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EMPLOYMENT MULTIPLIERS IN THE U.S. ECONOMY

Dean Baker and Thea Lee

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Introduction

While academics and policymakers have been engaged in a long-standing debate over the importance, extent, and causes of the decline in manufacturing output and employment in the U.S. economy,[1] some facts are undisputed. Since its peak, manufacturing employment in the United States has fallen by almost 3 million—from 21 million jobs in 1979 to 18 million jobs at the end of 1992 (U.S. Department of Labor, 1993). During this period, real hourly wages have fallen dramatically (by almost 9 percent), with the greatest losses falling on those workers at the bottom of the pay scale and with the fewest years of formal education (see Mishel and Bernstein, 1993, chapter 3). Since most of the productivity growth that occurred in the 1980s was concentrated in the manufacturing sector, the loss of manufacturing jobs contributed to slower overall productivity growth, which in turn affected the potential for wage increases.

In this study, we construct a measure of the importance of manufacturing employment to the U.S. economy. We estimate all the secondary employment associated with each manufacturing job, whether in supplier industries or in those sectors where workers spend their paychecks. We compare these employment multipliers across sectors and across selected industries, including aerospace, textiles, apparel, steel, automobiles, and machinery.

This provides a means of evaluating the impact of a decline in final demand in one industry on economy-wide job losses and makes it possible to compare potential job losses across industries. This gives a clearer sense of the importance of that industry to the economy, thus showing the extent to which policies designed to support that industry may be desirable.

We find that the average manufacturing job generates four and a half times as many secondary jobs as does the average retail job and almost three times as many secondary jobs as a job in the personal and business service sector. Within manufacturing, the auto industry in particular stands out, in that auto production is associated with significantly more secondary employment than any other industry studied. Other above average industries include carpet production and basic steel products. However, even the manufacturing industries with relatively low indirect job creation—apparel, machinery, and textiles—have multipliers at least double that of one of the fastest growing parts of the service sector—retail trade.

Computing Employment Multipliers

The total impact of any change in demand includes a direct or primary impact and a secondary impact. When consumers purchase less domestically produced apparel, for instance, the direct impact is a loss of domestic apparel jobs.

The secondary employment associated with an industry has two components. The first component consists of the workers employed in the supplier industries that produce the raw materials, tools, machinery, and other inputs used in the production process and in bringing the goods to market. Each apparel job, for example, is associated with about one-fifth of a job in yarn mills and one-twelfth of a job in wholesale trade, among others.

The second component of secondary employment, which we call the "respending multiplier," measures the employment generated when workers in the industry and its supplier industries spend their incomes. Workers generally spend (rather than save) the bulk of their wages, and this spending creates demand for the goods these workers consume. The amount of employment created through this respending effect depends on the wages received by workers in an industry and its major suppliers, as well as on the proportion of their income that they spend. This effect will be larger in the relatively high-wage sectors of the economy. As part of this second component we have also included the jobs of public-sector workers who are employed at the federal, state, or local levels with the tax revenues generated by the workers directly or indirectly employed.

In this study we calculate the sum of these two effects. We use input-output tables from the Bureau of Labor Statistics (BLS) to calculate the number of workers employed in supplier jobs. We adjust these figures to account for workers employed in the production of new plant and equipment, which is not included in the BLS tables. Then we apply a respending multiplier, which is adjusted to account for inter-industry differentials in the weekly wage. The exact methodology we use is explained in more detail in the appendix.

It is worth pointing out here some of the uses and limitations of these estimates. Our calculations represent the secondary employment which is *associated* with employment and output in a particular industry, rather than ironclad predictions of job losses or gains that will result from an initial change in employment. That is, we look at the number of supplier jobs and the respending impact that are generated by a given job at a given moment in time. For example, the production of an automobile domestically employs workers engaged in automobile assembly (primary jobs), as well as workers producing auto parts, rubber, glass, and upholstery (supplier jobs). It also leads to employment in local retail, service, and goods-producing establishments as the auto-assembly workers spend their paychecks (respending impact). These workers in turn generate tax revenue as a result of what they pay out in income, payroll, sales, or other taxes. This revenue can then be used to employ government workers at the federal, state, or local level.

It is not possible to conclude from this information alone, however, that the loss of a job in the primary industry will *inevitably* lead to the loss of the secondary

jobs identified here. If, for example, General Motors were to move an auto assembly plant outside the country, primary jobs would certainly be lost, but the supplier jobs could also move or they could remain in place. Whether the supplier jobs go with the primary job depends on a number of factors, including corporate strategy, relative costs of production, and transportation costs. In most cases, however, supplier jobs will follow the final product, so any over-estimation resulting from this methodology is probably small.

Similarly, our measure of the respending impact reflects an estimate of jobs lost when everything else is held constant. In most cases workers who lose their jobs will be eligible for unemployment compensation or other government benefits. Some may also be able to find other jobs quickly if the economy is expanding. We have abstracted from these effects and simply measured the impact of the loss in purchasing power that results from individuals losing their jobs, in effect assuming that their income falls to zero. Insofar as they are able to offset this loss of income with government benefits or new employment, the actual decline in purchasing power will be less.

On the other hand, these estimates are based on *current* employment requirements and cannot account for the dynamic consequences of the growth or decline of particular sectors. These calculations ignore the extent to which different industries are likely to have varying rates of innovation and productivity improvement. This can be a major factor in determining the importance of a particular sector for the economy. For example, insofar as the steel industry is likely to have more rapid productivity growth and produce more innovations than retail trade it will make a substantially greater contribution to overall economic growth and well-being over time. These considerations are omitted since there is no way to quantify these effects within the scope of this study.[2] Still, it is reasonable to assume that these effects are an important determinant of the overall importance of a particular industry to the economy as a whole. In this sense, the estimates reported here may understate the long-run impact on the economy of job loss in a certain industry. In particular, our estimates may understate the differential impact of employment in manufacturing industries compared to service industries, since manufacturing productivity growth has far outstripped that in other sectors during the last two decades.

What the calculations presented here *do* provide is a powerful indicator of the magnitude of disruptions created by a given change in employment or demand in particular industries.

For example, we estimate that an average of 437 jobs are associated with 100 jobs in the steel industry, as compared to an average of 147 jobs per 100 jobs in

personal and business services. This indicates that the loss of jobs in the steel industry is likely to have a far larger ripple effect on the economy than an increase in employment of the same size would have in personal and business services. There will be many more jobs lost in the supplier industries for steel than will be generated in the supplier industries for personal and business services.

In addition, since the steel industry and its major supplier industries are comparatively well paid sectors of the economy, the purchasing power generated by the jobs lost in this sector will be far greater than the purchasing power of the same number of workers in personal and business services. The resulting falloff in consumption will lead to a further falloff in employment. Thus, it would be necessary to create approximately 217 jobs in personal and business services to create enough direct and indirect employment to offset the loss of 100 jobs in the steel industry. To take another example, there are 570 jobs associated with every 100 jobs in the carpet and rug industry. It would take an increase of approximately 271 jobs in personal and business services to offset the loss of 100 jobs in the carpet and rug industry. Similarly, 158 retail jobs would be needed to offset the total employment loss associated with 100 jobs lost in the apparel sector.[3] These comparisons can be made for any of the industries in the study.

Literature Review

In order to place our estimates in context, we have reviewed some representative attempts to calculate multipliers, either for specific industries, or at the aggregate level. We have included studies by private forecasting firms (Wharton Econometric Forecasting Associates—WEFA), government agencies (the Congressional Budget Office—CBO), academics (University of Illinois at Chicago) and labor unions (the United Auto Workers—UAW), among others. (A complete list of references is provided at the end of the paper.) The studies also range from sectoral studies of particular industries (tobacco, textiles, and auto) to economy-wide applications. In this section, we will explain the differences and similarities in approach among the various studies.

All the studies reviewed share the same basic elements. First, the studies identify the jobs directly in question. Second, they trace the supplier jobs, usually by applying standard input-output tables. Finally, they estimate the impact of workers' respending on the rest of the economy.

Despite the overall similarity of approach, however, the multiplier estimates varied widely between studies. Mainly, studies differed in how broadly they defined the supplier industries and in the size of the estimated respending effect. Some of the

estimates were more conservative than ours, while others estimated larger impacts than we found to be supportable. Some of the differences arose from the use of different scenarios, which may apply for other policy scenarios, but were not appropriate for our purpose.

In the tobacco industry, for example, WEFA calculated the impact on the U.S. economy of the total disappearance of the entire tobacco industry. They construct a counterfactual scenario in which no tobacco was consumed, produced, or marketed in the United States for the 25 year period 1963-1987. This appears designed to show what would happen to the U.S. economy if consumers totally ceased purchasing and consuming tobacco, whether by individual choice or government mandate. In the case of manufacturing goods, this assumption would not be relevant, since no one is suggesting that Americans cease consuming manufactured goods altogether. The implicit counterfactual for our purposes is that goods are imported rather than produced domestically.

As noted above, there is a wide variation between studies in the size of the assumed respending multiplier. The estimates range from a low of .25 jobs created for every job in the direct and supplier industries to a high of 1.9 jobs per job. We use an estimate of .5 jobs per job, which appears to be the most widely used figure.

For example, CBO uses a respending multiplier of .5 jobs per job. CBO cites a Department of Defense estimate that "for every military and civilian job that is lost to a community as a result of a base closing, the local economy generally experiences the loss of another half job in businesses that provide services to base employees" (CBO, p. 33). We found this estimate to be consistent with the academic literature on "macro" multiplier effects (see Appendix).

A UAW publication that analyzes the impact of the U.S. auto industry on the overall economy uses a respending multiplier from the RIMS macro model. The RIMS model estimates that only about .25 jobs are created for each original job. This estimate is on the low end of those we surveyed.

The only estimate for the respending multiplier over .5 came from WEFA's study of the tobacco industry. WEFA finds that there are almost two jobs created by the respending impact of the "core and supplier" tobacco workers for each direct job. This multiplier is four times higher than any other found in the studies surveyed. WEFA's methodology also inflates the impact of tobacco workers' respending on the economy in several additional ways.

To estimate the impact of the loss of the tobacco industry, WEFA assumes that the reduction in tobacco consumption and production was not replaced by any other goods during the period in question (1963-1987). This assumption almost certainly

overstates the impact of tobacco consumption on the economy. If consumers had not been buying cigarettes for the last 25 years, they probably would have spent their income on a variety of other goods—unless they chose to work shorter hours, which could moderate the effect slightly. The purchase of these other goods would also presumably create additional spending and jobs throughout the economy. A more appropriate comparison might thus have been between the jobs generated by tobacco production versus those generated by the goods consumed instead of tobacco.

In addition, WEFA uses an extremely broad definition for the tobacco supplier industries, perhaps overstating the number of jobs involved in "bringing tobacco products to market." For example, according to their calculations, about 45 percent of the core and supplier tobacco jobs are in wholesale and retail. This is about double the figure obtained through the BLS tables.

The existing literature on manufacturing multipliers clearly establishes a basic methodology and framework. Nevertheless, within that framework, estimates differ widely because of differences in application. Our study falls within the guidelines of existing studies, but also makes several innovations.

None of the studies we identified calculated aggregated multiplier effects for the manufacturing and service sectors as we do here. This comparison is extremely useful, since it highlights the positive contribution of manufacturing employment in two ways. First, manufacturing jobs contain more "linkages" to other jobs in the economy than do service jobs, because they require the purchase of relatively more manufactured inputs and services. To the extent that those inputs are produced domestically rather than imported, they also contribute to economic growth and activity.

Second, we take into account the impact on the respending multiplier of the variation in wages between industries. This allows us to show that the relatively high wages in manufacturing have a larger impact on respending than do the lower wages of the service sector.

Third, we also have attempted to account for a deficiency in the way the BLS constructs its input-output tables. These tables ignore the capital services used up in the production process. We have used the Bureau of Labor Statistics Multifactor Productivity Tables to get an estimate of the amount of capital used in the production process and then calculated the amount of employment that is associated with this capital input (see Appendix). By including an estimate of the workers employed in the capital goods sector we are generating a better approximation of the total number of supplier jobs.

Finally, we are careful not to "double-count" various effects, leading to estimates of dubious reliability.

Manufacturing, Services, and Retail Trade

The first set of comparisons we made involved overall averages for the manufacturing sector, personal and business services, and retail trade. In order to come up with sectoral totals, we computed a weighted average, using total employment as a weight.

As **Table 1** indicates, the total indirect (or secondary) employment associated with the average manufacturing job is almost three times larger than the total indirect employment associated with the average job in personal and business services, and four and a half times as large as the secondary employment associated with a typical job in retail trade.

The main source of this disparity is the difference in the number of jobs generated in the supplier industries for the three sectors (shown in the first row of Table 1). Manufacturing jobs create an average of 221 additional jobs in supplier industries for every 100 jobs. This is almost four times the 58 supplier jobs per 100 jobs in personal and business services and more than seven times the figure for retail trade. These differences can be readily explained by comparing the amount of equipment and materials required by workers in each sector.

The gap in the secondary employment generated by each sector is further widened by the differences in the respending employment between the sectors. Since

Table 1
Impact per 100 Jobs: Manufacturing, Retail Trade, and Personal and Business Services

Sector	Manufacturing	Retail Trade	Personal & Business Services
1. Supplier Jobs	220.74	29.70	58.39
2. Respending Employment	174.29	54.06	75.64
3. Government Revenue (millions of dollars)			
a. Federal	1.86	.69	.88
b. State and Local	1.03	.38	.49
4. Government Employment			
a. Federal	5.20	1.93	2.46
b. State and Local	21.55	8.00	10.19
5. Total Indirect[a]	**421.78**	**93.69**	**146.68**

[a]Sum of Rows 1, 2, 4a, and 4b

workers in the manufacturing sector have significantly higher earnings on average than workers in retail trade or personal and business services, the manufacturing sector will generate the most additional jobs per worker as workers spend their incomes.

The respending employment figures in the second row, 174 for manufacturing, 54 for retail trade, and 76 for personal and business services, thus reflect both the higher respending employment per worker directly employed in the manufacturing sector and the fact that more workers are employed in supplier industries in manufacturing.

The third row indicates the amount of federal tax revenue generated from the wages of 100 workers employed directly in that sector as well as from the wages of the workers indirectly employed. This amounts to $1.86 million, $.69 million, and $.88 million for manufacturing, retail trade, and personal and business services respectively. The next line gives an identical calculation for state and local tax revenue. These figures are $1.03 million, $.38 million, and $.49 million, respectively. The following line converts the federal tax revenue figures into employment at the federal level, 5.20 jobs, 1.93 jobs, and 2.46 jobs respectively. Line 4b does the same conversion for state and local government employment. Row 5, which we label total indirect employment, is the sum of supplier industry employment; respending employment; and federal, state, and local government employment. Total indirect employment generated for each 100 jobs is 422 jobs in manufacturing, 94 jobs in retail, and 147 jobs in personal and business services.

Having explained the use of the tables, we now proceed to examine a broad range of industry groups. The industries selected—aerospace, textiles, apparel, iron and steel, automobiles, and nonelectrical machinery—are key manufacturing sectors of the economy. In each case, we have calculated multipliers that can be used to estimate the employment impacts of various scenarios. We have also broken down each industry into sub-categories, in order to determine where there are significant differences in the employment multipliers within an industry. In each case, we have kept the same categories used in Table 1.

Textiles

The data allow us to estimate employment multipliers in four segments of the textile industry. The first consists of weaving, finishing, yarn and thread mills (Standard Industrial Categories [SIC] # 221-224, 226, 228). The other three categories were knitting mills (SIC# 225), carpets and rugs (SIC# 227), and miscellaneous textile goods (SIC# 229). As can be seen from the first row of **Table 2**,

categories were knitting mills (SIC# 225), carpets and rugs (SIC# 227), and miscellaneous textile goods (SIC# 229). As can be seen from the first row of **Table 2**, the amount of employment in supplier industries was by far the greatest in the last two categories. Weekly wages were also somewhat higher on average in these two industries than in the first two (both of which pay slightly below the average for the economy as a whole).

This increased the gap in respending employment generated through workers' consumption (as shown in the second row). The amount of tax revenue and government jobs generated reflect these disparities as well. The ratio of total indirect employment to direct employment is almost three times as high in carpets and rugs (the highest category within textiles) as in knitting mills (the lowest category).

Since the vast majority of the jobs in the larger textile sector are in the fist two categories listed, yarn and thread mills and knitting mills, the average ratio for textiles as a whole, 267, is weighted towards the lower end of the table. While this number is low compared to the overall average in manufacturing (422), it is still approximately two to three times higher than the figures for retail trade and services (94 and 147, respectively).

Table 2
Impact per 100 Jobs: Textiles

	Weaving & Finishing, Yarn & Thread Mills (SIC# 221-24,226,228)	Knitting Mills (SIC# 225)	Carpets and Rugs (SIC# 227)	Miscellaneous Textile goods (SIC# 229)	**All Textiles (Total)**
1. Supplier Jobs	124.21	93.35	323.45	220.37	**135.82**
2. Respending Employment	111.76	87.35	212.45	165.07	**111.73**
3. Government Revenue (millions of dollars)					
a. Federal	1.26	1.06	2.39	1.45	**1.33**
b. State and Local	.70	.58	1.32	.80	**.73**
4. Government Employment					
a. Federal	3.53	2.95	6.68	4.05	**3.71**
b. State and Local	14.62	12.22	27.68	16.78	**15.39**
5. Total Indirect[a]	**254.12**	**195.87**	**570.26**	**406.27**	**266.65**

[a]Sum of Rows 1, 2, 4a, and 4b

Table 3
Impact per 100 Jobs: Apparel

	Apparel SIC# 231-238	Misc. Fabric. Textile Goods SIC# 239	**Apparel Total SIC# 23**
1. Supplier Jobs	93.09	147.45	**105.11**
2. Respending Employment	77.09	117.46	**86.02**
3. Government Revenue (millions of dollars)			
a. Federal	1.02	1.37	**1.10**
b. State and Local	.56	.76	**.60**
4. Government Employment			
a. Federal	2.84	3.83	**3.06**
b. State and Local	11.76	15.88	**12.67**
5. Total Indirect[a]	**184.78**	**284.62**	**206.86**

[a]Sum of Rows 1, 2, 4a, and 4b

Apparel

We break the apparel industry down into two separate categories, as shown in **Table 3**. The first category comprises most of the industry (SIC# 231-238). The second category includes only miscellaneous fabricated textile goods (SIC# 239). The amount of employment in apparel supplier industries is about half the average for manufacturing. The respending employment is also somewhat below the manufacturing average, both because of the comparatively low number of jobs generated in supplier industries and because wages in the apparel industry are below the average for manufacturing as a whole.

Overall, 207 secondary jobs are associated with every 100 apparel jobs. While this is well below the average for manufacturing, the average apparel job is associated with more than twice as much secondary employment as the average retail job and about 40 percent more employment than a job in personal and business services.

Iron and Steel

The iron and steel industries are broken down into two categories in **Table 4** below. The first category consists of blast furnaces and basic steel (SIC# 331). The second category is iron and steel foundries (SIC# 332). Employment in supplier industries is quite large in the first category, which contains the bulk of employment

Table 4
Impact per 100 Jobs: Iron and Steel

	Blast Furnaces and Basic Steel Products SIC# 331	Iron and Steel Foundries SIC# 332	**All Iron and Steel SIC# 331 & 332**
1. Supplier Jobs	211.06	92.95	**172.06**
2. Respending Employment	198.78	118.19	**172.17**
3. Government Revenue (millions of dollars)			
a. Federal	1.92	1.17	**1.67**
b. State and Local	1.06	.65	**.92**
4. Government Employment			
a. Federal	5.35	3.27	**4.66**
b. State and Local	22.19	13.54	**19.34**
5. Total Indirect[a]	**437.38**	**227.95**	**368.23**

[a]Sum of rows 1, 2, 4a and 4b.

in the iron and steel sector. Respending employment is high in both sectors, mainly because wages in the industry are high relative to the average for the economy.

In the steel industry as a whole, there are 368 indirect jobs associated with every 100 steel jobs. In blast furnaces, the figure is considerably higher, 437 indirect jobs per 100 direct jobs, which is somewhat higher than the average for all manufacturing.

Automobile Manufacturing

The automobile industry was broken down into four categories, as shown in **Table 5**: automotive stampings (SIC# 3465); motor vehicle and car bodies (SIC# 3711); motor vehicle parts and accessories (SIC# 3714); and truck and bus bodies, trailers, and motor homes (SIC# 3713, 3715, and 3716).

All these categories generate unusually large amounts of employment in their supplier industries. In fact, the second category, motor vehicle and car bodies, generates more employment in supplier industries than any other sector we examined. All of the categories within automobile manufacturing also pay wages substantially above average for the economy. Respending employment in each category is therefore quite high. The tax revenues generated and the number of government jobs which are thereby financed are also correspondingly large. The

Table 6a
Impact per 100 Jobs: Nonelectrical Machinery

	Mining and Oil Field Machinery (SIC# 3532-33)	Material Handling and Machinery Equipment (SIC# 3534-37)	Metalworking Machinery (SIC# 354)	Special Industry Machinery (SIC# 355)	General Industry Machinery (SIC# 356)
1. Supplier Jobs	95.12	127.51	78.97	133.84	130.45
2. Respending Employment	121.38	137.95	115.45	140.08	134.65
3. Government Revenue (millions of dollars)					
a. Federal	1.19	1.38	1.1	1.40	1.37
b. State and Local	.66	.75	.61	.78	.76
4. Government Employment					
a. Federal	3.32	3.84	3.09	3.93	3.83
b. State and Local	13.78	15.91	12.82	16.28	15.89
5. Total Indirect[a]	**233.60**	**285.21**	**210.33**	**294.13**	**284.82**

[a]Sum of Rows 1, 2, 4a, and 4b

Table 6b
Impact Per 100 Jobs: Nonelectrical Machinery

	Computer Equipment (SIC# 3571-72,3715,3717)	Office and Accounting Machinery (SIC# 3578-9)	Refrigeration and Service Industry Machinery (SIC# 358)	Miscellaneous Industrial Machinery (SIC# 359)	**Total Machinery** (SIC# 35)
1. Supplier Jobs	202.65	136.41	163.56	82.21	**131.17**
2. Respending Employment	177.76	133.42	147.03	112.17	**138.17**
3. Government Revenue (millions of dollars)					
a. Federal	1.81	1.39	1.17	1.11	**1.39**
b. State and Local	1.00	.76	.64	.61	**.77**
4. Government Employment					
a. Federal	5.04	3.87	3.26	3.09	**3.88**
b. State and Local	20.91	16.06	13.52	12.81	**16.08**
5. Total Indirect[a]	**406.36**	**289.76**	**327.37**	**210.28**	**289.30**

[a] Sum of rows 1, 2, 4a and 4b

Table 7
Impact per 100 Jobs: Aerospace Industry

	Aircraft (SIC# 3721)	Aircraft and Missile Engines (SIC# 3724, 3764)	Aircraft and Missile Parts and Equipment (SIC# 3728, 3769)	Guided Missiles and Space Vehicles (SIC# 3761)	All Aircraft (Total)
1. Supplier Jobs	186.82	173.78	177.00	160.32	**181.76**
2. Respending Employment	190.44	186.96	181.05	175.11	**185.50**
3. Government Revenue (millions of dollars)					
a. Federal	1.84	1.80	1.75	1.69	**1.79**
b. State and Local	1.02	.99	.97	.93	**1.06**
4. Government Jobs					
a. Federal	5.14	5.02	4.88	4.72	**5.00**
b. State and Local	19.55	18.97	18.59	17.82	**20.31**
5. Total Indirect[a]	**401.95**	**384.73**	**401.52**	**357.97**	**387.57**

[a]Sum of rows 1, 2, 4a, and 4b

number of jobs created in supplier industries, since workers in each sector have earnings that are significantly higher than average. The number of jobs created in supplier industries ranges from a low of 79 in the case of metalworking machinery to a high of 203 in computer equipment. The average for the industry as a whole is 131.

The total amount of indirect employment generated per hundred workers came to 289 for the industry as a whole, somewhat lower than the manufacturing average.

Aerospace

We examined four sub-categories of the aerospace industry, as listed in **Table 7**: aircraft (SIC# 3721); aircraft and missile engines (SIC# 3724,3764); aircraft and missile parts and equipment (SIC# 3728,3769); and guided missiles and space vehicles (SIC# 3761). All of these categories generate substantial amounts of indirect employment with relatively few differences between them.

The number of supplier jobs is large since there is a great deal of labor employed in producing inputs to the final product. The range here is from 197 supplier jobs per 100 workers in aircraft and missiles parts and equipment to 160 supplier jobs per 100 workers in guided missiles and space vehicles. The industry-wide average is 182 supplier jobs per hundred workers. Respending employment is also higher than in the average manufacturing industry, since jobs in the aerospace industry pay comparatively high

wages. The supplier jobs also pay comparatively high wages, which amplifies the amount of respending employment. The average amount of respending employment for the industry as a whole is 186 jobs per hundred workers employed in the aerospace industry compared to 174 jobs per hundred in manufacturing generally and only 54 jobs per hundred in retail trade. The total amount of indirect employment per 100 workers averages 388 for the industry as a whole.

Conclusion

Our examination of job multiplier effects across industries strongly supports the conclusion that the secondary impact of job losses will vary widely by sector. Predictably, jobs in manufacturing have far larger multiplier effects than jobs in retail trade or personal and business services. This is attributable to the fact that manufacturing jobs tend to require far more intermediate goods and capital equipment than retail trade or personal and business services. They also tend to pay higher wages, which means that the reduction of purchasing power associated with a loss of jobs in manufacturing is much greater than with retail trade or personal and business services. Although there were substantial differences in employment multipliers within manufacturing, even those industries at the low end still had multipliers higher than the average for services and retail trade.

An implication of this finding is that when the economy loses manufacturing jobs to import competition, it has to produce a significantly larger increase in service sector employment in order to offset the loss. In this sense, not all jobs can be considered equal. It is likely that the importance of manufacturing to the economy would be amplified further if we were to move beyond the static multipliers calculated here to consider the degree to which innovations and technological progress take place in various sectors. The multipliers we have calculated should, however, be sufficient to raise real concern about the rate at which the United States is losing manufacturing jobs.

Appendix

This appendix describes our calculations in greater detail than in the text. It also lays out more precisely the methodology we used to calculate the multipliers that appear in the text. The tables included here(Appendix tables 1 through 7) contain additional information, which was used to estimate the intermediate values needed to obtain the final estimates.

Our goal in this work was to obtain as accurate as possible a measure of all the indirect employment that could be tied to direct employment in various sectors or industries. We tried to trace three different channels through which jobs will indirectly lead to other jobs. First, there are the supplier jobs in the industries that produce parts, materials, or capital goods, that the workers in a given sector use on the job. Second, there are the jobs that are created as a result of the workers' consumption. Third, there are government jobs that are financed by the tax revenue that comes out of workers' wages. In our calculations we estimated each of these effects separately, and then summed them to get an overall figure for an employment multiplier.

In order to measure the indirect jobs created through the first channel we used the input-output or employment requirements tables from the Bureau of Labor Statistics. These tables trace all the inputs into a given product and the jobs associated with those inputs, giving the total amount of direct and indirect employment per million dollars of sales.

We then divided the number of workers who are employed in supplier industries by the number that are directly employed in the industry itself to determine the supplier jobs per hundred workers. Thus if Nm is the total employment per million dollars and Nd is the total direct employment per million dollars, for our calculation we took [(Nm-Nd)/Nd] * 100 = N_{s1}, where N_{s1} is the number of supplier jobs in industries producing parts and materials per hundred jobs in the industry's final product.

Since these tables only count parts and materials, but not the capital used up in the production process, we had to calculate separately the number of supplier jobs in the capital goods industries. To make this calculation we used the Bureau of Labor Statistics Multifactor Productivity Tables (MPT). These give estimates of the percentage of the total value of output attributable to capital services for each two-digit SIC category. This allowed us to calculate the amount of capital goods used up per hundred workers. For example, if the MPT indicate that capital services account for 20 percent of the total value of output in an industry, we would multiply [(100/

Nd)*$1,000,000]*.2, to get the total amount of capital services used up per hundred workers.

We then estimated the number of supplier jobs created in the capital goods industry from employment requirements tables. To make this calculation we assumed that the capital goods were broken down in the form of 60 percent equipment and 40 percent structures in all cases. This has been approximately the proportion for the economy as a whole. The total figure from these two calculations appears as "supplier jobs" in our charts.

Both of the tables we used are now somewhat dated. The employment requirements table was produced in 1987 based on 1982 input-output tables. The Multifactor Productivity tables were published in 1988. Unfortunately, these are the most recent consistent sets of data of this sort available. It is unlikely, however, that the production procedures have been altered sufficiently in the intervening years to lead to significantly different results.

The one place where there have been some changes that may be of consequence is in the area of imports. In constructing the employment requirements table, BLS attempted to adjust for imported inputs by assuming that materials and parts are imported in an industry in the same percentage as its final output. This is at best a first approximation, and undoubtedly one that gives an increasingly inaccurate picture as import percentages continue to grow. Nonetheless, we have not attempted to make any adjustments for this, since there is no clear basis on which such an adjustment can be made.

In order to estimate accurately the employment resulting from the spending by workers employed directly or indirectly in each industry we had first to estimate their purchasing power relative to other jobs in the economy. To do this we first multiplied the base of the 100 workers directly employed by the ratio of weekly wages in that particular industry to the economy-wide average. The difference between this figure and 100 appears as the "direct employment purchasing power adjustment" in the appendix tables. Thus, industries with higher-than-average wages would have their respending multiplier adjusted upward, while low-paying industries would be adjusted in the reverse direction.

We then identified those supplier industries that accounted for more than 8 percent of the total amount of indirect employment. For these industries we made a similar adjustment, comparing workers' wages to the economy-wide average. In the case of workers in supplier industries that accounted for less than 8 percent of indirect employment, we assumed that wages were equal to the economy-wide

average. Our measure, "purchasing power equivalent," is then the sum of the purchasing power attributed to these three groups of workers.

We then multiplied this number by .5 to get our measure of "respending employment." We used .5 based on our review of macroeconomic models, including Data Resources Inc. (DRI), Wharton, the Federal Reserve Board, and the Economic Policy Institute's modified version of Ray Fair's model. These models yield a consensus estimate of about 1.5 as the overall multiplier, with .5 being its respending component.

We used 1990 wage rates as reported in the BLS publication *Employment and Earnings*. The relative wages from that year may be slightly different at present, but we felt that the data from 1990 were less distorted by the effects of the recession than the data from 1991.

We based all our aggregations on the 1990 data from *Employment and Earnings*. We weighted each industry by its share of total employment. This approach was applied both for the 2-digit aggregations and also for the broader aggregation by manufacturing, personal and business services, and retail trade. We used employment levels as the base of aggregation for both the calculation of jobs per hundred jobs and for jobs per million dollars of final demand.

In order to calculate the amount of government employment that can be reasonably attributed to the workers directly or indirectly employed by a particular sector we first estimated the amount of tax revenue that would have been generated. To arrive at these estimates we took the average percentage of total output that goes to tax revenue at each level of government and multiplied it by the wages earned by the workers directly and indirectly employed in each industry. We only took the wage component, excluding corporate profits, since in many cases the loss of jobs will not be associated with a reduction in profits, such as a case where production is moved overseas. This means our tax calculations may understate the revenue and jobs associated with the loss of primary employment, but this methodology appeared more accurate than one which included the loss of corporate and excise taxes as well.

We then converted the tax revenue to government jobs by calculating the ratio of total government revenue to government employment. Applying this ratio to our tax revenue estimates gave us the figures for federal, state, and local employment in the charts.

To get our final figure for total indirect jobs we then summed the three components—supplier jobs; respending employment; and federal, state, and local jobs. The figure for jobs per million dollars was then calculated using this base, but adjusting for the number of workers that would be directly employed by one million dollars of spending in a particular industry.

The last row contains an estimate of the number of jobs created directly and indirectly per million dollars of final expenditures in each sector. These data are useful for determining the impact on employment of lost or gained output in particular sectors.

With purchases rather than employment as the denominator, the patterns are reversed. Personal and business services generate one and a half times as many jobs per million dollars as retail trade, and more than twice as many as manufacturing. The fact that manufacturing employment involves higher wage workers and requires large amounts of equipment and materials means that the same amount of money generates fewer jobs in manufacturing than in retail trade or services. In other words, a policymaker with a billion dollars to allocate could choose to spend it on goods that created many relatively low-paying jobs or fewer jobs in more capital-intensive, high-wage industries.

Appendix Table 1
Impact per 100 Jobs: Manufacturing, Retail Trade, and Business Services

Sector	Manufacturing	Retail Trade	Personal & Business Services
1. Supplier Jobs	220.74	29.70	58.39
2. Direct Employment Purchasing Adjustment	27.81	-48.37	-7.11
3. Purchasing Power Equivalent	348.57	108.11	151.28
4. Respending Employment	174.29	54.06	75.64
5. Government Revenue (millions of dollars)			
a. Federal	1.86	.69	.88
b. State and Local	1.03	.38	.48
6. Government Employment			
a. Federal	5.20	1.93	2.46
b. State and Local	21.55	8.00	10.19
7. Total Indirect[a]	421.78	93.69	146.68
8. Total Jobs per $1,000,000	41.84	60.63	89.80

[a]Sum of rows 1, 4, 6a and 6b

Appendix Table 2
Impact per 100 Jobs: Textiles

	Weaving, Finishing, Yarn & Thread Mills (SIC# 221-24,226,228)	Knitting Mills (SIC# 225)	Carpets and Rugs (SIC# 227)	Miscellaneous Textile goods (SIC# 229)	All Textiles (Total)
1. Supplier Jobs	124.21	93.35	323.45	220.37	135.82
2. Purchasing Power Adjustments					
Wholesale Trade Employment	19.98	7.22	40.88	16.86	—
Adjustment	3.78	1.37	5.67	3.19	—
SIC# 221-4, 6, & 8 employment	19.82	73.2	18.84	—	—
Adjustment	—	-1.47	-5.42	-1.40	—
3. Direct Employment Purchasing Adjustment	-4.48	-18.54	1.2	7.99	—
4. Purchasing Power Equivalent	223.51	174.7	424.90	330.14	—
5. Respending Employment	111.76	87.35	212.45	165.07	117.73
6. Government Revenue (millions of dollars)					
a. Federal	1.26	1.06	2.39	1.45	1.33
b. State and Local	.70	.58	1.32	.80	.73
7. Government Employment					
a. Federal	3.53	2.95	6.68	4.05	3.71
b. State and Local	14.62	12.22	27.68	16.78	15.39
8. Total Indirect[a]	254.12	195.87	570.26	406.27	266.65
9. Total Employment per $1,000,000	49.46	46.90	45.60	40.84	47.70

[a]Sum of Rows 1, 5, 7a, and 7b

Appendix Table 3
Impact per 100 Jobs: Apparel

	Apparel SIC# 231-238	Misc. Fabric. Textile Goods SIC#239	Apparel SIC# 23
1. Supplier Jobs	93.09	147.45	105.11
2. Purchasing Power Adjustment			
Weaving, Finishing, Yarn and Thread Mills SIC# 221-4, 226, 228	18.02	39.92	—
Adjustment	-1.34	-2.97	—
Knitting mills SIC# 225	16.93	—	—
Adjustment	-3.14	—	—
Wholesale Trade SIC# 50-51	7.93	14.02	—
Adjustment	1.50	2.65	—
3. Direct Employment Purchasing Power Adjustment	-35.93	-12.21	—
4. Purchasing Power Equivalent	154.18	234.92	—
5. Respending Employment	77.09	117.46	86.02
6. Government Revenue (millions of dollars)			
a. Federal	1.02	1.37	1.10
b. State and Local	.56	.76	.60
7. Government Employment			
a. Federal	2.84	3.83	3.06
b. State and Local	11.76	15.88	12.67
8. Total Indirect[a]	184.78	284.62	206.86
9. Total Employment per $1,000,000	59.22	49.30	57.03

[a]Sum of rows 1, 5, 7a and 7b.

Appendix Table 4
Impact per 100 Jobs: Iron & Steel

	Blast Furnaces and Basic Steel Products SIC# 331	Iron and Steel Foundries SIC# 332	All Iron and Steel SIC# 331 & 332
1. Supplier Jobs	211.06	92.95	172.06
2. Purchasing Power Adjustments			
SIC# 15-17	—	6.34	—
Adjustment	—	3.27	—
3. Direct Employment Purchasing Adjustment	86.3	40.15	—
4. Purchasing Power Equivalent	397.56	236.37	—
5. Respending Employment	198.78	118.19	172.17
6. Government Revenue (millions of dollars)			
a. Federal	1.92	1.17	1.67
b. State and Local	1.06	.65	.92
7. Government Employment			
a. Federal	5.35	3.27	4.66
b. State and Local	22.19	13.54	19.34
8. Total Indirect[a]	437.38	227.95	368.23
9. Total Employment per $1,000,000	30.93	41.76	34.51

[a]Sum of rows 1, 5, 7a and 7b.

Appendix Table 5
Impact per 100 Jobs: Automobile Manufacturing

	Automotive Stampings (SIC# 3465)	Motor Vehicle and Car Bodies (SIC# 3711)	Motor Vehicle Parts and Accessories (SIC# 3714)	Truck and Bus Bodies, Trailers and Motor Homes (SIC# 3713,3715-16)	All Motor Vehicles (Total)
1. Supplier Jobs	226.23	676.86	187.94	221.13	364.24
2. Purchasing Power Adjustments					
SIC# 331	14.49	—	—	—	—
Adjustment	12.5	—	—	—	—
SIC# 3714	—	84.29	—	—	—
Adjustment	—	55.92	—	—	—
SIC# 50-51	19.49	63.80	26.32	16.38	—
Adjustment	3.69	12.07	4.98	3.10	—
3. Direct Employment Purchasing Adjustment	74.29	111.98	66.34	31.00	—
4. Purchasing Power Equivalent	416.71	956.83	359.26	355.23	571.55
5. Respending Employment	208.36	478.42	179.63	177.62	285.78
6. Government Revenue (millions of dollars)					
a. Federal	2.01	4.72	1.76	1.88	2.82
b. State and Local	1.11	2.60	.97	1.03	1.56
7. Government Employment					
a. Federal	5.61	13.18	4.91	5.24	7.87
b. State and Local	23.27	54.64	20.35	21.71	32.65
8. Total Indirect[a]	463.47	1223.10	392.83	425.70	690.54
9. Total Employment per $1,000,000	38.89	38.71	32.78	51.65	37.34

[a]Sum of rows 1, 5, 7a, and 7b.

Appendix Table 6a
Impact per 100 Jobs: Nonelectrical Machinery

	Mining and Oil Field Machinery (SIC# 3532-33)	Material Handling and Machinery Equipment (SIC# 3534-37)	Metalworking Machinery (SIC# 354)	Special Industry Machinery (SIC# 355)	General Industry Machinery (SIC# 356)
1. Supplier Jobs	95.12	127.51	78.97	133.84	130.45
2. Purchasing Power Adjustments					
SIC# 50-51	9.39	13.11	6.56	13.07	11.80
Adjustment	1.82	2.48	1.24	2.47	2.23
3. Direct Employment Purchasing Power Adjustment	45.91	45.91	50.70	43.85	36.62
4. Purchasing Power Equivalent	242.75	275.90	230.90	280.16	269.30
5. Respending Employment	121.38	137.95	115.45	140.08	134.65
6. Government Revenue (millions of dollars)					
a. Federal	1.19	1.38	1.11	1.40	1.37
b. State and Local	.66	.75	.61	.78	.76
7. Government Employment					
a. Federal	3.32	3.84	3.09	3.93	3.83
b. State and Local	13.78	15.91	12.82	16.28	15.89
8. Total Indirect[a]	233.60	285.21	210.33	294.13	284.82
9. Total Employment per $1,000,000	42.98	42.56	47.09	41.27	39.99

[a]Sum of Rows 1, 5, 7a, and 7b

Appendix Table 6b
Impact per 100 Jobs: Nonelectrical Machinery

	Computer Equipment (SIC# 3571,3715,3717)	Office and Accounting Machinery (SIC# 3578-79)	Refrigeration and Service Industry Machinery (SIC# 358)	Miscellaneous Industrial Machinery (SIC# 359)	Total Machinery (SIC# 35)
1. Supplier Jobs	202.65	136.41	163.56	82.2	131.17
2. Purchasing Power Adjustments					
SIC# 3674	15.28	—	—	—	—
Adjustment	6.57	—	—	—	—
SIC# 3671- 2, 5-9	25.08	—	—	—	—
Adjustment	4.16	—	—	—	—
SIC# 50-51	12.85	—	—	—	—
3. Direct Employment Purchasing Power Adjustment	39.70	28.42	27.12	40.89	—
4. Purchasing Power Equivalent	355.51	264.83	294.05	224.34	—
5. Respending Employment	177.76	132.42	147.03	112.17	138.17
6. Government Revenue (millions of dollars)					
a. Federal	1.81	1.39	1.17	1.1	1.39
b. State and Local	1.00	.76	.64	.61	.77
7. Government Employment					
a. Federal	5.04	3.87	3.26	3.09	3.88
b. State and Local	20.91	16.06	13.52	12.8	16.08
8. Total Indirect[a]	406.36	289.76	327.37	210.28	289.30
9. Total Employment per $1,000,000	18.09	34.22	38.86	50.52	38.33

[a]Sum of Rows 1, 5, 7a, and 7b

Appendix Table 7
Impact per 100 Jobs: Aerospace Industry

	Aircraft (SIC# 3721)	Aircraft and Missile Engines (SIC# 3724, 3764)	Aircraft and Missile Parts and Equipment (SIC# 3728, 3769)	Guided Missiles and Space Vehicles (SIC# 3761)	All Aircraft (Total)
1. Supplier Jobs	186.82	173.78	177.00	160.32	181.76
2. Purchasing Power Adjustments					
SIC 3728, 3769	20	—	—	—	—
Adjustment	13.02	—	—	—	—
SIC 3721	—	19.94	—	—	—
Adjustment	—	16.16	—	—	—
SIC 381	—	—	—	13.15	—
Adjustment	—	—	—	9.60	—
3. Direct Employment Purchasing Adjustment	81.04	83.98	65.09	76.74	—
4. Purchasing Power Equivalent	380.88	373.92	362.09	350.2	370.99
5. Respending Employment	190.44	186.96	181.05	175.11	185.50
6. Government Revenue (millions of dollars)					
a. Federal	1.84	1.80	1.75	1.69	1.79
b. State and Local	1.02	.99	.97	.93	1.06
7. Government Jobs					
a. Federal	5.14	5.02	4.88	4.72	5.00
b. State and Local	19.55	18.97	18.59	17.82	20.31
8. Total Indirect[a]	401.95	384.73	401.52	357.97	387.57
9. Total Employment per $1,000,000	39.59	33.72	31.75	26.26	34.70

[a]Sum of rows 1, 5, 7a, and 7b

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