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The National-Level Economic Impact of the Manufacturing Extension Partnership (MEP): Estimates for Fiscal Year 2022

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Table of Contents

List of Tables

List of Figures

I. EXECUTIVE SUMMARY

Study overview

The Hollings Manufacturing Extension Partnership (MEP), part of the National Institute of Standards and Technology (NIST), contracted with Summit Consulting and the Upjohn Institute (the Team) to analyze the overall effect of MEP projects on the U.S. economy in fiscal year 2022 (FY 2022). MEP Centers deliver technical assistance to primarily small and medium-sized manufacturing establishments to help them improve their productivity and competitiveness. The Centers assist with product development, new investments, and improved products and processes as well as provide tools and resources for business expansion and business continuity planning that contribute to improved sales and cost savings. These improvements increase the productivity, profitability, and competitiveness of client establishments, which in turn improves the economy by creating jobs, increasing earnings, and expanding the tax base.

Each year, NIST MEP surveys their clients using an independent third-party vendor (Fors Marsh Group) to gather information and data on the impact of the services provided by MEP Centers. The survey asks clients to estimate the effects of MEP services on the following business outcomes:

- Jobs created and retained;
- Sales created and retained;
- Cost savings; and
- Investments.

The study's purpose is to use client-reported outcomes to estimate the overall effect of NIST MEP on the U.S. economy. Using a model developed by Regional Economic Models, Inc. (REMI), the study estimates the indirect and induced effects of the reported increase in jobs, sales, cost savings, and investments by MEP clients.

This study updates the May 2022 report that estimated the economic impact analysis of MEP using survey results from FY 2021.[1] The Team used the same methodology for FY 2022 that Upjohn used for previous estimates.[2] The study uses the REMI model to estimate the induced and indirect effects of the impacts reported by MEP clients on the surveys administered. It takes the self-reported outcomes of MEP clients at face value without attempting to validate them. Notably, MEP implements an outlier verification process where any sum over $5M (combined sales, cost savings and investment) or 250 (combined new and retained jobs) must be confirmed by MEP Centers after reaching out to clients.

[1] Optimal Solutions Group, LLC and Robey Analytics 2021. "The National-Level Economic Impact of the Manufacturing Extension Partnership (MEP): Estimates for Fiscal Year 2021." Prepared for National Institute of Standards and Technology Manufacturing Extension Partnership. https://optimalsolutionsgroup.com/2022/04/13/the-national-level-economic-impact-of-the-manufacturing-extension-partnership-mep/

[2] The methodology for this report was developed by the Upjohn Institute and used in four previous reports for NIST on the national-level economic impact of MEP. This report builds on these previous efforts and was completed in consultation with the Upjohn Institute.

Three scenarios are presented to estimate the impact of NIST MEP:

- **Scenario 1** is the unconstrained approach in which it is assumed that an increase in sales of one establishment does not affect or reduce the sales across other establishments. This scenario also assumes that job creation does not result in poaching or transfer of employees from another local company or competitor. This scenario is included to serve as an upper bound on the estimates.
- **Scenario 2** assumes that competition among establishments mitigates the overall effects of the estimated increase in sales and employment, since establishments that do not benefit from the services rendered by MEP may lose market share to those that do and thus grow less quickly than they would have otherwise.
- **Scenario 3** estimates the fraction of reported outcomes required for the program to break even, as measured by the projected tax increases covering the annual cost of the program for FY 2022 ($158 million). This allows the study to determine whether the cost of MEP is justified by the benefits it generates.

This MEP economic impact study showed higher aggregate impacts from the MEP National Network in FY 2022 compared to FY 2021. This likely reflects several factors, including the mix of industries served and how MEP Center projects affected new and retained jobs and sales. While jobs are the primary driver in this analysis, other monetary measures, including lower production costs, increased investments, and other benefits of Center-client relationships, are important when estimating the broader economic effects. Each fiscal year, the benefits to clients change, as do the estimates of impacts. In addition to ongoing MEP-supported activity, FY 2022 includes activity supported by CARES Act funding and other one-time federal support due to the COVID-19 Pandemic. These funding mechanisms were not included in the return-on-investment calculations but may have had a role in job creation.[3]

This study finds that the investment of federal dollars into MEP Centers—$158 million in FY 2022—yields, in the most conservative model, a return to the Treasury of $2.9 billion. This results in a calculated return on investment (ROI) of 18.1:1, as shown in Table 1 below.

Table 1: Estimates of NIST MEP impacts for FY 2022

Forecast	Jobs	GDP*	Output*	Personal Income*	Returns to Treasury*	Return on Investment
Unconstrained model using industry variables	899,803	$119.7.5	$236.0	$67.8	$9.5	60.4:1
Constrained model using firm variables	269,373	$29.9	$55.4	$19.9	$2.9	18.1:1
5.5% of reported impact (to reach 1:1 ROI)	16,913	$2.0	$3.8	$1.3	$0.2	1:1

*In billions of dollars]

[3] The study acknowledges that $50M of CARES funding was intended for Centers to use in a variety of ways. Reportable projects with clients were one of the activities Centers used CARES funding for. However, it is difficult to break out what percentage of the funding was dedicated to that specific Center activity.

II. MODELING THE NET IMPACT OF MEP ACTIVITIES

Modeling the net impact

The Hollings Manufacturing Extension Partnership, part of NIST, contracted with Summit Consulting and the Upjohn Institute to estimate the broader economic effects of the collective activities of its MEP Centers on the U.S. economy.[4] The estimates are based on a quarterly independent survey of manufacturing clients assisted by NIST MEP and conducted by the Fors Marsh Group. The survey asks clients to provide estimates of the effect of MEP services and activities on their establishments with respect to jobs, sales, investments, and cost savings. This analysis leverages surveys conducted during FY 2022.

The Team made no attempt to validate the outcomes reported by MEP clients in the survey beyond the MEP verification process. The values were entered in the REMI model to forecast the overall impact of MEP Centers. The method is consistent with standard approaches estimating impacts of a given establishment on the local economy.

The study presents three scenarios and associated estimates of economic impact, as shown in Table 1.

Scenario 1 uses an unconstrained approach, which assumes that an increase in sales of one establishment does not affect or reduce the sales of another establishment. This assumption, while not entirely realistic, is the best one to estimate impacts at the state level but less so at the national level. This scenario, and the use of industry variables, assumes that all products are exported out of the study region. Since this is unlikely as it applies to the national economy, the findings are probably overestimated. We do not recommend this scenario for national estimates because it does not account for competition among establishments and the displacement effects from competition across establishments. We include the unconstrained scenario as an ***upper bound*** on the results.

Scenario 2 is more conservative and assumes that competition among establishments reduces the effects. This scenario uses firm variables in the REMI model. It assumes that some production remains in the region and is not exported, which displaces competitors' production. While this scenario is more applicable to this study's national focus, it serves as a ***lower bound*** to the set of estimates.

Scenario 3 also uses firm variables to indicate the ***break-even point***, or at what point the returns (based on the survey outcomes) would generate enough personal tax revenue to equal MEP funding, which was $158 million in FY 2022. While it would be difficult to attribute all changes in establishment behavior to the MEP Center–client relationship, the calculated break-even point suggests that if MEP causally contributed to only about 5.2% of reported economic outcomes, it would pay for itself and be revenue neutral.

[4] The REMI model only applies to the 50 states including Washington D.C. Therefore, MEP clients in Puerto Rico were excluded from the analysis.

The core of the analysis is the outcomes of MEP Center clients. The survey asks clients to quantify in dollars or numbers across the following outcomes:

- Jobs created or retained;
- Sales created or retained;
- Investments in products or processes;
- Investments in plants or equipment;
- Investments in information systems or software;
- Investments in workforce practices or employee skills;
- Investments in other areas of business;
- Production cost reduction through cost savings; and
- Avoided investments or savings on investments.

More than 12,000 clients from across the United States were surveyed. MEP Centers are in all 50 states. Each jurisdiction with a MEP presence obtained survey responses from its respective clients.[5]

This analysis does not construct a control group of randomly selected companies to compare the performance of creating new and retained jobs and sales or on cost savings and investments. This limits the causality that can be assigned to MEP efforts in assisting establishments. Because of self-selection bias, establishments opting to use MEP services may also be more inclined to invest in workforce training, equipment, and other technology on their own. Similarly, MEP Center clients may be growing and better able to leverage MEP-based services to add jobs and increase sales. Because the Team did not attempt to validate the accuracy of the outcomes reported in the survey, we present these caveats when interpreting the results. These caveats are consistent with estimating the net impact on the local economy of a company that reports plans to expand its employment. In estimating the net impact of such an exogenous shock to a local economy, we typically take the company's assessments at face value.

To be consistent with the methodology of prior net-impact analyses, Upjohn followed a guide created by Mark Ehlen and M. Hayden Brown, "A Guide for Estimating and Reporting the Macroeconomic Impacts of MEP Centers."[6] The guide provided a methodology to estimate economic impacts on a state based on the collective outcomes of surveys completed by the clients served by each MEP Center. The guide also recommended the use of an economic impact model from REMI for creating estimates. Informed by the guide, Upjohn made several decisions regarding the use of the survey data and assumptions in the REMI model about the dynamics of the U.S. economy.

Decisions regarding data elements

Use of employment or sales outcomes

Although the survey captures both employment and sales outcomes, both cannot be used in the REMI model at the same time without double-counting the effects of the outcomes associated with MEP

[5] The REMI model only applies to the 50 states and Washington D.C., not to U.S. territories.
[6] Ehlen, Mark A., and M. Hayden Brown. 2000. "A Guide for Estimating and Reporting the Macroeconomic Impacts of MEP Centers." NIST Interagency/Internal Report (NISTIR) – 6499, U.S. Department of Commerce, National Institute of Standards and Technology, Gaithersburg, MD. Last modified July 6, 2009. https://www.nist.gov/publications/guide-estimating-and-reporting-macroeconomic-impacts-mep-centers

activities. Either employment or sales should be used consistently when aggregating the responses. We chose to use the reported estimates of the number of jobs created or retained, when available, instead of sales. Our decision assumed that clients are better able to estimate the impact of MEP activities on employment rather than sales because clients typically keep close tabs on head count and are more likely to be able to attribute a change in the number of personnel to MEP projects. Sales, on the other hand, are more volatile and depend on outside market factors beyond a client's control.[7] However, if employment change is not identified in the survey outcomes, the model uses sales and calculates the number of additional workers required to generate the observed increase in sales.[8]

Use of survey investment data

The REMI model also requires a decision regarding when to use investment data from the survey in the model. Either the model can determine the amount of investment that would be commensurate with the employment (or sales) increase, or that feature can be turned off and the amount reported from the survey can be used as an input to the model instead.

There are pros and cons to each approach. Using the investment estimated by the REMI model may overestimate the amount of capital expenditure induced by MEP activities, and the model would generate additional indirect and induced effects on employment and other outcomes based on the overestimate of the investment expenditures. Using the investment expenditures from the survey assumes that the clients have accurately attributed additional investment expenditures to MEP projects and that these are consistent with what is needed to accommodate increased sales and additional personnel. Neither approach is optimal. We view the results from entering client-reported investment expenditures as a more conservative approach since it is possible that clients who do not report investment expenditures or clients who report investment expenditures that are less than needed to accommodate sales or employment increases may have excess capacity due to prior investments or slack demand.[9]

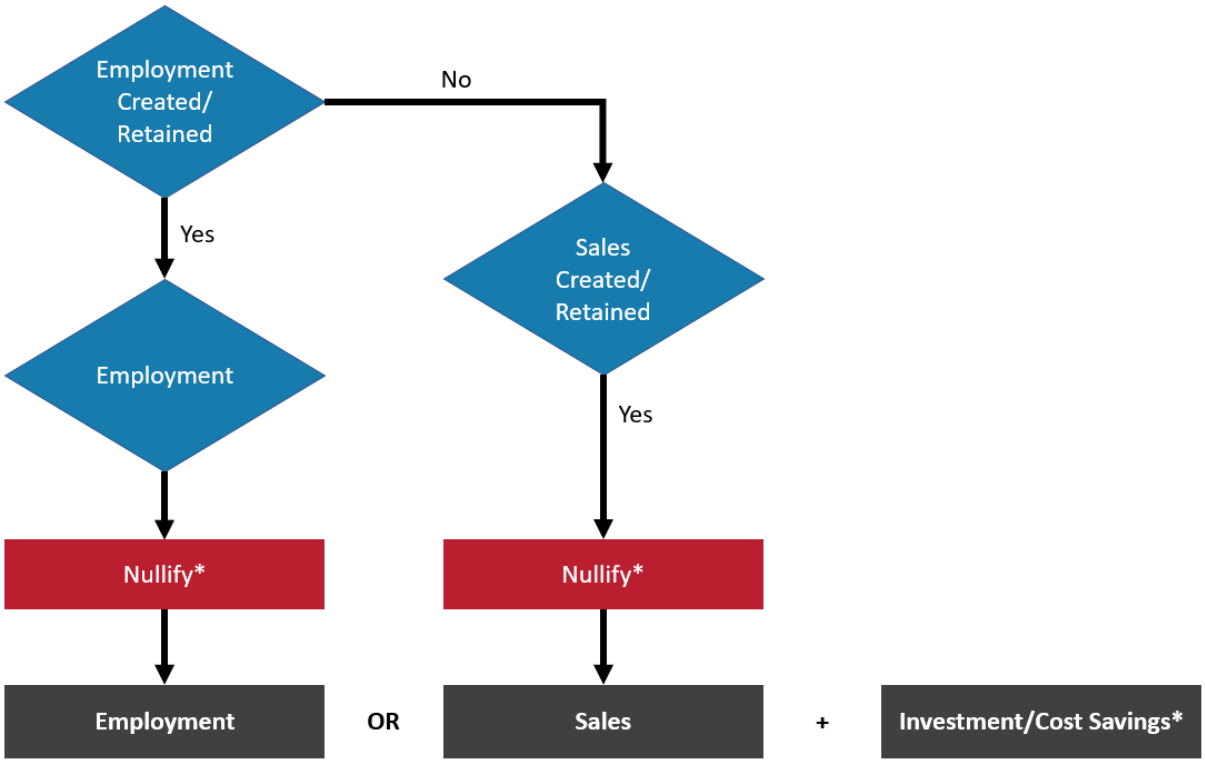
Nullifying capital investments

In Upjohn's version of the REMI model, it is possible to "nullify" capital investment caused by changes in sales and employment, assuming new jobs and sales use existing capital stocks. Within the MEP survey and as noted above, data on several production-related investments were collected and used in place of the assumed changes in capital stock. This change in methodology provides a more realistic view of impacts on the national economy.

[7] For FY 2022, the percent of respondents indicating "Don't Know" for New or Retained Sales was about double that for New or Retained Jobs.
[8] Appendix C provides further analysis of the decision to backfill sales when employment was missing.
[9] Appendix D provides further analysis of the decision to include investment survey outcomes in the model.

Figure 1 below is a graphical representation of the decision tree.

Figure 1: The Team's decision tree for using survey data



Assumptions regarding market dynamics

Since Ehlen and Brown's development of the guide, REMI has added some policy variables that are helpful in estimating impacts at the macro level. Part of the dilemma with this research is found in attempting to estimate the effect that helping one company has on others that do not receive help from an MEP Center. Ehlen and Brown refer to this as "beggar thy neighbor" and define it as "in the course of improving one's own condition, making a neighbor worse off."[10] They continue: "[R]elevant to state impacts, the sales increases that MEP clients report may only be displacing the sales of other in-state firms…."[11] While this is true at the state level, it is exacerbated at the national level when the only mitigating factors that do not affect other companies are when there is either import substitution or increases in exports for that firm. REMI offers a solution by allowing sales and employment to be placed in various policy variables, including ones that assume all new output is exported and ones that assume more productive firms will "crowd out" their less productive competitors. The "crowding out" or competitive scenario (Scenario 2) is more realistic and yields a more conservative estimate of the outcomes than the unconstrained or noncompetitive approach (Scenario 1).

[10] Ehlen and Brown. "A Guide for Estimating and Reporting the Macroeconomic Impacts of MEP Centers." p. 39.
[11] Ibid.

III. SURVEY RESPONSES FROM MEP CLIENTS

This section summarizes the survey responses of MEP client establishments collected by Fors Marsh Group. MEP clients were asked to indicate whether they believed that MEP activities affected each possible business outcome. If they responded "yes," the respondent was asked to provide a quantitative estimate of MEP impact for that specific outcome, such as the number of jobs created or the cost savings in dollars. Of the 12,527 clients surveyed in FY 2022, 8,916 (71%) responded to the survey.

Table 2 and Table 3 provide summary results for MEP survey outcomes in FY 2022. Table 2 summarizes the number of MEP clients indicating positive impacts on possible business outcomes while Table 3 summarizes sales, jobs, savings, and investments. Although most surveys did not indicate positive effects on all variables, we sum the responses at the state and national levels and treat the aggregate numbers as an overall direct effect of MEP activities on MEP clients.

Table 2: Survey responses for FY 2022

Outcome	Number of Responses	Indicated MEP Had a Positive Impact	
		Number	*Percent*
Number of jobs created	8,916	3,641	40.8%
Number of jobs retained	8,916	4,339	48.7%
Increase in sales	8,916	3,112	34.9%
Retained sales	8,916	3,349	37.6%
Cost savings	8,916	4,338	48.7%
Investment in plant and equipment	8,916	3,726	41.8%
Investment in products and processes	8,916	3,726	41.8%
Investment in information systems	8,916	3,029	34.0%
Investment in workforce training	8,916	4,476	50.2%
Other investments	8,916	1,835	20.6%
Investment savings	8,916	3,168	35.5%
At least one positive response	8,644	7,384	82.8%

Table 3: Summary of MEP Center results for MEP clients in FY 2022

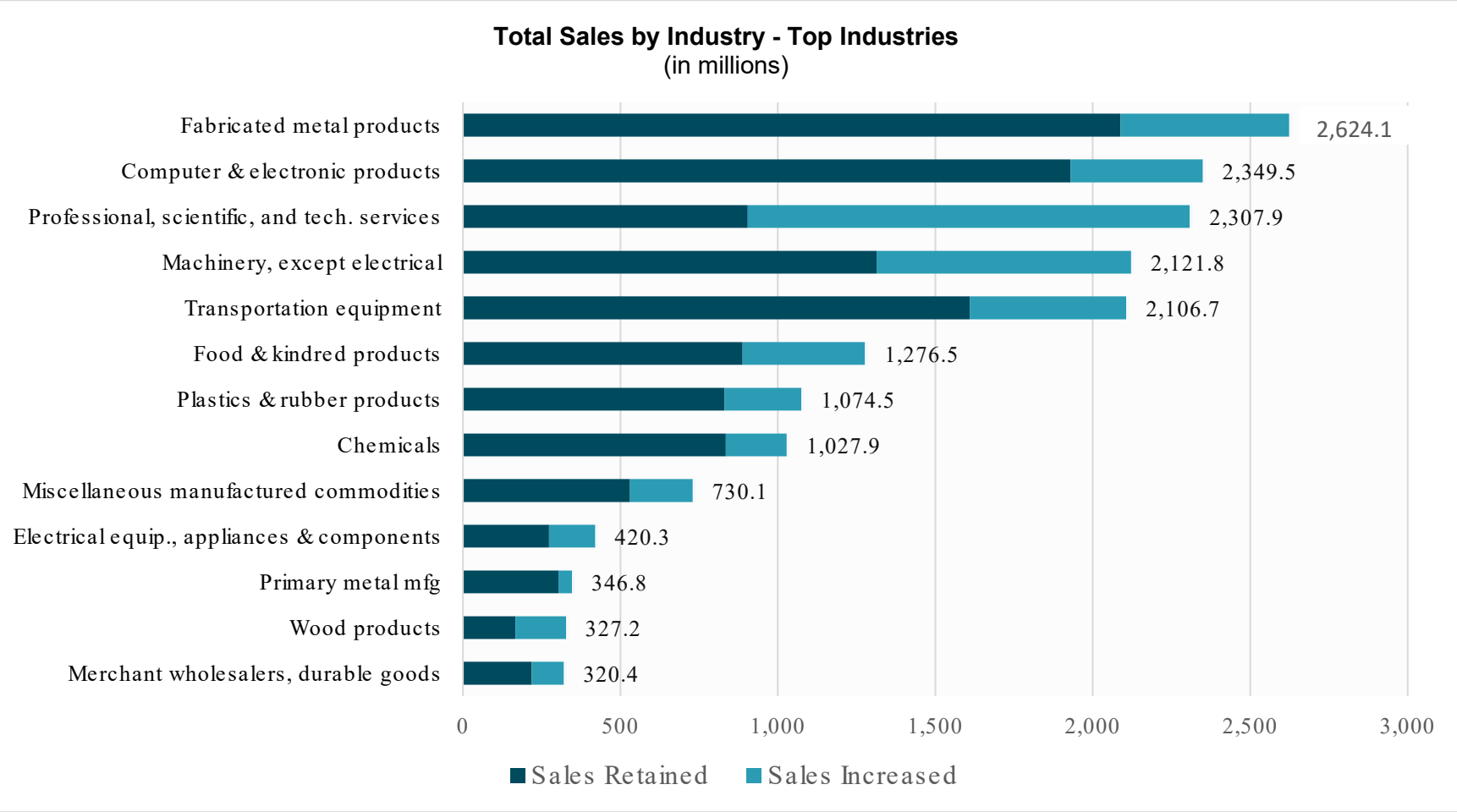
Outcome	Value
Sales	***$18.6B***
New sales	$5.6B
Retained sales	$13.0B
Jobs	***113,487***
New jobs	29,397
Retained jobs	84,090
Cost savings	***$1.4B***
Investment savings	***$1.0B***
Investments	***$6.3B***
Products and processes	$2.2B
Plant and equipment	$2.9B
Information systems	$325M
Workforce training	$382M
Other	$536M

Overall, the top five industries are consistent across the analyzed outcomes. Transportation Equipment Manufacturing (NAICS 336), Fabricated Metal Product Manufacturing (NAICS 332), and Food Manufacturing (NAICS 311) are consistently in the top five industries that experience positive impacts delivered via MEP Centers.

Overview of sales

In Figure 2 below, most of the industries' positive sales effects were from retained sales rather than increased sales. Except for Professional, Scientific, and Technical Services (NAICS 541), retained sales accounted for well over half of the sales effects.

Figure 2: Total sales by industry (top industries)

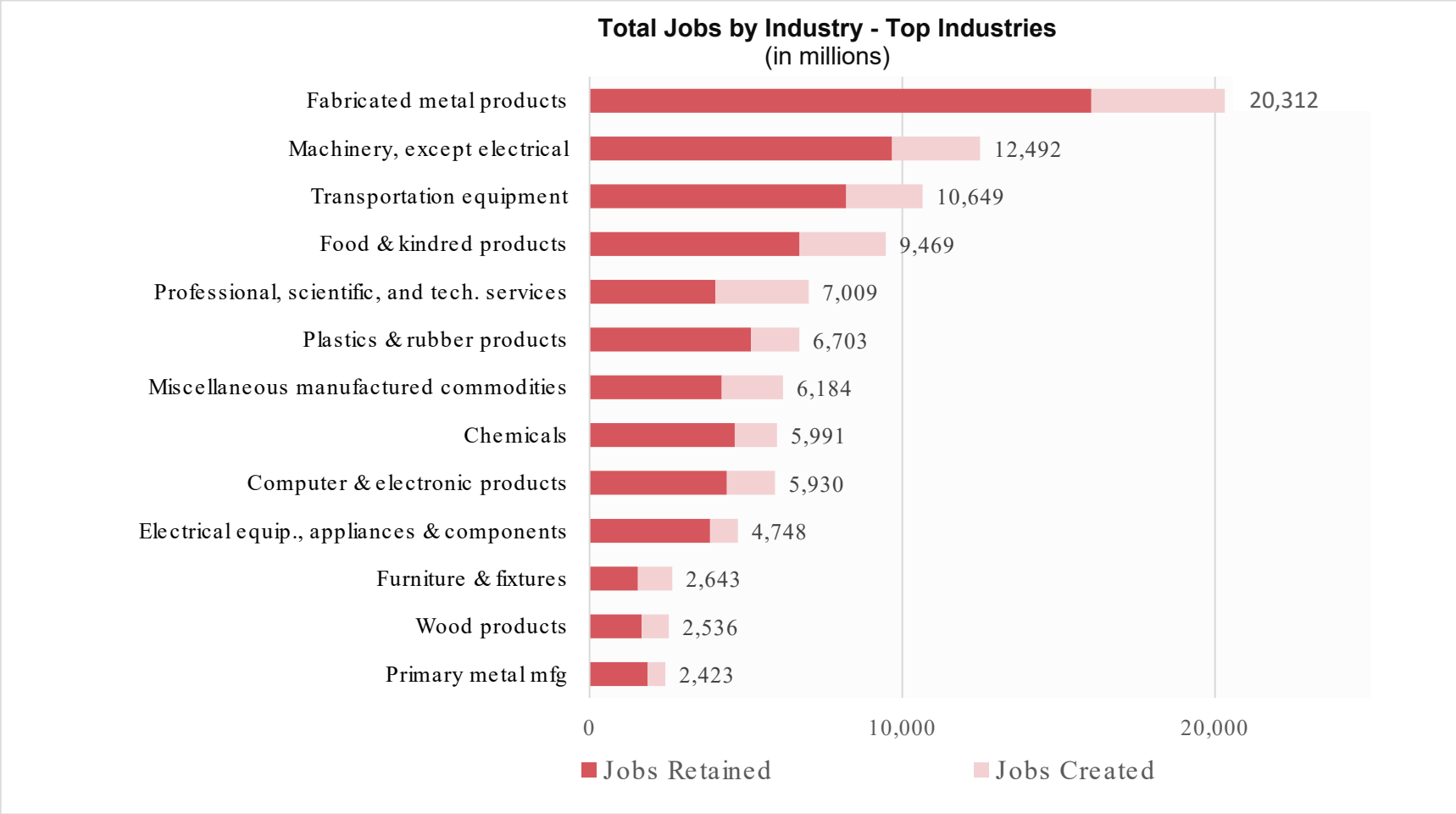


Note: The total sales for the next 13 industries are approximately $1.6 billion.

Overview of jobs

Figure 3 shows the number of created and retained jobs by industry and mirrors the general results reported for sales.

Figure 3: Jobs by industry (top industries)



Note: The total jobs for the next 13 industries are approximately $16.4 billion.

Overview of investments

Most of the investments were in plants and equipment ($2.9 billion) and in new products and processes ($2.2 billion), as shown in Figure 4.

Figure 4: Breakdown of total investments

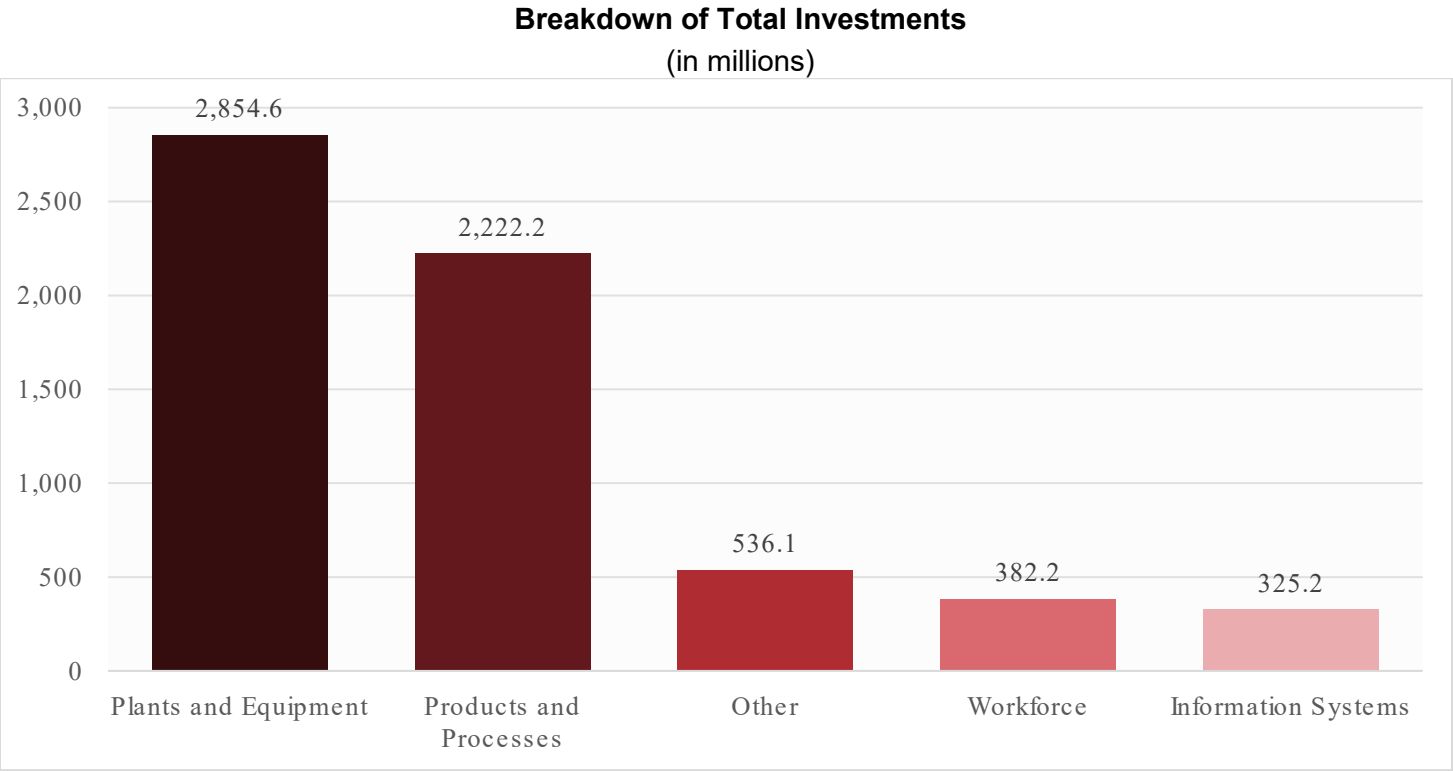
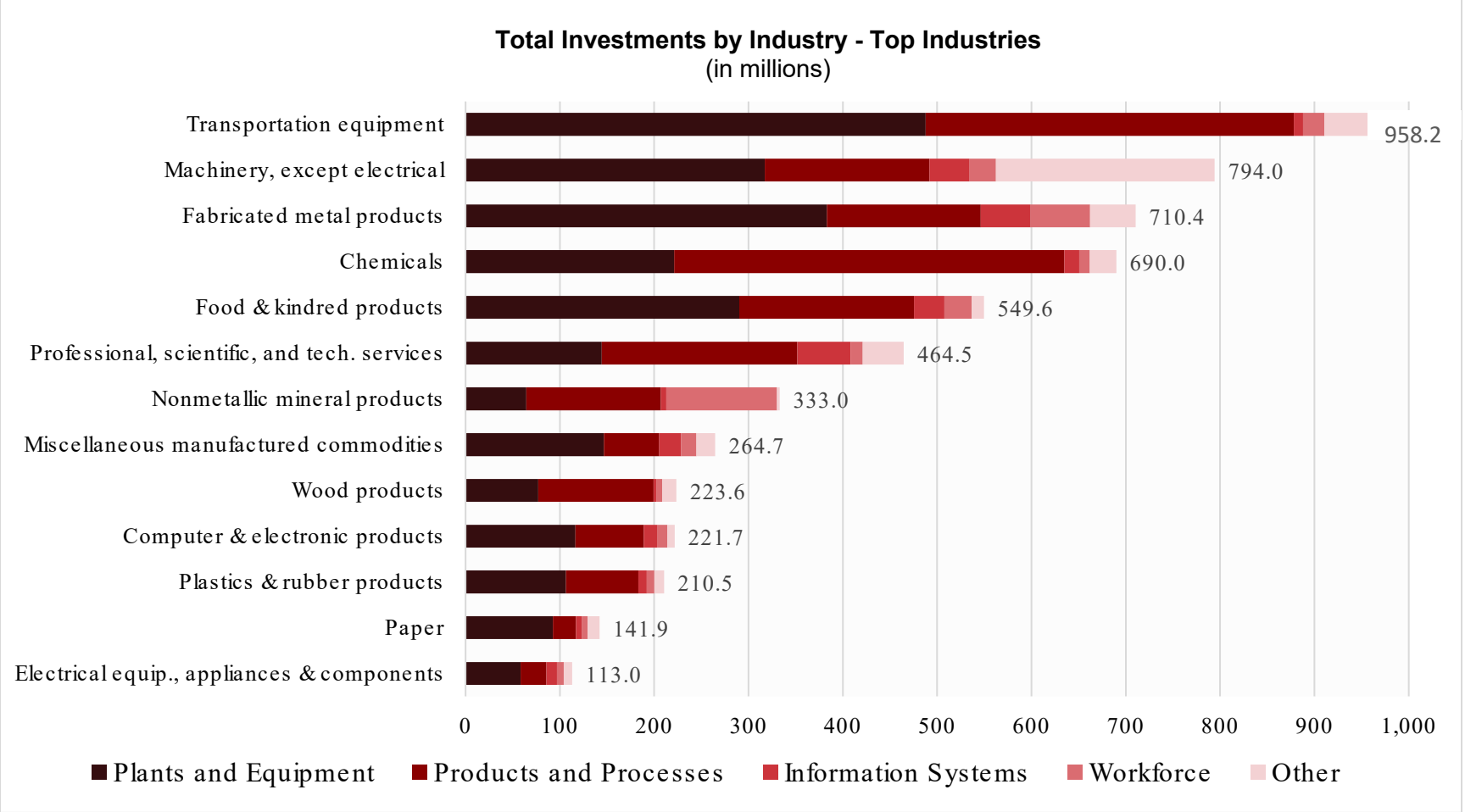


Figure 5 shows the breakdown of total investments by industry, which remains consistent across the NAICS codes. Plants and equipment, as well as products and processes, account for most of the investments across almost all the industries.

Figure 5: Total Investments by industry (top industries)

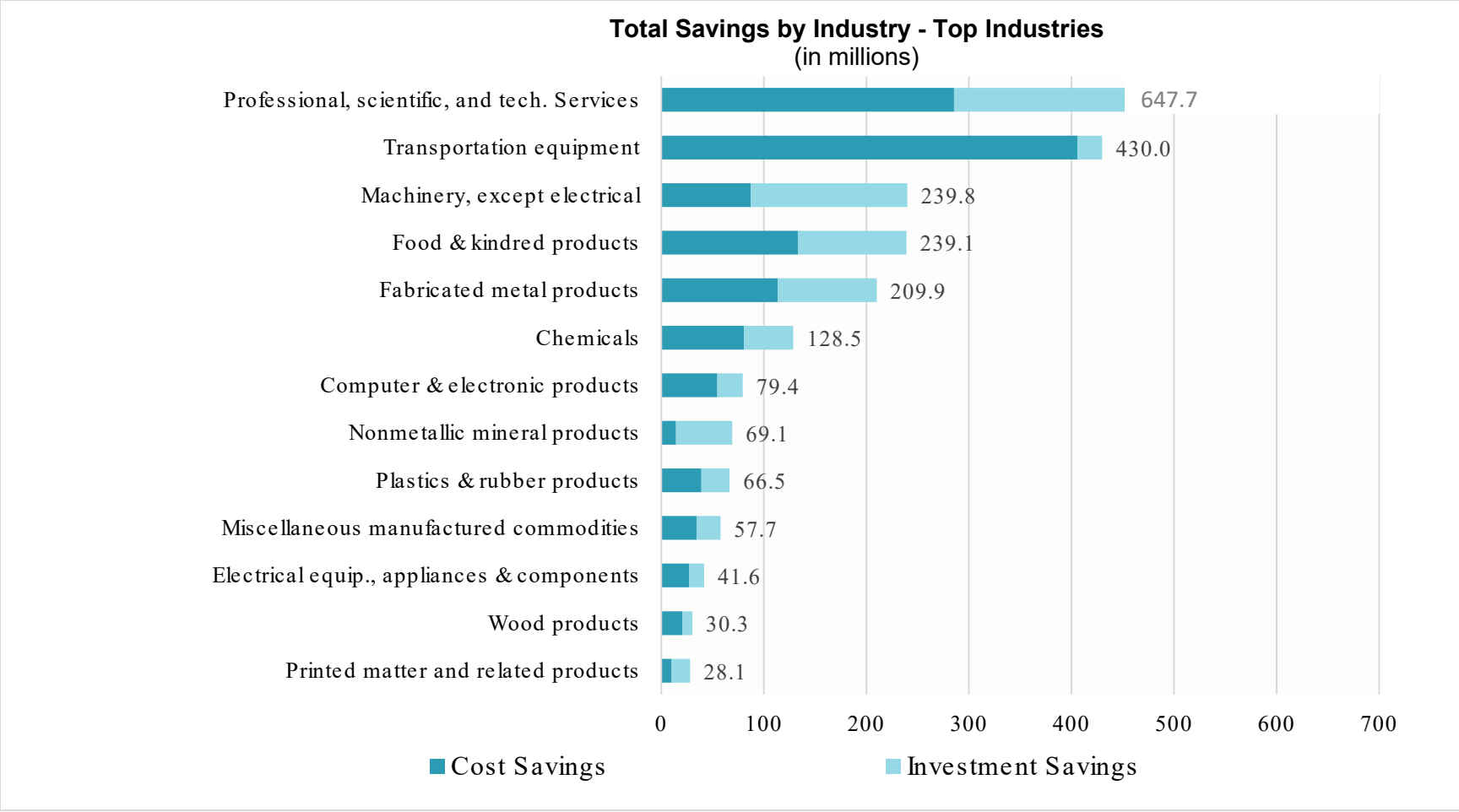


Note: The total investments for the next 13 industries are approximately $645 million.

Cost savings and investment savings

Figure 6 examines the industries with the highest aggregate cost savings. The ranking of industries is somewhat different. Professional, Scientific, and Technical Services (NAICS 541) had the most savings, with a total of $648 million, followed by Transportation and Equipment Manufacturing (NAICS 336) with a total of 430 million. The third-highest industry saved only about a third as much as the top industry, $240 million.

Figure 6: Total savings by industry (top industries)

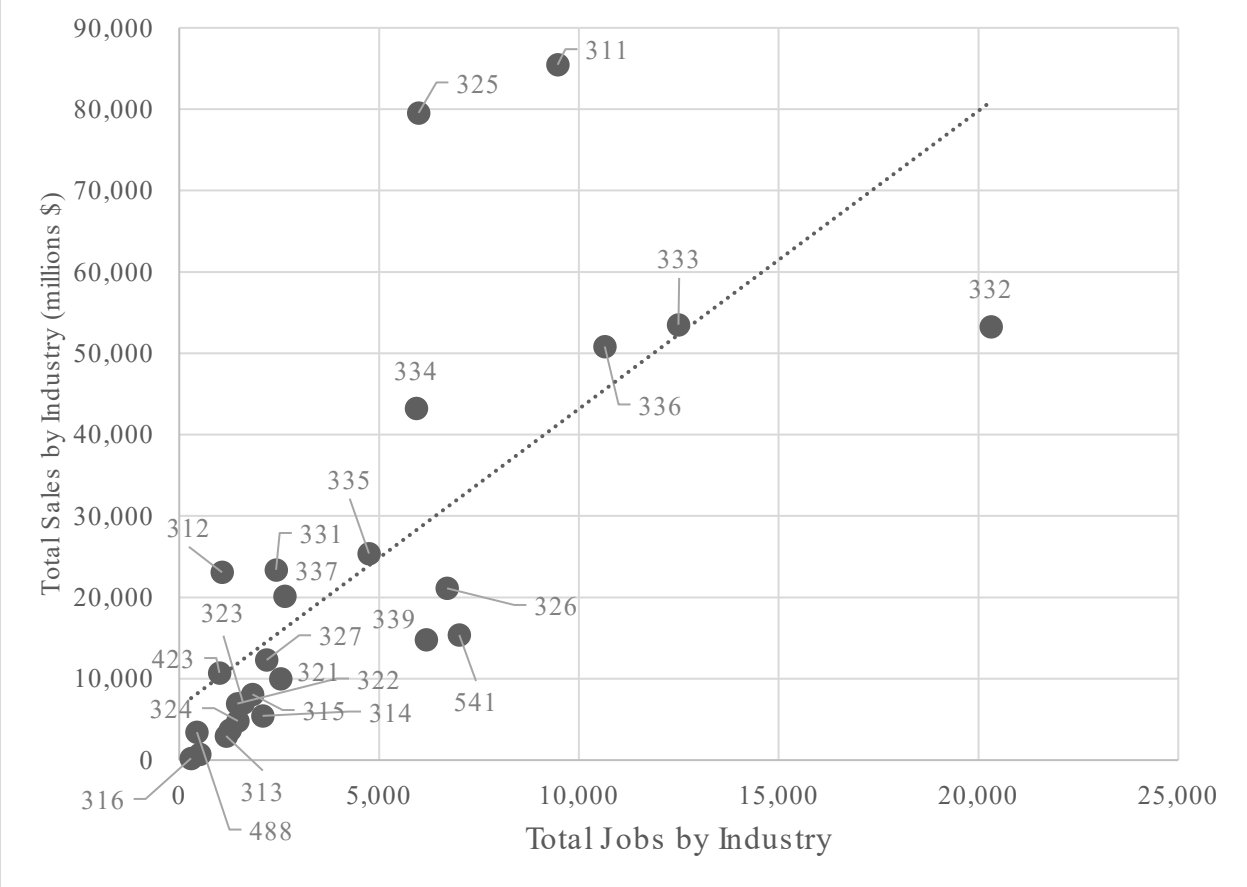


Note: The total savings for the next 13 industries are approximately $192 million.

Sales and jobs

Figure 7 shows a positive linear relationship between total sales and total jobs created or retained.

Figure 7: Total sales and total jobs created or retained by NAICS code



NAICS-Industry Key	NAICS-Industry Key
311-Food Manufacturing	331-Metal Foundries
312-Beverage Manufacturing	332-Fabricated Metal Products Manufacturing
313-Textile Mills	333-General Purpose Machinery Manufacturing
314-Textile Manufacturing	334-Instruments Manufacturing
315-Apparel Manufacturing	335-Electrical Equipment Manufacturing
316-Leather Goods	336-Transportation Equipment Manufacturing
321-Wood Product Manufacturing	337-Furniture Manufacturing
322-Paper Product Manufacturing	339-Miscellaneous Manufacturing
323-Printers	42-Wholesale Trade
324-Petroleum & Coal Products Manufacturing	48-Transportation
325-Chemical Products Manufacturing	54-Professional, Scientific, & Technical Services
326-Rubber Products Manufacturing	56-Administrative & Support Services
327-Nonmetallic Mineral Products Manufacturing	81-Other Services

Note: Some of the MEP clients are in nonmanufacturing industries but provide manufacturing support through professional, administrative, and other services. Appendix B provides a list of the NAICS code descriptions.

IV. ECONOMIC IMPACTS FOR FY 2022

This section summarizes the economic impact results for FY 2022, shown in Table 4. This study finds that the federal investment of $158 million into MEP Centers yields a return to the Treasury of about $2.9 billion, for a return on investment of 18.1:1 according to the more conservative, firm-based estimate.

Using the firm-based scenario, MEP and its Centers contributed to the addition of an estimated 269,373 jobs. In addition, the combined efforts added over $55.4 billion in output, an additional $29.9 billion in gross domestic product (GDP), and more than $19.9 billion in personal income to the economy in FY 2022.

While Scenario 1's unconstrained approach, which uses industry variables and assumes all goods and services produced are exported, is unrealistic, it does provide a set of upper bounds of MEP's effect on the economy. This scenario estimates that MEP contributed to the addition of 899,803 jobs, more than $236 billion in additional output, an increase of about $119.7 billion in GDP, and nearly $67.8 billion more in personal income.

Finally, at the estimated break-even point, investment in NIST MEP contributes to the addition of about 16,913 jobs, $3.8 billion in output, $2.0 billion in GDP, and $1.3 billion in income.

Table 4: Estimates of NIST MEP impacts for FY 2022

Forecast	Jobs	GDP*	Output*	Personal Income*	Returns to Treasury*	Return on Investment
Unconstrained model using industry variables	899,803	$119.7	$236.0	$67.8	$9.5	60.4:1
Constrained model using firm variables	269,373	$29.9	$55.4	$19.9	$2.9	18.1:1
5.5% of reported impact (to reach 1:1 ROI)	16,913	$2.0	$3.8	$1.3	$0.2	1:1

*In billions of dollars

V. CHANGES FROM 2018 TO 2022

Year-to-year variation across the annual client surveys and the REMI model could complicate the comparisons of MEP impacts over time. Differences in MEP impacts across years may be associated with differences in the following factors:

- Survey completion rate;
- Completion rate of key questions, such as the client's estimated number of jobs created due to MEP services;
- Employment size of each client establishment; and
- NAICS-based industry mix, measured by the response rate.

We analyzed a 5-year trend of data included in calculations of economic impact addressing these factors. Table 5 illustrates the most recent 5-year trend of the additional jobs, additional GDP, returns to Treasury, ROI, and break-even points. This year shows a noted increase in impact. Several factors contribute to the increase in impact in FY 2022. The main change impacting the results is total investment, which increased by 23.5%, from $5.1 billion in 2021 to $6.3 billion in 2022. Investments such as plant, equipment, and workforce accounted for over 60% of total impact. The total investment grew consistently over the last 5 years, contributing to the increased economic impact between 2018 and 2022. As previously mentioned, FY 2022 includes activity supported by CARES Act funding and other one-time federal support due to the COVID-19 Pandemic. These funding mechanisms were not included in the return-on-investment calculations but may have positively impacted the increase in impact.

Table 5: Summary of FY 2018 to FY 2022 comparison

National Impact Estimate	2018	2019	2020	2021	2022
Additional Jobs	236,802	217,646	252,631	190,024	269,373
Additional GDP *	$ 24.9	$ 22.9	$ 20.9	$ 26.5	$29.9
Additional Returns to the Treasury *	$ 2.02	$ 1.87	$ 1.99	$ 2.03	$2.9
Return On Investment (ROI)	14.1: 1	13.4: 1	13.6: 1	13.5: 1	18.1:1
"Break-Even" Point (Percent of impacts required for a 1:1 ROI)	6.9 %	7.5 %	7.5 %	7.4 %	5.3 %

*Billions of dollars

Other factors contributing to the increased impact in 2022 were additional survey responses (111 more than in the previous year) and increased or retained sales (which grew by 29.2%). The decline in employment and decreased cost savings were consistent with overall national trends in manufacturing, following the decline caused by the COVID-19 pandemic in 2019-2020 and recovery during an extremely tight labor market.

A methodology change was made to improve the accuracy of modeling the economic impact of workforce investment. Previously, training dollars were modeled as spending in the private education sector only. Improvements to the methodology allowed for greater industry detail, modeling investments also through the governmental post-secondary education and private social or civic nonprofit.

APPENDIX A Economic outcome definitions

As with most economic impact studies, this study focuses on four main economic outcome variables and a tax revenue variable:

- Jobs created or retained;
- Change in GDP;
- Change in income;
- Change in gross output; and
- Returns to the U.S. Treasury (tax revenue).

The REMI model generates these outcomes for the national economy using the survey responses as inputs. Each of the five variables are described in this section.

Jobs created or retained

The estimated number of jobs created or retained by MEP activities are simply "jobs" as counted by the U.S. Bureau of Economic Analysis and can be either full- or part-time positions. They are likely distributed across multiple industries. In any given industry, a "job" may represent a summation of positions across several industries in which each industry has less than one complete position. For example, the impact study may report one "job," but the spending patterns in the study may generate positions in three industries. However, each industry may require only one-third of a person's time. In this case, the three industries that employ one-third of a person each to meet demand would add up to one "job" in the REMI model.

Employment is composed of three elements:

- **Direct:** The employment created by actual investment, growth, or change;
- **Indirect:** The employment created by the need of the new firm to purchase goods and services, essentially the local supply chain; and
- **Induced:** The household that supplies goods and services to the workers in the prior two elements. Examples include education, dry cleaners, accountants, gas stations, lawyers, and grocers.

Gross domestic product

GDP is an economic measure of the value of goods and services produced within the U.S. It is the broadest measure of economic activity within a region or country. It consists of compensation of employees; taxes on production and imports, less subsidies; and gross operating surplus. It does not include intermediate inputs, so it is a measure of the value that labor and capital contribute to production.

Income

National income is the goods and services produced by citizens and residents of the U.S. (i.e., gross national product) minus the consumption of fixed capital (i.e., depreciation).

Gross output

Gross output includes both GDP and expenditures on intermediate inputs. In this way, it is considered double-counting, but it is an essential statistical tool to understand the relationships between industries. Gross output is principally a measure of an industry's sales or receipts, so it is like the sales reported by individual MEP clients. For the purposes of the model, the sales and receipts are aggregated at the national level.

Returns to the U.S. Treasury

Returns to the U.S. Treasury are estimated using average (mean) personal income for all additional workers (direct, indirect, and induced) who were employed as a result of MEP client activities. Using 2022 Internal Revenue Service tax tables, the tax incidence for the mean wage is estimated and then applied to all workers. Although this is an estimate, we acknowledge that some workers will earn more than the average and some will earn less. Similarly, some workers will pay more taxes than the reported value and some will pay less. Note that the average tax based on the average wage is not discounted by any legal form of tax adjustment, including short-form or itemized deductions. In tax year 2022, the tables were published for the single, married filing separately, married filing jointly, and head of household categories. For the purposes of this study, the "head of household" tax rate was applied to estimates of average income.

APPENDIX B NAICS codes

Table 6 provides the descriptions of the three-digit NAICS codes used throughout the report.

Table 6: NAICS codes used by MEP clients

NAICS Code	Industry
311	Food Manufacturing
312	Beverage and Tobacco Product Manufacturing
313	Textile Mills
314	Textile Product Mills
315	Apparel Manufacturing
316	Leather and Allied Product Manufacturing
321	Wood Product Manufacturing
322	Paper Manufacturing
323	Printing and Related Support Activities
324	Petroleum and Coal Products Manufacturing
325	Chemical Manufacturing
326	Plastics and Rubber Products Manufacturing
327	Nonmetallic Mineral Product Manufacturing
331	Primary Metal Manufacturing
332	Fabricated Metal Product Manufacturing
333	Machinery Manufacturing
334	Computer and Electronic Product Manufacturing
335	Electrical Equipment, Appliance, and Component Manufacturing
336	Transportation Equipment Manufacturing
337	Furniture and Related Product Manufacturing
339	Miscellaneous Manufacturing
423	Merchant Wholesalers, Durable Goods
488	Support Activities for Transportation
541	Professional, Scientific, and Technical Services
561	Administrative and Support Services
811	Repair and Maintenance

Note: Some of the MEP clients are in nonmanufacturing industries but provide manufacturing support through professional, administrative, and other services.

APPENDIX C Use of sales outcomes when employment is missing

When job information was unavailable, the model relied on sales. Table 7 and Table 8 provide cross-tabulations between the jobs and sales metrics in FY 2022. Generally, most of the respondents who experienced benefits in employment also experienced benefits in sales, and those who responded "no" to jobs were also more likely to respond "no" to sales. There were more "I don't know" responses for the sales questions than the jobs questions. This may be because jobs are more easily observable and memorable, such as meeting new hires, than increased sales, which would require some knowledge of the company's financial information. Still, these tables indicate that sales information is appropriate to use when employment information is unavailable.

Table 7: FY 2022 comparison of created jobs and increased sales responses

		Increased Sales			
		Yes	*No*	*NA*	*Total*
Created Jobs	*Yes*	2,249	631	761	3,641
	No	757	2,646	882	4,285
	NA	106	118	4,377	4,601
	Total	3,112	3,395	6,020	12,527

Table 8: FY 2022 comparison of retained jobs and retained sales responses

		Retained Sales			
		Yes	*No*	*NA*	*Total*
Retained Jobs	*Yes*	2,762	703	874	4,339
	No	432	2,022	660	3,114
	NA	154	235	4,684	5,073
	Total	3,349	2,960	6,218	12,527

APPENDIX D Use of investments and savings in REMI

The cost-savings and investment questions had a smaller share of positive responses than the employment and sales questions. Still, we were able to examine whether they were appropriate to use in the model by estimating production function models using sales as the output measure and examining their coefficients for reasonableness. Based on the model results, we used the investment and savings survey responses in the model and determined they may be close to the production functions in the REMI model.

We include two sets of models of the production functions. The first set uses the increase in sales as the dependent variable and job creation and each investment type as independent variables. The second set uses sales retention as the dependent variable and the amount of jobs retained and each cost-savings category as the independent variables. The regressions include dummy variables for the three-digit NAICS codes. See Table 9 below.

The coefficients of capital and labor are all statistically significant in every model. The two coefficients for each model sum to less than 1, which suggests that the production functions are below Cobb-Douglas production functions, with diminishing returns to scale.

Table 9: Production function model outputs

Dependent Variable: Increase in Sales				
Type of Capital	***Jobs-Creation Coefficient***	***Investment Coefficient***	***R-Squared***	***Number of Observations***
Products and process	0.45 (38.34)	0.231 (19.75)	0.36	5,942
Plant and equipment	0.451 (38.64)	0.227 (19.49)	0.36	6,031
Information systems	0.504 (44.70)	0.156 (13.50)	0.34	6,005
Other	0.503 (43.35)	0.134 (11.45)	0.33	5,884

Note: Investment in workforce is not considered capital hence it is not included

Dependent Variable: Sales Retention				
Type of Capital	***Job-Retention Coefficient***	***Savings Coefficient***	***R-Squared***	***Number of Observations***
Save on investment	0.578 (49.38)	0.109 (9.35)	0.39	5,124
Cost of savings	0.563 (48.70)	0.154 (13.13)	0.40	5,280