Dakota. Each of these states has at least several thousand jobs in the MTI, and in a small state this can constitute a material contribution to the total economy.

B. Medical Technology Jobs Pay High Wages

One of the outstanding characteristics of the MTI is the strong pay scale. Nationally, medical technology jobs paid \$45,600 per year compared to \$35,100 in the average job (this is based on 2002 data, the most recent year with reliable and comprehensive data that could be used to make comparisons across states; the study estimates average MTI pay rose to \$60,000 in 2006). This is almost a 30 percent premium for jobs in the MTI. Medical technology also pays a healthy premium relative to other manufacturing jobs. The average U.S. manufacturing job paid \$40,300 per year, so medical technology paid about 15 percent more. High pay scales indicate that the industry requires workers with high levels of skill, education, training and experience.

There was an appreciable level of variation in payroll per employee across states (**Exhibit 4**). Florida was the median state, at \$41,800 per year, and a total of 17 states had values between \$40,000 and \$45,000. Annual pay per medical technology employee was \$50,000 or greater in six states (Washington, Massachusetts, New Jersey, Minnesota, Maryland, and Georgia), and pay was over \$49,000 in California, Wisconsin and Arizona. In contrast, there were only six states in which pay was less than \$34,000.

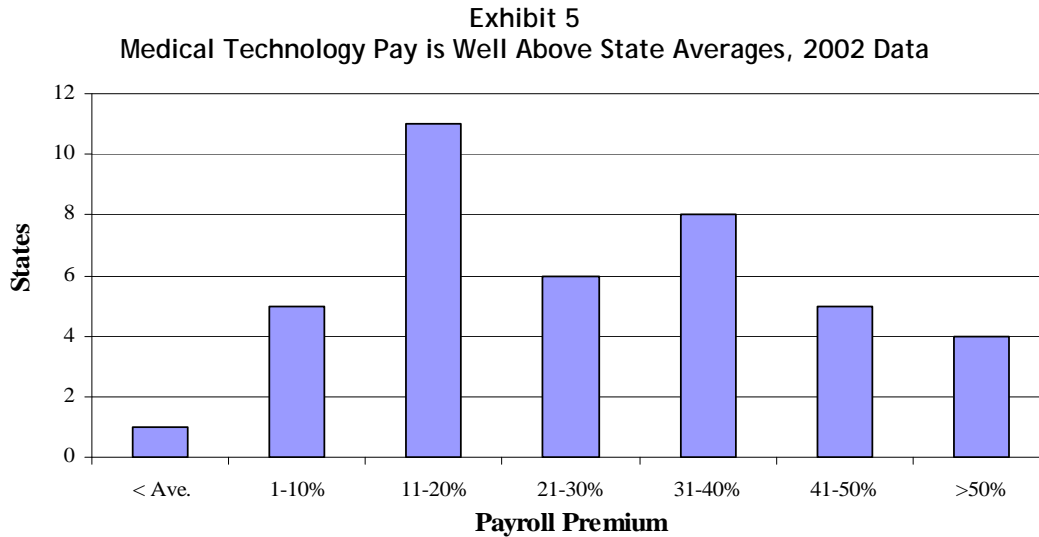
Exhibit 4
Medical Technology Payrolls Are Well Above State Averages, 2002



The more important finding is that in most states medical technology pay per employee is substantially higher than the statewide average for all jobs. In all of the states with lower than average medical technology pay, it was still above the state average pay.

Exhibit 5 shows that in several states medical technology jobs pay more than 50 percent above the average job in that state (these were Mississippi, Arizona, Arkansas and Wisconsin). In only one state does medical technology pay less than the average job and that state is New York, which has the highest average pay scale in the nation (but lower than the District of Columbia).

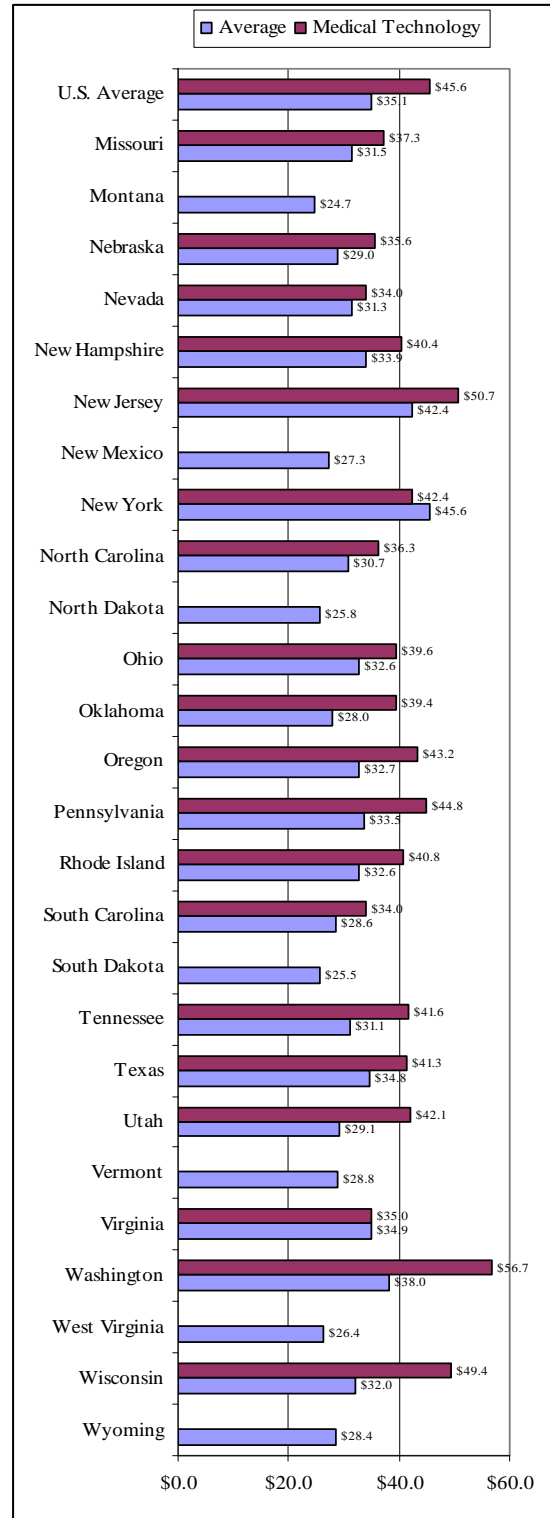
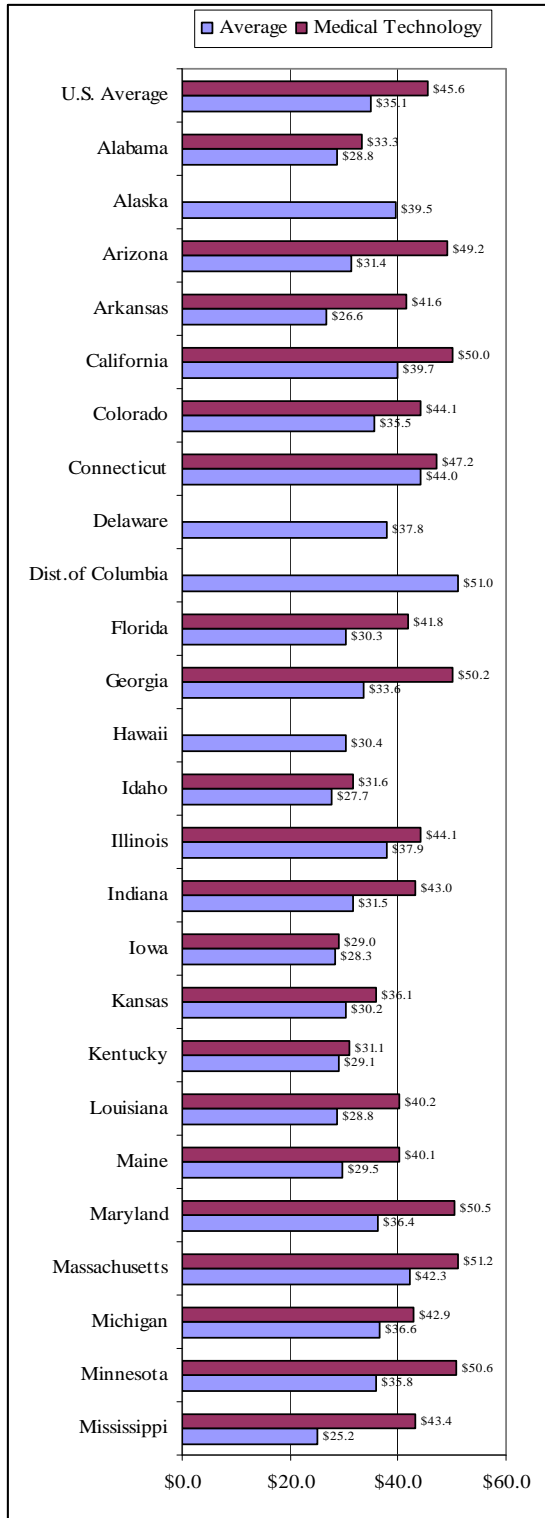
In the median state, Colorado, medical technology jobs pay 24.4 percent more than the average job. Detailed comparisons could not be made for ten of the smallest states and the District of Columbia because payroll data was suppressed by the Department of Commerce to preserve confidentiality.



State-by-state comparisons of medical technology wages and the state average are graphed in **Exhibit 6**. For each state data is shown on the average annual payroll per employee of (reporting) medical technology establishments relative to the average annual payroll of all private establishments (as reported in the 2002 County Business Patterns Survey).

For example, in Alabama the MTI paid \$33.3 per worker compared to the state average of \$28.8 per worker. There is no MTI value for Alaska because the payroll data was suppressed in order to protect the confidentiality of the few, small medical technology establishments in the state (Alaska is estimated to have fewer than 100 medical technology jobs).

Exhibit 6
 State by State Comparisons of Medical Technology Pay versus State Average in 2002
 (MTI and Total Private Payroll per Employee, \$ in 1,000s)



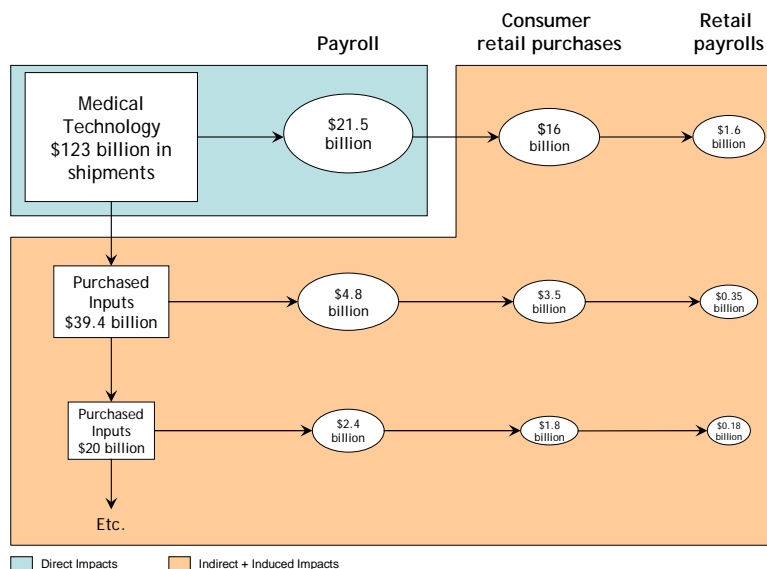
IV. How Medical Technology Industry Impacts are Multiplied

The direct employment and payroll impacts of a medical technology establishment are just the “tip of the iceberg” in terms of the economic benefits. Additional benefits accrue through several mechanisms, which are schematically portrayed in **Exhibit 7**. These are consumer spending by the MTI workforce, purchases of goods and services as “inputs” to medical technology production, marketing and sales processes (which employees workers), and subsequent consumer spending by the input industry workforce. These effects are repeated, although at a fraction of the original impact.

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 heart 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 MTI multiplier can be demonstrated with national data (see **Exhibit 7**). The MTI had shipments worth \$123 billion in 2006. Firms engaged in this industry paid \$21.5 billion to their 357,700 employees. These economic values are considered the “direct” impacts of an industry (shaded in blue). Direct impacts are often public information.

Exhibit 7
Graphical Exposition of the “Multiplication” of Direct Economic Benefits



The multiple of the direct impacts arises from (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 “tan” colored part of Exhibit 7.

The indirect economic impacts from the MTI arise from the \$39.4 billion in purchased inputs. These purchases include components and parts, raw materials (e.g., metals, plastics, chemicals), office supplies and utilities (communications, energy, water). The enterprises that sold the inputs generate their own cycles of impacts from further purchases of inputs as well as their payrolls. In a “typical” or median establishment purchased inputs constitute about 50 percent of the value of sales and payrolls about 12 percent. 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. MTI workers spent about \$16 billion 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 ten percent of their sales (most of their costs are for the goods they sell), and these incomes 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 7**, each subsequent step in the impact multiplier chain is materially smaller than the prior step, 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).

Economic impact multipliers for manufacturing establishments are often in the range of about “2.0” to “3.0,” although smaller and larger multipliers are common. Multipliers are unique to each particular industry (due to their distinct differences in manufacturing processes, staffing patterns and use of purchased inputs) and the specific geographic area. Multiplier impacts within a state or local area will be smaller than for the nation as a whole, because specialized inputs may not be available in the state or locality.

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 (1997 and 2002 are the most recent). 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.

A. MTI Impacts on State Employment

The MTI has a quite robust impact on the economy of the U. S., and on the respective states in which MTI establishments operate. These impacts are again measured in terms of jobs, payrolls and sales/value of shipments. In terms of jobs, the 357,700 MTI jobs are estimated to generate a total of 1.96 million jobs, representing a “direct effect” job multiplier of 5.47. That is, each job in the U.S. MTI generates an additional 4.47 jobs in the national economy ($1 + 4.47 = 5.47$). This impact estimate represents the sum of the impacts across all eight of the medical technology product sectors, which have values ranging from 4.0 to 9.0, with the median value equal to about 5.2.

The job multipliers in states are distinctly less than the national multiplier. The median state employment multiplier is 3.01 (in Connecticut each MTI job only generated an additional 2.01 jobs). About half of the state job multipliers are between 2.50 and 3.50 (see **Exhibit 8**). There are 15 states with job multipliers greater than 3.5, and 12 states with values below 2.5.

Exhibit 8
About Half of State MTI Job Multipliers are Between 2.5 and 3.5



State and local area multipliers are less than the national multiplier because establishments in smaller areas will 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 the MTI, but state officials will be more concerned about the local area impacts.

The states with the highest multipliers are identified in **Exhibit 9**. California has the highest multiplier, at 4.31, followed closely by Indiana, Georgia and Maryland. The primary characteristic of this set of high multiplier states is that they are larger than average states and they have large medical technology sectors (see **Exhibit A** in the **Appendix**). 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 a concentration of an industry 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 9
The Ten States with the Highest MTI Job Multipliers

California	4.31	North Carolina	3.76
Indiana	4.07	Minnesota	3.75
Georgia	3.99	Pennsylvania	3.74
Maryland	3.98	Texas	3.71
Massachusetts	3.83	New Jersey	3.65

Three of the states on the top ten list have slightly different stories. Maryland has the smallest MTI employment at only 3,900 workers. However most of these jobs were in the in vitro diagnostics sector, which has the highest state and national multipliers of any of the MTI sectors. Maryland’s in vitro diagnostics jobs multiplier was 4.9, just about the median for this industry sector. Georgia and North Carolina have about 7,000 and 8,000 MTI workers, respectively, but they are concentrated in the surgical instruments and appliances sectors, and have relatively high job multipliers for these industries. These states have apparently developed healthy supply chains for MTI, even with relatively moderate amounts of industry.

The variability of jobs/employment multipliers across MTI sectors and states is demonstrated in **Exhibit 10**. The median and quartile state multiplier values are listed for each MTI sector, along with the national multiplier. At a median state value of 4.64, the in vitro diagnostic multiplier is materially greater than any of the other sectors, and several sectors have median state values of about 2.3, or half the value of the in vitro multiplier. This demonstrates that the mix of MTIs in a state can also have a large impact on the ultimate MTI multiplier, which is a weighted average of the multipliers of each sector operating in the state.

Exhibit 10
Median and Quartile State Employment Multipliers for the MTI Sectors

Industry Sector	Median	25 th - 75 th percentiles	National
Medical Technology Industry	3.01	2.58 - 3.57	5.47
Invitro diagnostic substances	4.64	3.39 - 5.44	9.36
Electromedical/therapeutic devices	2.24	2.42 - 3.36	5.23
Irradiation apparatuses	3.50	2.78 - 4.33	6.96
Laboratory apparatus and furniture	2.75	2.31 - 3.30	4.91
Surgical and medical instruments	3.00	2.46 - 3.40	5.20
Surgical supplies and appliances	2.81	2.27 - 3.11	5.21
Dental equipment and supplies	2.32	2.32 - 2.96	4.41
Ophthalmic goods	2.34	2.07 - 2.60	3.96

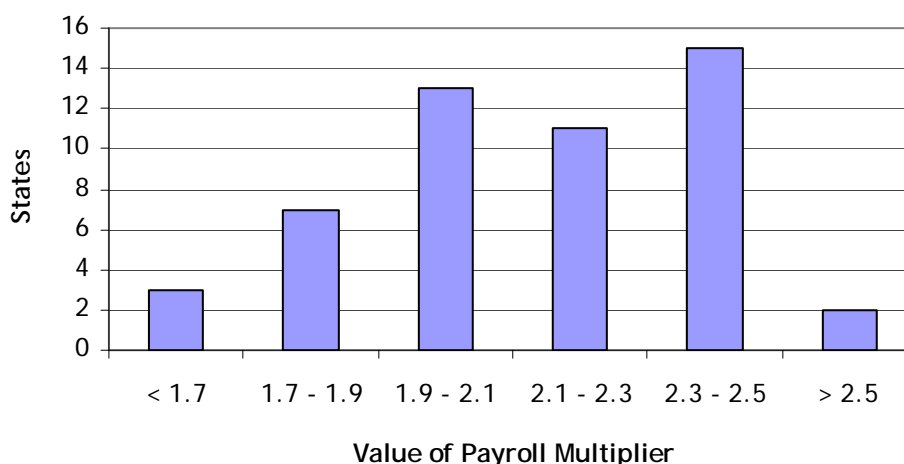
There are also lessons from low state multipliers (in the case of the MTI, less than 2.5). Multipliers in this range are likely to reflect the fact that there has been little presence of an industry in the state (or that it has only come into the state recently), and that there has been little incentive to attract a network of specialized suppliers. Thus, when a new establishment of an industry locates in a state the impact multiplier is likely to be relatively low. It would be expected that the impact multiplier would grow over time as local supply networks develop.

B. MTI Impacts on State Payrolls and Output

Payroll impacts on states are probably just as important as the employment/jobs impacts. State and local economic developers are concerned about the pay scale of the jobs attracted to an area. The MTI makes very positive contributions to states in which it operates (the fact that payroll per employee is above most state average pay scales was discussed above). The \$21.5 billion U.S. MTI payroll generated a total of \$70.8 billion in payrolls across all industries in 2006. This is a “direct effect” multiplier for payrolls across the nation of 3.29.

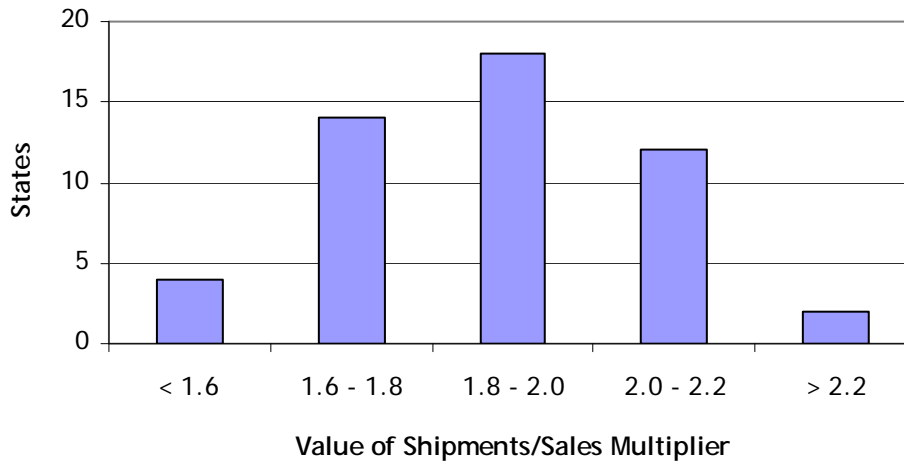
Payroll multipliers at the state level are again more modest: the median state impact was 2.13: each additional dollar of MTI payroll generated an additional 1.13 dollars in payroll in the rest of the state economy. The quartiles were 1.95 and 2.37, so half of states had payroll multipliers between these values (**Exhibit 11**). Payroll multipliers for the MTI are smaller than employment multipliers because ultimately much of the payroll is spent in the retail sector and for “low tech” inputs, where pay scales are much lower than in the MTI.

Exhibit 11
About Half of State MTI Payroll Multipliers are Between 1.9 and 2.37



Discussions of the contribution of an industry to a state or locality often give more prominence to sales/value of shipments than to jobs or payrolls. The analysis indicates that nationally the \$123 billion in MTI shipments generated a total of \$355 billion in output, which represents a sales multiplier of 2.86. Thus, each dollar of MTI shipments generated an additional \$1.86 of shipments/sales across other industries, including MTI suppliers, their suppliers and retailers. The median state shipments/sales multiplier was 1.90, and half of the state sales multipliers were between 1.75 and 2.05 (**Exhibit 12**).

Exhibit 12
About Half of State MTI Shipments Multipliers are Between 1.75 and 2.05



The detailed state-by-state estimates of MTI impacts are in the **Appendix, Exhibit C**. Estimates are shown of the MTI direct impacts (employment/jobs, payrolls, and shipments/sales) as well as the respective total impacts, which are the sum of the direct impacts plus the indirect impacts (via purchases of input supplies) plus the induced impacts (largely consumer purchases of retail goods). The state-by-state multipliers are also included in this exhibit.

As discussed above, 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, payroll and sales/shipments and the respective impact multipliers obtained from the Bureau of Economic Analysis's Regional Input-Output Modeling System.

V. Conclusion

The medical technology industry (MTI) is a critical component of the U.S. health sector. In addition to the profound contributions of medical technology to the health and well-being of our populace, in 2006 the industry:

- Employed 357,700 workers;
- Paid \$21.5 billion in salaries; and
- Shipped \$123 billion worth of products.

The national impacts of this industry were even more substantial. Taking into account the national multiplier impacts, the MTI created (direct plus indirect plus stimulated impacts):

- A total of 1.96 million jobs;
- Payrolls that totaled \$93 billion; and
- A total of \$355 billion in shipments/sales.

These values are inclusive of the “direct” impacts itemized above. These figures can be compared to 2006 national totals of 136 million jobs and gross domestic product of \$13.25 trillion. Thus the MTI had total impacts (direct plus indirect effects) of 1.4 percent of national employment and 2.7 percent of gross domestic product. The impact on GDP is a larger share than for jobs because the medical technology industry is a high wage and high skill industry, as is true for many of the inputs that it purchases to build products.

The MTI has desirable impacts on economies of the respective states through their employment, payroll and sales. The total economic benefits are a multiple of the direct impacts. In the “median” state, the impact of the MTI (half of the states have greater and lesser impacts, respectively) is:

- Each medical technology job generates an additional 2.0 jobs in that state;
- Each medical technology payroll dollar generates an additional \$1.05 in payroll in that state; and
- Each dollar of medical technology sales generates an additional \$0.90 in sales in that state.

State multipliers are smaller than the national multipliers because certain specialized inputs may not be available from in-state suppliers, so purchases are done outside of the state.

In states that have higher than average concentrations of MTIs, or where such industries have operated for longer periods of time (which has allowed in-state supply networks to develop and mature), the impact multipliers are somewhat greater than the median state impacts.

Medical technology establishments operate in every state as well as the District of Columbia. Large states had the highest MTI employment in 2006: California had 72,500 MTI workers, and the next largest were Massachusetts, Florida, Minnesota, New Jersey and Pennsylvania with between 17,500 and 22,000 workers each. Importantly, several smaller states (with fewer than one million workers) had high concentrations of MTI jobs. Utah and Delaware actually had the highest concentration of MTI jobs relative to total employment – almost three times the national average – and Nebraska, New Hampshire and South Dakota were also in the top ten states with respect to share of MTI jobs relative to total employment.

In virtually all states wage rates for MTI jobs were above the state average salary. The median state (Colorado) paid 24.4 percent more to MTI workers than workers in the average job. In Mississippi, Arizona, Arkansas and Wisconsin, medical technology jobs paid more than 50 percent above the average job in that state. Only in the state with the highest average pay scale in the nation – New York – is the MTI pay less (about seven percent) than the state average salary. The MTI pay in New York was still above the median state MTI pay.

Appendix A Industry Definition, Data Sources and Methodology

The medical technology industry (MTI) 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. Still, within each industry sector there are at least several different product types (e.g., prescription eyeglasses and contact lenses under ophthalmic goods). The Census Bureau industry sectors that collectively comprise the MTI as defined in this report are identified in **Exhibit A**.

Exhibit A Manufacturing Sectors Included in the Medical Technology Industry

Manufacturing Industry Sector	Code	Manufacturing Industry Sector	Code
In vitro diagnostic substances	325413	Surgical and medical instruments	339112
Electromedical and electrotherapeutic apparatuses	334510	Surgical supplies and appliances	339113
Irradiation apparatuses	334517	Dental equipment and supplies	339114
Laboratory apparatus and furniture	339111	Ophthalmic goods	339115

Available data was obtained for each of the eight above specified sectors for each state and the District of Columbia. This included data about state-level employment, payroll and value of shipments, as well as the economic impact “multipliers.”

All of the data for this report has been acquired from the Bureau of Economic Analysis, U.S. Department of Commerce. This includes both data about size and location of the MTI as well as the economic impact “multipliers”.

The primary source of economic size and location data for this report is the 2002 Economic Census (EC-2002) from the Bureau of Economic Analysis (BEA), U.S. Economics and Statistics Administration. EC-2002 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 payroll, each by state. The Economic Census is performed every five 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 (IRS) and private business data services. “Missing” data is logically or statistically imputed, providing a rigorous, comprehensive profile of economic activity in the nation.

The Economic Census has two main limitations. First, the MTI has grown since 2002. Second, EC-2002 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 MTI 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 2005 data in November 2006.

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.” ASM national data has been used to project 2002 values to 2005, based on the assumption that national proportional changes in employment, payroll and shipments were equivalent across all states. Projected changes from 2005 to 2006 were based on the 2004-2005 rates of change in each measure.

Data suppression was a minor issue. The data on employment, payroll and values of shipments that was suppressed represented approximately ten percent of the respective national totals across the eight 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-industry sector basis. The methods used to “fill in” the suppressed ten percent of jobs, payroll and shipments are described in the paragraphs below.

While the EC-2002 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 EC-2002 indicated the size range of employment (e.g., 100-249, 250-499, 500-999, 1000-2499), but not the payroll 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 payroll and value of shipments were estimated based on the national average payroll and shipments per employee, respectively.

Data for states with fewer than 100 workers in an industry sector were entirely suppressed in EC-2002. In this situation, data was 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 EC-2002. Again, the mid-range value of employment was used and multiplied by the industry sector national average for payroll 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 nearly 500 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, which in-vitro diagnostics is a part of. The most recent multipliers were released in November 2006, and are based on 1997 national benchmark input-output data and 2004 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 payroll 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 payroll for the medical technology sectors.

Data Sources

2002 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: 2005. U.S. Census Bureau, Economics and Statistics Administration, U.S. Department of Commerce, November, 2006.

County Business Patterns, United States 2004. U.S. Census Bureau, Economics and Statistics Administration, U.S. Department of Commerce, June 2006.

Regional Input-Output Modeling System (RIMS II), Regional Economic Analysis Division, Bureau of Economic Analysis, U.S. Department of Commerce. Multipliers for the Medical Technology Industry in the 50 States and DC were purchased from RIMS II.

Data from the 2002 Economic Census, Annual Survey of Manufactures and County Business Patterns were accessed January 2007 through "American FactFinder," the U.S. Census Bureau Web Portal.

Exhibit A
Employment, Payroll and Sales of the Medical Technology Industry, by State

State	Employment (FT and PT)	Payroll (\$ in 000's)	Sales (\$ in 000's)	State	Employment (FT and PT)	Payroll (\$ in 000's)	Employment (FT and PT)	Sales (\$ in 000's)
United States	357,670	\$21,532,031	\$21,532,031	Missouri	4,043	\$207,999	4,043	\$1,217,110
Alabama	2,328	\$109,432	\$516,831	Montana	266	\$12,776	266	\$73,103
Alaska	43	\$2,666	\$16,310	Nebraska	4,651	\$250,473	4,651	\$1,501,838
Arizona	4,506	\$285,105	\$1,441,380	Nevada	295	\$13,706	295	\$85,001
Arkansas	2,236	\$152,759	\$824,310	New Hampshire	3,298	\$170,818	3,298	\$850,751
California	72,485	\$4,709,613	\$26,934,535	New Jersey	17,953	\$1,182,246	17,953	\$5,898,160
Colorado	7,969	\$473,368	\$2,602,314	New Mexico	989	\$52,285	989	\$312,444
Connecticut	7,638	\$462,107	\$2,839,547	New York	16,607	\$898,232	16,607	\$4,789,721
Delaware	3,067	\$196,603	\$1,260,761	North Carolina	7,804	\$380,650	7,804	\$2,706,456
District of Columbia	34	\$1,877	\$10,446	North Dakota	108	\$5,103	108	\$29,666
Florida	19,949	\$1,074,927	\$5,656,912	Ohio	12,820	\$669,048	12,820	\$3,832,584
Georgia	6,801	\$413,349	\$2,583,508	Oklahoma	983	\$51,691	983	\$334,274
Hawaii	76	\$4,344	\$25,590	Oregon	3,927	\$210,767	3,927	\$957,207
Idaho	451	\$21,153	\$106,265	Pennsylvania	17,482	\$998,141	17,482	\$5,488,656
Illinois	9,967	\$571,253	\$3,070,157	Rhode Island	1,358	\$75,889	1,358	\$423,592
Indiana	15,548	\$923,503	\$7,068,951	South Carolina	3,702	\$199,598	3,702	\$1,370,837
Iowa	1,107	\$54,419	\$290,626	South Dakota	1,767	\$93,662	1,767	\$572,430
Kansas	1,254	\$70,493	\$666,336	Tennessee	5,820	\$323,062	5,820	\$2,073,257
Kentucky	1,516	\$61,989	\$382,672	Texas	14,253	\$766,942	14,253	\$4,268,898
Louisiana	372	\$21,418	\$119,244	Utah	8,894	\$509,806	8,894	\$2,576,363
Maine	2,048	\$114,985	\$521,624	Vermont	199	\$12,299	199	\$70,557
Maryland	3,867	\$262,013	\$1,158,159	Virginia	2,934	\$150,167	2,934	\$1,053,764
Massachusetts	21,847	\$1,472,064	\$8,171,987	Washington	7,131	\$565,537	7,131	\$2,996,111
Michigan	6,089	\$335,796	\$2,111,015	West Virginia	806	\$40,600	806	\$248,115
Minnesota	18,571	\$1,266,699	\$6,662,554	Wisconsin	8,805	\$573,026	8,805	\$3,973,349
Mississippi	771	\$43,319	\$175,644	Wyoming	236	\$12,252	236	\$77,730

Source: The U.S. Census Bureau, as adjusted by The Lewin Group.

Exhibit B
Average Impact Multipliers for Medical Technology, by State

State	Multiplier			State	Multiplier		
	Jobs	Payroll	Sales		Jobs	Payroll	Sales
Median State	3.00	2.12	1.90	Missouri	3.55	2.44	2.02
US-National	5.47	3.29	2.89	Montana	2.13	1.72	1.61
Alabama	2.72	2.10	1.97	Nebraska	2.60	2.10	1.88
Alaska	2.22	1.64	1.42	Nevada	2.03	1.88	1.68
Arizona	2.58	2.02	1.79	New Hampshire	2.93	2.19	1.96
Arkansas	3.12	2.02	1.90	New Jersey	3.65	2.50	2.11
California	4.31	2.58	2.21	New Mexico	3.06	1.77	1.61
Colorado	3.25	2.37	2.09	New York	2.67	2.13	1.87
Connecticut	3.01	2.12	1.92	North Carolina	3.76	2.48	2.12
Delaware	3.58	2.43	1.70	North Dakota	2.18	1.81	1.61
Dist. of Col.	2.38	1.46	1.21	Ohio	3.20	2.37	2.14
Florida	3.21	2.10	1.87	Oklahoma	3.04	2.03	1.88
Georgia	3.99	2.50	2.13	Oregon	2.93	2.14	1.96
Hawaii	1.99	1.91	1.69	Pennsylvania	3.74	2.44	2.23
Idaho	2.76	2.00	1.78	Rhode Island	2.58	2.05	1.86
Illinois	3.63	2.59	2.24	South Carolina	2.73	2.08	1.96
Indiana	4.07	2.36	1.98	South Dakota	2.76	1.85	1.65
Iowa	2.38	1.95	1.86	Tennessee	3.57	2.30	2.05
Kansas	2.97	2.17	1.78	Texas	3.71	2.31	2.10
Kentucky	2.47	2.06	1.98	Utah	3.28	2.34	2.07
Louisiana	2.63	2.02	1.75	Vermont	2.14	1.78	1.67
Maine	3.48	2.38	1.78	Virginia	2.67	2.21	1.94
Maryland	3.98	2.44	1.83	Washington	3.26	2.13	1.94
Massachusetts	3.83	2.48	2.06	West Virginia	2.25	1.76	1.58
Michigan	3.51	2.24	1.97	Wisconsin	3.44	2.19	2.01
Minnesota	3.75	2.27	2.08	Wyoming	1.72	1.61	1.50
Mississippi	2.23	1.93	1.79				

Exhibit C
Impact Estimates and Multipliers for Jobs, Payroll and Output, by State

State Name	MTI Jobs (FT & PT)	Multiplier for Jobs	Effect of MTI Jobs on Jobs in State	MTI Payroll	Multiplier for Earnings	Effect of MTI Payroll on State Payroll	MTI Shipments	Multiplier for Output	Effect of MTI Sales on Output in State
		Average		(\$ in millions)	Average	(\$ in millions)	(\$ in millions)	Average	(\$ in millions)
Sum of States	357.7	3.60	1,286.0	\$21,532	2.36	\$50,851	\$123,000	2.06	\$253,147
National Total	357.7	5.47	1,956.3	\$21,532	3.29	\$70,809	\$123,000	2.89	\$354,918
Alabama	2.3	2.72	6.3	\$109	2.10	\$230	\$517	1.97	\$1,021
Alaska	0.0	2.22	0.1	\$3	1.64	\$4	\$16	1.42	\$23
Arizona	4.5	2.58	11.6	\$285	2.02	\$575	\$1,441	1.79	\$2,577
Arkansas	2.2	3.12	7.0	\$153	2.02	\$308	\$824	1.90	\$1,567
California	72.5	4.31	312.8	\$4,710	2.58	\$12,148	\$26,935	2.21	\$59,587
Colorado	8.0	3.25	25.9	\$473	2.37	\$1,122	\$2,602	2.09	\$5,446
Connecticut	7.6	3.01	23.0	\$462	2.12	\$980	\$2,840	1.92	\$5,438
Delaware	3.1	3.58	11.0	\$197	2.43	\$478	\$1,261	1.70	\$2,138
District of Col.	0.0	2.38	0.1	\$2	1.46	\$3	\$10	1.21	\$13
Florida	19.9	3.21	64.0	\$1,075	2.10	\$2,256	\$5,657	1.87	\$10,552
Georgia	6.8	3.99	27.2	\$413	2.50	\$1,033	\$2,584	2.13	\$5,512
Hawaii	0.1	1.99	0.2	\$4	1.91	\$8	\$26	1.69	\$43
Idaho	0.5	2.76	1.2	\$21	2.00	\$42	\$106	1.78	\$189
Illinois	10.0	3.63	36.1	\$571	2.59	\$1,477	\$3,070	2.24	\$6,885
Indiana	15.5	4.07	63.3	\$924	2.36	\$2,181	\$7,069	1.98	\$13,976
Iowa	1.1	2.38	2.6	\$54	1.95	\$106	\$291	1.86	\$541
Kansas	1.3	2.97	3.7	\$70	2.17	\$153	\$666	1.78	\$1,186
Kentucky	1.5	2.47	3.7	\$62	2.06	\$128	\$383	1.98	\$758
Louisiana	0.4	2.63	1.0	\$21	2.02	\$43	\$119	1.75	\$209
Maine	2.0	3.48	7.1	\$115	2.38	\$273	\$522	1.78	\$926
Maryland	3.9	3.98	15.4	\$262	2.44	\$639	\$1,158	1.83	\$2,119
Massachusetts	21.8	3.83	83.8	\$1,472	2.48	\$3,646	\$8,172	2.06	\$16,854
Michigan	6.1	3.51	21.4	\$336	2.24	\$752	\$2,111	1.97	\$4,160
Minnesota	18.6	3.75	69.7	\$1,267	2.27	\$2,881	\$6,663	2.08	\$13,878
Mississippi	0.8	2.23	1.7	\$43	1.93	\$84	\$176	1.79	\$314

Exhibit C, continued
Impact Estimates and Multipliers for Jobs, Payroll and Output, by State

State Name	MTI Jobs (FT & PT)	Multiplier for Jobs	Effect of MTI Jobs on Jobs in State	MTI Payroll (\$ in millions)	Multiplier for Earnings	Effect of MTI Payroll on State Payroll (\$ in millions)	MTI Shipments (\$ in millions)	Multiplier for Output	Effect of MTI Sales on Output in State (\$ in millions)
		Average			Average			Average	
Missouri	4.0	3.55	14.4	\$208	2.44	\$508	\$1,217	2.02	\$2,454
Montana	0.3	2.13	0.6	\$13	1.72	\$22	\$73	1.61	\$118
Nebraska	4.7	2.60	12.1	\$250	2.10	\$526	\$1,502	1.88	\$2,822
Nevada	0.3	2.03	0.6	\$14	1.88	\$26	\$85	1.68	\$143
New Hampshire	3.3	2.93	9.7	\$171	2.19	\$374	\$851	1.96	\$1,670
New Jersey	18.0	3.65	65.6	\$1,182	2.50	\$2,952	\$5,898	2.11	\$12,417
New Mexico	1.0	3.06	3.0	\$52	1.77	\$93	\$312	1.61	\$504
New York	16.6	2.67	44.4	\$898	2.13	\$1,909	\$4,790	1.87	\$8,941
North Carolina	7.8	3.76	29.3	\$381	2.48	\$945	\$2,706	2.12	\$5,738
North Dakota	0.1	2.18	0.2	\$5	1.81	\$9	\$30	1.61	\$48
Ohio	12.8	3.20	41.0	\$669	2.37	\$1,587	\$3,833	2.14	\$8,209
Oklahoma	1.0	3.04	3.0	\$52	2.03	\$105	\$334	1.88	\$630
Oregon	3.9	2.93	11.5	\$211	2.14	\$452	\$957	1.96	\$1,879
Pennsylvania	17.5	3.74	65.5	\$998	2.44	\$2,435	\$5,489	2.23	\$12,244
Rhode Island	1.4	2.58	3.5	\$76	2.05	\$156	\$424	1.86	\$788
South Carolina	3.7	2.73	10.1	\$200	2.08	\$415	\$1,371	1.96	\$2,688
South Dakota	1.8	2.76	4.9	\$94	1.85	\$173	\$572	1.65	\$945
Tennessee	5.8	3.57	20.8	\$323	2.30	\$744	\$2,073	2.05	\$4,249
Texas	14.3	3.71	52.8	\$767	2.31	\$1,771	\$4,269	2.10	\$8,952
Utah	8.9	3.28	29.2	\$510	2.34	\$1,193	\$2,576	2.07	\$5,323
Vermont	0.2	2.14	0.4	\$12	1.78	\$22	\$71	1.67	\$118
Virginia	2.9	2.67	7.8	\$150	2.21	\$332	\$1,054	1.94	\$2,042
Washington	7.1	3.26	23.2	\$566	2.13	\$1,207	\$2,996	1.94	\$5,804
West Virginia	0.8	2.25	1.8	\$41	1.76	\$71	\$248	1.58	\$391
Wisconsin	8.8	3.44	30.3	\$573	2.19	\$1,256	\$3,973	2.01	\$8,001
Wyoming	0.2	1.72	0.4	\$12	1.61	\$20	\$78	1.50	\$116