The National-Level Economic Impact of the Manufacturing Extension Partnership (MEP): Estimates for Fiscal Year 2020

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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 2020 (FY2020). 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 and provide tools and resources for business expansion and business continuity planning that contribute to 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. 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
- 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 2020 report that estimated the economic impact analysis of MEP using survey results from FY2019.[1] The Team used the same methodology for FY2020 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.

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[1] Robey, Jim, Kathleen Bolter, Randall W. Eberts, Natalie Patten, and Nick Perttunen. 2020. "The National-Level Economic Impact of the Manufacturing Extension Partnership (MEP): Estimates for Fiscal Year 2019." Prepared for National Institute of Standards and Technology (NIST) and Manufacturing Extension Partnership (MEP). https://research.upjohn.org/cgi/viewcontent.cgi?article=1248&context=reports

[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 the Manufacturing Extension Partnership. 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 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 FY2020 ($146 million). This allows the study to determine whether the cost of MEP is justified by the benefits it generates.

The entire country, and the thousands of small and midsize manufacturers along with MEP Centers across the U.S., faced enormous challenges as a result of the COVID-19 pandemic and the resulting economic dislocation. Despite these obstacles, manufacturers proved to be resilient, and MEP Centers continued to deliver a consistent and significant return on investment to the nation.

This MEP economic impact study showed higher aggregate impacts from the MEP National Network in FY2020 compared to FY2019. 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.

This study finds that the investment of federal dollars into MEP Centers—$146 million in FY2020—yields, in the most conservative model, a return to the Treasury of $1.99 billion. This results in a calculated return on investment (ROI) of 13.6:1, as shown in **Table 1** below. The NIST MEP investment of $140 million in FY2019 generated an economic and financial return of 13.4:1.

Table 1: Estimates of NIST MEP impacts for FY2020

Forecast	Jobs	GDP*	Output*	Personal Income*	Returns to Treasury*	Return on Investment
Unconstrained model using industry variables	693,438	$74.6	$152.8	$44.0	$5.76	39.4:1
Constrained model using firm variables	252,631	$20.9	$39.2	$15.5	$1.99	13.6:1
7.47% of reported impact (to reach 1:1 ROI)	18,503	$1.5	$2.9	$1.1	$0.15	1:1

*In billions of dollars

II. MODELING THE NET IMPACT OF MEP ACTIVITIES

Modeling the net impact

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 estimate the broader economic effects of the collective activities of its MEP Centers on the U.S. economy.[3] The estimates are based on a quarterly independent survey of manufacturing clients sponsored 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. The results used in this analysis covered projects completed in fiscal year 2020 (FY2020).

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 product is 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 Regional Economic Models, Inc. (REMI). 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 $146 million in FY2020. 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 7.5% of reported economic outcomes, it would pay for itself and be revenue neutral.

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[3] The REMI model only applies to the 50 states. 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
- Avoided investments or savings on investments

More than 10,000 clients from across the country were surveyed. MEP Centers are in all 50 states and Puerto Rico. Each jurisdiction with a MEP presence obtained survey responses from their respective clients. The survey observations not identified with a North American Industry Classification System (NAICS) code and those from Puerto Rico are not included in this analysis, resulting in 167 observations that are in the summary data but not in the economic impact estimates.[4]

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 plans 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."[5] 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.

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[4] The REMI model only applies to the 50 states, not to U.S. territories.
[5] 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

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 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. 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.[6]

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.[7]

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.

[6] Appendix C provides further analysis of the decision to backfill sales when employment was missing.
[7] 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
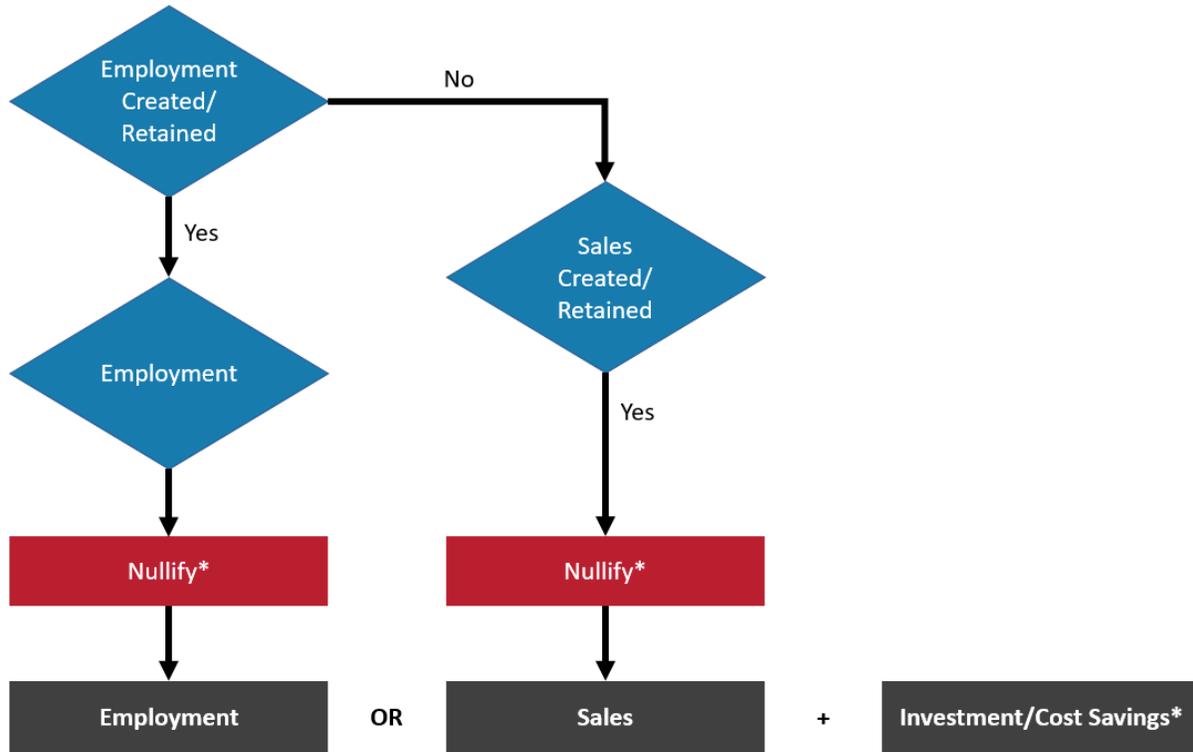
Assumptions regarding market dynamics

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 a 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".[8] 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…".[9] 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).

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

III. SURVEY RESPONSES FROM MEP CLIENTS

This section summarizes the survey responses of MEP client establishments collected by Fors Marsh. 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 10,839 clients surveyed in FY2020, 8,500 (78.4%) responded to the survey.

In **Table 2** below, the percentage of "yes" responses ranged from 19.5% (other investments) to 52.0% (investment in workforce training). Only 307 clients responded "yes" to all 11 elements and provided a quantitative estimate of the impact. Fifty-six percent of clients who responded to the employment questions indicated jobs were created, retained, or both as a result of the program. Twenty-three percent of clients who responded to the sales questions indicated a positive response to both increased and retained sales. Of those who responded to all four employment and sales questions (8,498), about 39% responded that they had positive effects in both employment and sales, and only 18% responded "no" to all employment and sales questions. **Table 3** provides a summary of MEP Center results in FY2020.

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 FY2020

Outcome	Number of Responses	Indicated MEP Had a Positive Impact	
		Number	*Percent*
Number of jobs created	8,499	3,029	35.6%
Number of jobs retained	8,498	4,012	47.2%
Increase in sales	8,499	2,676	31.5%
Retained sales	8,499	3,121	36.7%
Cost savings	8,499	4,316	50.8%
Investment in plant and equipment	8,499	3,637	42.8%
Investment in products and processes	8,499	3,451	40.6%
Investment in information systems	8,499	2,751	32.4%
Investment in workforce training	8,498	4,420	52.0%
Other investments	8,498	1,661	19.5%
Investment savings	8,499	3,008	35.4%
At least one positive response	8,500	7,127	83.8%

Table 3: Summary of MEP Center results for MEP clients in FY2020

Outcome	Value
Sales	*$13.0b*
New sales	$2.9b
Retained sales	$10.1b
Jobs	*105,748*
New jobs	23,668
Retained jobs	82,080
Cost savings	*$1.4b*
Investment savings	*$1.4b*
Investments	*$4.9b*
Products and process	$1.3b
Plant and equipment	$2.4b
Information systems	$342m
Workforce	$213m
Other	$693m

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)
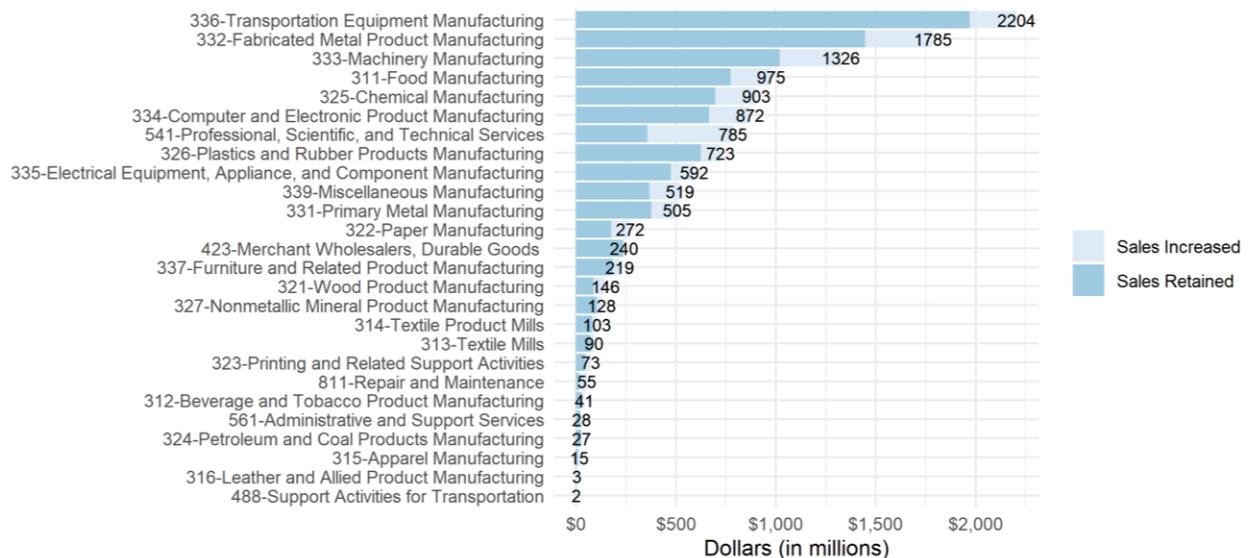
Overview of jobs

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)
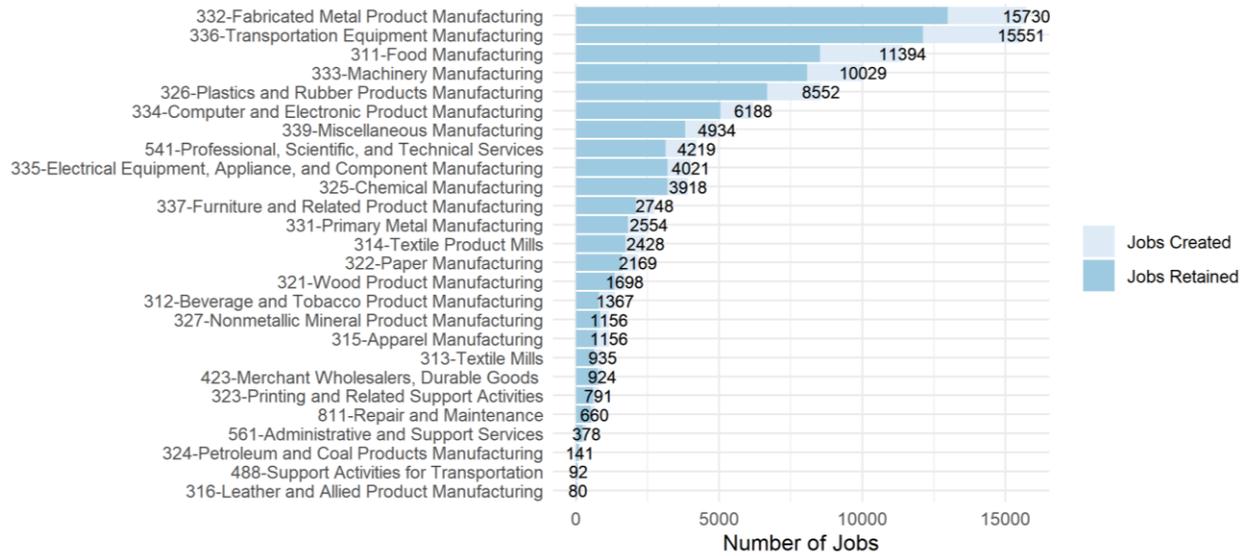
Overview of investments

Most of the investments were in plants and equipment ($2.4 billion) and in new products and processes ($1.3 billion), as shown in **Figure 4**.

Figure 4: Breakdown of investments
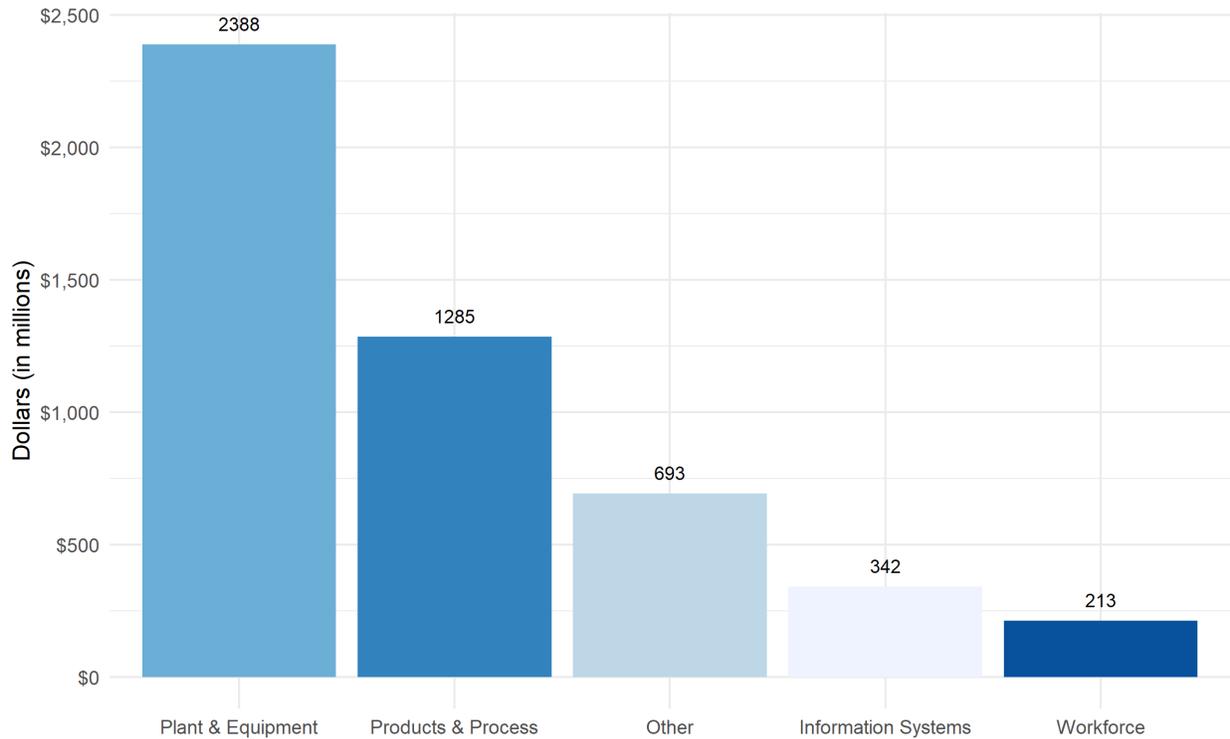
Figure 5 shows the breakdown of total investments by industry, which remains consistent across the NAICS codes. Plant and equipment, as well as products and process, account for most of the investments across almost all the industries.

Figure 5: Investments by industry (top industries)
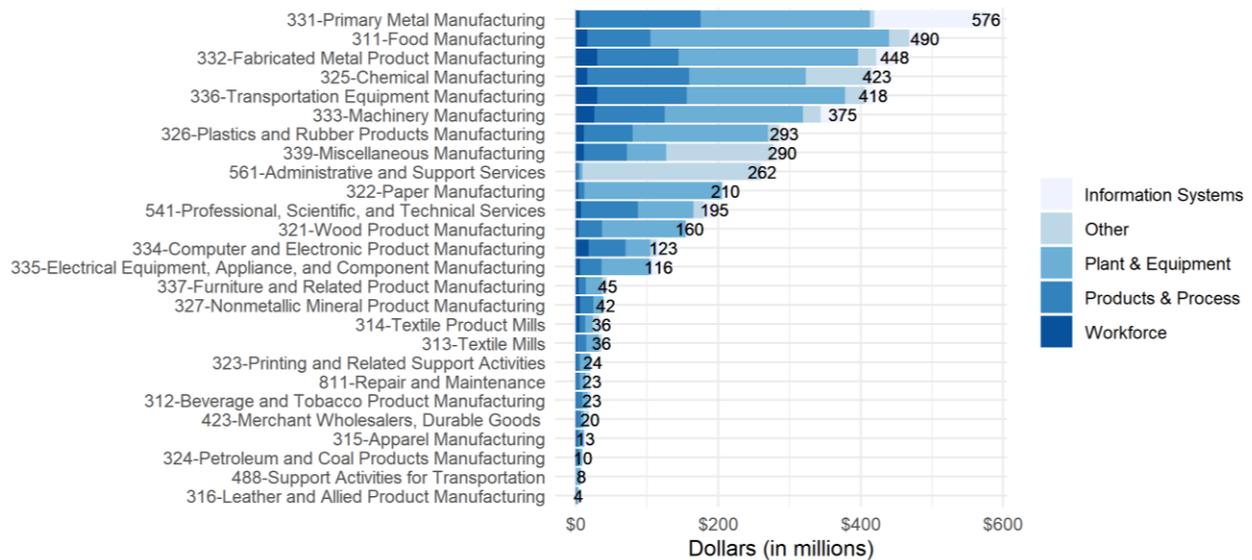
Cost savings and investment savings

Figure 6 examines the industries with the highest aggregate cost savings. The ranking of industries is somewhat different. Electrical Equipment, Appliance, and Component Manufacturing (NAICS 335) had the most savings, with a total of $585 million, followed by Professional, Scientific, and Technical Services (NAICS 541), with a total of $507 million. The third-highest industry saved only about half as much, $256 million.

Figure 6: Total savings by industry (top industries)
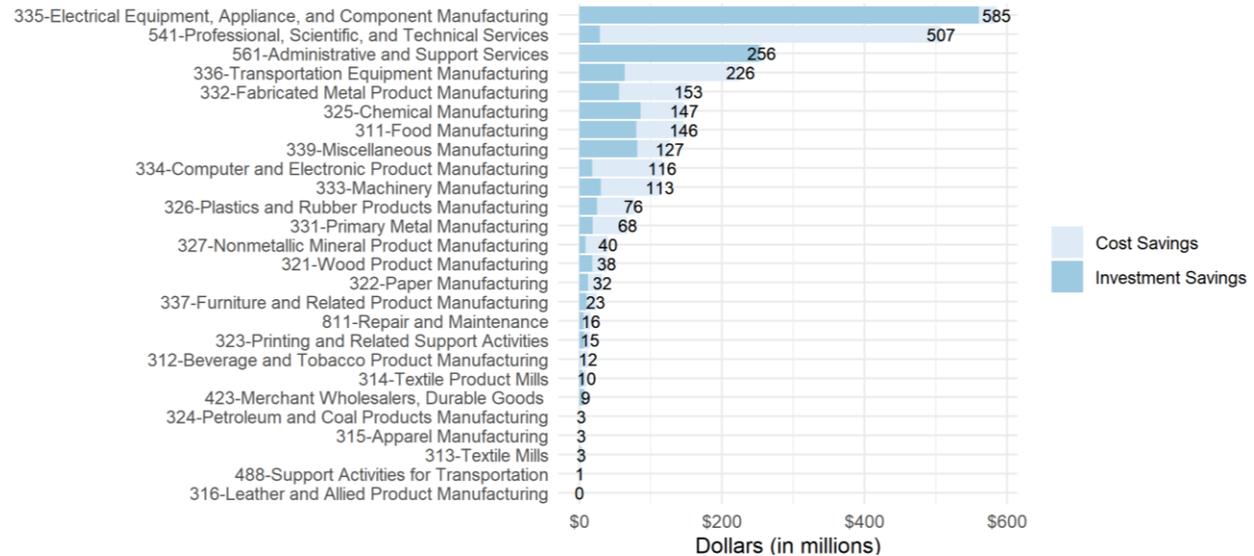
Sales and jobs

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
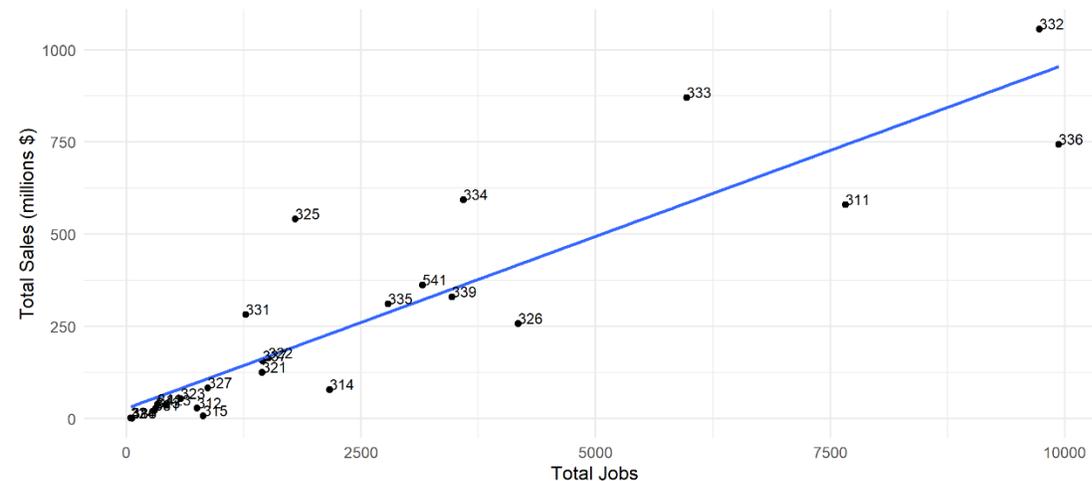
Note: Appendix B provides a list of the NAICS code descriptions.

IV. ECONOMIC IMPACTS FOR FY2020

This section summarizes the economic impact results for FY2020, shown in **Table 1**. This study finds that the federal investment of $146 million into MEP Centers yields a return to the Treasury of about $1.99 billion, for a return on investment of 13.6:1 according to the more conservative, firm-based estimate.

Using the firm-based scenario, MEP and its Centers contributed to the addition of an estimated 252,631 jobs to what was an uneven economy. In addition, the combined efforts added just over $39 billion in output, an additional $21 billion in gross domestic product (GDP), and more than $15 billion in personal income to the economy in FY2020.

While the first scenario'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 693,438 jobs, more than $150 billion in additional output, an increase of about $75 billion in GDP, and nearly $44 billion more in personal income.

Finally, at the estimated break-even point, investment in NIST MEP contributes to the addition of about 18,503 jobs, just under $3 billion in output, $1.5 billion in GDP, and $1.1 billion in income.

V. CHANGES FROM 2019 TO 2020

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
- NAICS-based industry mix, measured by the employment base
- Job-creation rate by industry by year (number of jobs the client says were created because of MEP assistance divided by the employment base)

We explored each of these potential differences between FY2019 and FY2020 to determine whether annual comparisons could be made without adjustment. Our findings are summarized in **Table 4** and described in this section. We determined that there are no adjustments needed to make reliable comparisons of the FY2019 and FY2020 impact estimates.

Table 4: Summary of FY2019 and FY2020 comparisons

Metric	2019	2020	Change
Survey completion rate	82.1%	78.4%	-3.7pp
Survey responses	8,425	8,501	+0.9%
Job Creation			
Number of clients reporting positive job-creation impact	3,245	3,029	-216
Percent of clients reporting positive job-creation impact	38.5%	35.6%	-2.9pp
Number of jobs created	28,132	23,668	-18.9%
Job Retention			
Number of clients reporting positive job-retention impact	3,887	4,013	+3.4%
Percent of clients reporting positive job-retention impact	46.0%	47.2%	+1.2pp
Number of jobs retained	86,518	82,190	-5.3%
Employment Base			
Total employees	998,699	1,087,442	+8.3%
Average number of employees per client establishment	97.6	100.6	+3.0

Note: The number of observations for the FY2020 comparisons is different than the number of FY2020 clients. There was one client in the FY2019 data that completed two surveys. Both surveys were matched to that client in the FY2020 data, resulting in one additional FY2020 observation for the comparisons.

We used the FY2019 MEP survey data and the FY2020 MEP survey data for our comparisons and divided these data into three groups (see **Figure 8** below):

- The first group (matched group) consists of clients who responded to the survey in both years and is matched based on their MEP Enterprise Information System (MEIS) client ID codes.
- The second group (FY2020 unmatched group) includes respondents from FY2020 who were not surveyed in FY2019.
- The third group (FY2019 unmatched group) consists of respondents from FY2019 who were not surveyed in FY2020.

The matched group provides a control for understanding differences between the same respondents in the two surveys.

Figure 8: Depiction of the client groups
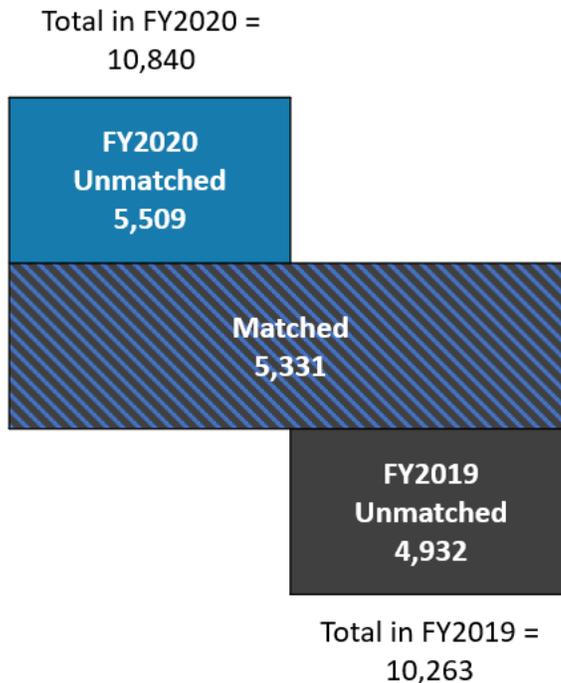
Note: The number of observations for the FY2020 comparisons (10,840) is different than the number of FY2020 clients (10,839). There was one client in the FY2019 data that completed two surveys. Both surveys were matched to the client in the FY2020 data, resulting in one additional FY2020 observation for the comparisons.

As shown in **Table 5** below, most of the survey responses for the matched group were filled out about a year apart for three quarters (Q4 2019, Q2 2020, and Q3 2020). The survey scheduled for Q1 2020 was postponed due to the declaration of a national emergency as a result of the COVID-19 pandemic, and those surveys were administered in Q2 2020.

Table 5: Matched group clients and survey quarters

| Survey Quarter	2018 Q4	2019 Q1	2019 Q2	2019 Q3	Total
2019 Q4	1,256	0	0	0	**1,256**
2020 Q1	0	1	0	0	**1**
2020 Q2	150	1,117	1,318	0	**2,585**
2020 Q3	53	89	119	1,228	**1,489**
Total	**1,459**	**1,207**	**1,437**	**1,228**	**5,331**

Survey completion rate

We compared the survey completion rates for FY2019 and FY2020 and determined that MEP impact results could be reliably compared based on the small discrepancy.

The "Survey Outcome Code" field indicates whether a client completed the survey (code 401) or not (code 049). For the matched group, 90.2% completed the survey in FY2019 and 82.4% completed the survey in FY2020. The overall completion rate for FY2020 (78.4%) is slightly lower than the completion rate for FY2019 (82.1%). However, because the number of clients in FY2020 was larger, there were more completed surveys in FY2020 than there were in FY2019.

Figure 9 shows that completion rates for FY2020 were consistently lower than completion rates for FY2019 across most industries.

Figure 9: Completion rates by industry, matched group only
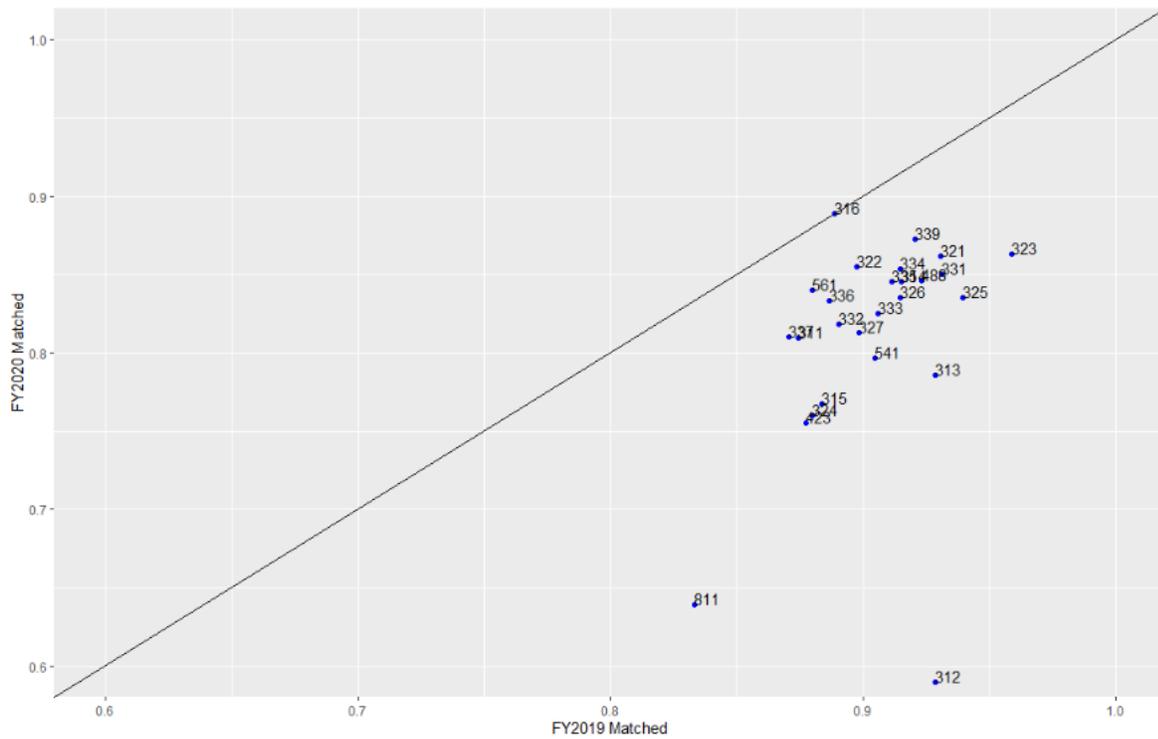
Note: NAICS code descriptions can be found in Appendix B.

Job creation

For each survey outcome, such as job creation or increase in sales, the respondents were asked whether MEP services impacted that outcome and were given three options: "yes" (coded with a 1), "no" (coded with a 2), and "I don't know" (coded with an 8). The sales and employment categories are most important for the analysis because they drive most of MEP's economic impact estimates.

Table 6 compares the percentage of responses that indicated MEP positively impacted the employment and sales outcomes between FY2019 and FY2020 for the matched group. The percentage of those who said MEP services helped create jobs was about 5 percentage points lower in FY2020. The other outcomes were generally consistent between the two fiscal years.

Table 6: Comparison of positive jobs and sales outcome responses, matched group only

Outcome		Percentage of Respondents Who Indicated Positive Impact	
		FY2019	*FY2020*
Jobs	Created	43.1%	38.2%
	Retained	51.2%	52.0%
Sales	Increased	38.3%	37.1%
	Retained	43.2%	43.9%

Table 7 shows that for both years, only about 10% to 11% of respondents did not know (coded 8) whether MEP services contributed to job creation.

Table 7: Comparison of job creation responses, matched and unmatched groups

Job-Creation Code	FY2019		FY2020	
	Number	*Percentage*	*Number*	*Percentage*
Yes (1)	3,245	38.5%	3,029	35.6%
No (2)	4,298	51.0%	4,521	53.2%
I don't know (8)	880	10.4%	950	11.2%
Total	**8,423**	**99.9%**	**8,500**	**100.0%**

Note: Percentage totals are a result of rounding and may not equal 100.0%.

Employment base

We defined the employment base as the total number of employees in a client's establishment. The employment base was similar between FY2019 and FY2020 and does not weaken or invalidate the reliability of comparisons between MEP impacts across years.

Dun & Bradstreet provided the number of employees for all but 34 of more than 10,000 surveys. For the FY2020 universe, the average number of employees was 101 and the median was 35.

Because the employee base was available for most of the clients who did not respond to the survey, we were able to compare the size of the establishments for respondents versus nonrespondents. Nonrespondents tended to be larger and have more employees than respondents. Clients who completed the survey had an average of 95 employees, and clients who did not complete the survey had an average of 122 employees. Similarly, respondents in the FY2019 survey had fewer employees on average than nonrespondents.

Industry base

We compared the employment shares of each industry for FY2019 and FY2020 and determined that they were largely consistent and do not require adjustment when comparing MEP impacts across years.

Figure 10 below shows the alignment of employment shares between the FY2020 survey and the FY2019 survey. The blue line represents the 45-degree line, where the FY2019 employment shares equal the FY2020 employment shares. Except for the Food Manufacturing industry (NAICS 311), the industries are very close to the line. The correlation coefficient is 0.95.

Figure 10: Comparison of manufacturing employment shares for FY2019 and FY2020
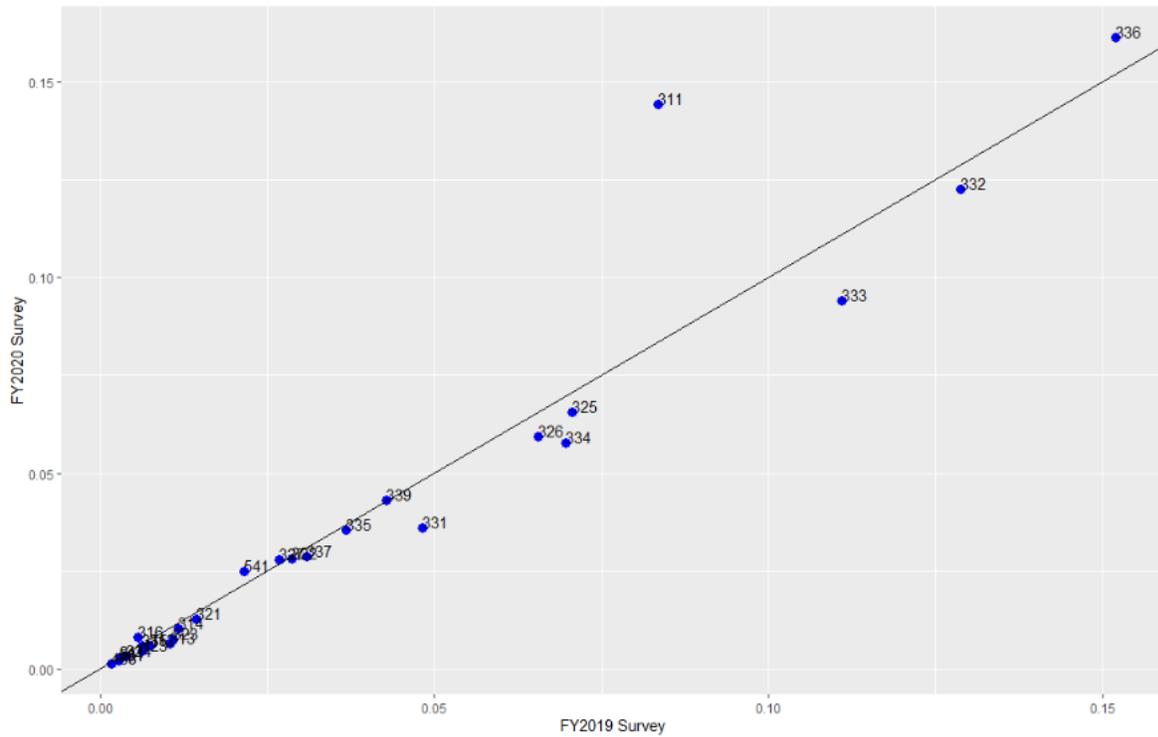
Note: NAICS code descriptions can be found in Appendix B.

Job-creation rate

The job-creation rate is defined as the respondent's estimated number of jobs created as a result of MEP assistance divided by the number of employees in the establishment. **Figure 11** below compares the job-creation rate between FY2019 and FY2020 by industry. The job-creation rate is consistent for both years. Again, we took these differences at face value and did not make any adjustments.

Figure 11: Comparison of job-creation rate by industry, matched group only
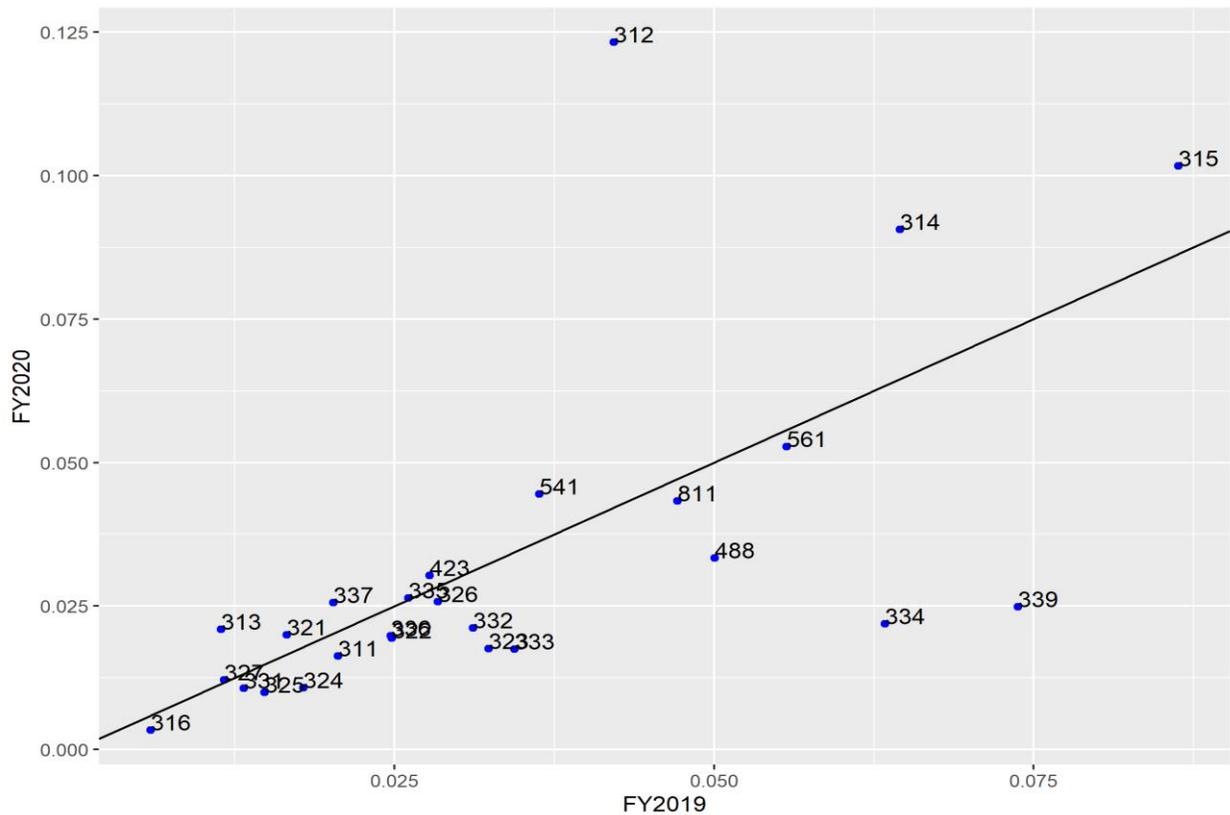
Note: NAICS code descriptions can be found in Appendix B.

Total hours in the program

We compared the total hours reported by Centers as provided in the program data appended to the survey results. For the surveys completed, the projects involved 708,653 total hours in project activity in FY2020 compared with 687,908 total hours in FY2019, an increase of 3.0%. This is partially due to a 5.6% increase in the number of clients, from 10,262 to 10,839.[10]

However, when restricting the analysis to the matched group, the total number of hours is only 0.1% higher in the FY2020 survey. Competitive Award Recipients (CARs) spent 617 more hours with clients, an increase from 464,186 hours in FY2019 to 464,803 hours in FY2020. This indicates that the project intensity was consistent across the two years, and we therefore did not make adjustments.

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[10] Results in this section only include clients with non-missing NAICS codes.

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
- 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
- **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 2018 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 2018, 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 8 provides the descriptions of the 3-digit NAICS codes used throughout the report.

Table 8: 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 9** and **Table 10** provide cross tabulations between the jobs and sales metrics in FY2020. 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 9: FY2020 comparison of created jobs and increased sales responses

		Increased Sales			
		Yes	*No*	*I don't know*	*Total*
Created Jobs	*Yes*	1,789	646	594	**3,029**
	No	769	2,726	1,025	**4,520**
	I don't know	118	122	710	**950**
	Total	**2,676**	**3,494**	**2,329**	**8,499**

Table 10: FY2020 comparison of retained jobs and retained sales responses

		Retained Sales			
		Yes	*No*	*I don't know*	*Total*
Retained Jobs	*Yes*	2,552	695	765	**4,012**
	No	408	1,990	641	**3,039**
	I don't know	160	193	1,094	**1,447**
	Total	**3,120**	**2,878**	**2,500**	**8,498**

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 the 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 11** below.

The coefficients of capital and labor are all statistically significant in every model. The two coefficients for each type of capital investment sum to around 1, which suggests that the production functions are somewhat close to Cobb-Douglas production functions, with constant returns to scale or with slightly increasing returns to scale. In the last model (retained sales, cost savings, and job retention), the two coefficients sum to 1.18 and 1.15, which suggests increasing returns to scale higher than any other models.

Table 11: Production function model outputs

Dependent Variable: Increase in Sales				
Type of Capital	*Investment Coefficient*	*Job-Creation Coefficient*	*R-Squared*	*Number of Observations*
Products and process	0.457 (13.27)	0.531 (8.67)	0.399	758
Plant and equipment	0.405 (12.99)	0.559 (9.71)	0.404	801
Information systems	0.391 (9.22)	0.663 (9.85)	0.362	628
Other	0.341 (8.20)	0.684 (9.21)	0.413	438
Dependent Variable: Sales Retention				
Type of Capital	*Savings Coefficient*	*Job-Retention Coefficient*	*R-Squared*	*Number of Observations*
Save on investment	0.375 (10.90)	0.808 (16.96)	0.425	791
Cost of savings	0.531 (17.50)	0.618 (15.70)	0.447	1,100