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Recent US Manufacturing Employment: The Exception that Proves the Rule

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17-12 Recent US Manufacturing Employment: The Exception that Proves the Rule

Robert Z. Lawrence

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Abstract

This Working Paper challenges two widely held views: first that trade performance has been the primary reason for the declining share of manufacturing employment in the United States, and second that recent productivity growth in manufacturing has actually been quite rapid but is not accurately measured. The paper shows that for many decades, faster productivity growth interacting with unresponsive demand has been the dominant force behind the declining share of employment in manufacturing in the United States and other industrial economies. It also shows that since 2010, however, the relationship has been reversed and slower productivity growth in manufacturing has been associated with more robust performance in manufacturing employment. These contrasting experiences suggest a tradeoff between the ability of the manufacturing sector to contribute to productivity growth and its ability to provide employment opportunities. While some blame measurement errors for the recently recorded slowdown in manufacturing productivity growth, spending patterns in the United States and elsewhere suggest that the productivity slowdown is real and that thus far fears about robots and other technological advances in manufacturing displacing large numbers of jobs appear misplaced.

JEL Codes: D24, J21, O14, F16

Keywords: Deindustrialization, Productivity Measurement

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INTRODUCTION

Manufacturing has played an important role in helping the United States achieve more inclusive income growth. Economic growth depends ultimately on improvements in productivity, and output per worker in manufacturing has historically grown more rapidly than output per worker in the rest of the economy. This has meant that manufacturing has made a disproportionate contribution to income growth.¹ In addition, manufacturing has helped make growth more inclusive because it has provided opportunities for men without a college degree to earn relatively high wages and enter the middle class. In 1970, for example, fully 35.6 percent of men without a college degree who held a full-time job worked in US manufacturing, and even in 2015, 17.4 percent of men without a college degree employed full-time worked in manufacturing.²

We like to believe that good things come together, but unfortunately, when it comes to manufacturing, there is a tradeoff between employment and productivity growth. Many see globalization as the most important reason for the erosion in US manufacturing employment, but I will show that for many decades relatively faster productivity growth interacting with unresponsive demand for goods has actually been the dominant force behind the declining share of employment in manufacturing in the United States and other industrial economies. Since 2010, however, the relationship has been reversed and much slower productivity growth in manufacturing has been associated with more robust performance in manufacturing employment and spending on goods.

Price changes tend to reflect productivity changes (Nordhaus 2005). Faster productivity growth in manufacturing will therefore generally lead to lower relative prices for manufactured goods. Figure 1 plots the ratio of (total factor) productivity growth in manufacturing to total factor productivity growth in GDP (TFPMAN/TFPGDP) from 1970 to 2010. It also plots the ratio of the prices for GDP to prices for gross manufacturing value-added (PGDP/PMAN). When (PGDP/PMAN) increases it means that manufacturing goods are becoming relatively cheap, and the figure shows vividly the close association between relative increases in productivity in manufacturing and relative declines in prices of manufactured goods.³

In principle, the tradeoff between employment and productivity growth is not inevitable. Faster productivity growth means that fewer workers (and other inputs) are needed to produce a given volume of output, but if the quantity demanded is very responsive to lower prices, the volume of goods sold could so increase that more rather than fewer workers would ultimately be employed. While there may be some manufacturing products for

1. Between 1998 and 2010, manufacturing contributed 29.3 percent of the increase in output due to labor productivity growth but averaged only 11.7 percent of all full-time employment (Bureau of Economic Analysis, <https://bea.gov/iTable/iTable.cfm?reqid=19&step=2#reqid=19&step=2&isuri=1&1921=survey> [accessed on October 31, 2017]).

2. University of Minnesota, IPUMS-CPS, Current Population Survey Data, <https://cps.ipums.org/cps> (accessed on October 31, 2017).

3. Of course if prices are overstated, productivity growth will be understated, both nonetheless both would still move together.

which demand *is* responsive to relative price, for the manufacturing sector as a whole this is not the case. Thus relatively faster productivity growth in manufacturing has led to smaller shares of spending on goods.⁴

In addition, economic growth due to faster productivity raises incomes. Whether this income growth increases employment in goods production depends on how people spend their income gains. As they become richer, people could in theory devote increasing or decreasing shares of their spending to goods. But in practice, as incomes rise, the share spent on goods declines (Boppart 2014). Poor people spend more of their money on goods. They tend to buy more food, clothing, and motorcycles.⁵ Rich people, by contrast, spend more of their money on services. They eat in restaurants, have personal trainers, hire accountants and lawyers, and see psychiatrists. Taken together, therefore, faster productivity growth in the production of goods and more rapid income growth both reduce the share of spending on goods and thus the share of workers required to produce them.⁶

Figure 2 provides estimates of ratios of relative prices, quantities, and values of US final spending on goods versus services and structures.⁷ The data are for final spending on goods and thus reflect not only the value-added in manufacturing but also the value-added in the raw materials used to produce the goods and the additional costs required to distribute them to final consumers. Thus they only reflect the demand for manufacturing value-added under the assumption that the margins for inputs and distribution remain constant. Nonetheless, they are revealing.

The data are expressed in logarithms and can thus be interpreted as percentages. The top line shows the decline in the prices of goods relative to services over the 69-year period—by 136 log points or just under 2 percent per year. By contrast the bottom line shows the increase in quantities of goods purchased relative to services—by 66 log points or just under 1 percent per year. The result is that the value of spending on goods has fallen relative to the value of spending on services and structures by roughly 1 percent annually (the middle line). The figure shows that Americans have responded to declining relative prices of goods and higher incomes by spending more of their money on services.

The decline in relative prices of goods and the rise in incomes do not boost demand for goods enough to offset the decline in the demand for labor and other inputs due to relatively faster productivity growth in the

4. The inelastic nature of the demand for manufactured goods as a whole is not really surprising, since we are considering the demand for an entire sector. We expect elasticities to be higher at low levels of aggregation. For example, Toyotas might be close substitutes for Hondas, but automobiles as a group will be less substitutable for other transportation vehicles such as motorcycles, trains, and buses, and in turn all manufactured goods less substitutable for all services or agricultural products.

5. Fajgelbaum and Khandelwal (2016) show that because the poor tend to spend higher shares of their incomes on goods and goods are more traded than services, this also means that they enjoy disproportionate gains from trade.

6. Boppart (2014, 2190) estimates the elasticity of substitution between goods and services as 0.596 and the expenditure elasticity in consumption at .78. He finds that between 1946 and 2011 changes in incomes and relative prices each accounted for about half of the decline in the share of spending on goods.

7. Since GDP is defined as Consumption (C) plus Investment (I) plus Government Spending (G) plus Exports (X) minus Imports (M), I can obtain total US spending (i.e., $C + I + G$) by subtracting the trade balance ($X - M$) from GDP. Since separate data for goods GDP and merchandise trade are also available I can obtain similar estimates of spending on goods. By subtracting spending on goods from total spending I obtain nominal spending on services and structures. Similarly using the data expressed in 2009 prices I can obtain estimates of the quantities of goods and services plus structures that have been purchased. I use the separately reported price indexes for goods and services to obtain relative goods prices.

production of goods.⁸ Therefore the share of goods in spending and the share of inputs used in the production (and consumption) of goods both decline. This impact can be seen vividly in US consumption spending, which on average accounted for 62 percent of all national spending between 1947 and 2017. Over this period the share of consumption spending on goods declined from 62 to 33 percent.⁹

This account relating the effects of US spending to US output of goods has abstracted from the impact of trade. If the United States were a closed economy, this would be all that matters. In reality, given domestic spending, a trade surplus in manufactured goods would add to manufacturing employment and a deficit would subtract from it.¹⁰ But the account of the United States as a basically closed economy fits the facts closely until the 1970s. The US manufacturing employment share began declining in the 1950s—long before the economy was exposed to trade.

Moreover, the rate at which the US manufacturing employment share has fallen over the past three decades as the economy globalized further—about 0.4 percentage points per year—is remarkably similar to the rate at which it fell in the 1960s and 1970s. This similarity suggests that the forces that operated in the early years continue to dominate. As shown in figure 3, when a trend line fitted to manufacturing employment data from 1960 to 1980 is projected out to 30 years, it precisely predicts the share of manufacturing employment in 2010. Without knowing about China’s rise, the North American Free Trade Agreement (NAFTA), or the formation of the World Trade Organization (WTO), a forecaster in 1980 would have been able to accurately predict the number of workers employed in manufacturing in 2010 without almost any error!

Donald Trump has blamed offshoring and trade for declines in manufacturing employment, singling out what he considers are flawed trade agreements. While there is evidence that the US trade deficit has contributed to some of the losses of manufacturing jobs since 2000, far more powerful even during this period has been the impact of faster productivity growth interacting with unresponsive demand for goods. For example, 985,000 US manufacturing jobs estimated to have been lost due to Chinese imports between 1999 and 2011 (Acemoglu et al. 2016) represent less than a fifth of the total loss of over 5 million US manufacturing jobs over the same period.¹¹ In Edwards and Lawrence (2013, 83), we estimate that because of rapid productivity growth in manufacturing, the manufacturing employment content of the US trade deficit in 2010 (2.7 million jobs) was actually lower than that estimated for 2000 (3.3 million jobs). In other words, rapid productivity growth in manufacturing implies that over time any given trade deficit translates into fewer jobs.

8. This statement implicitly assumes Hicks-neutral technical change.

9. Bureau of Economic Analysis, <https://bea.gov/iTable/iTable.cfm?reqid=19&step=2#reqid=19&step=3&isuri=1&1921=survey&1903=65> (accessed on October 31, 2017).

10. As emphasized by Matsuyama (2009), for example, in a small price-taking open economy, demand could be infinitely elastic and faster productivity growth could then increase employment.

11. “Applying this direct plus full input-output measure of exposure increases our estimates of trade-induced job losses for 1999–2011 to 985,000 workers in manufacturing alone and to 1.98 million workers in the entire economy” (Acemoglu et al. 2016, S145). A very similar job loss estimate of 0.8 million manufacturing jobs is obtained by Caliendo, Dvorkin, and Paro (2017, abstract). Hicks and Devaraj (2017, 6) estimate that that between 2000 and 2010, 13.4 percent of manufacturing jobs (750,000) lost were due to trade.

RECENT US EXPERIENCE

As can be seen in figure 3, since about 2010, the long-run trend line no longer fits the data. While still declining, manufacturing's share in US employment since 2010 has fallen much less than its long-run trend. Indeed, the small drop in the share of just 0.29 percentage points over the six-year period between 2010 and 2016 is less than the 0.40 percentage point annual average that was typical over the prior five decades. Recent manufacturing employment behavior has also been radically different than it was in the early 2000s. In the economic recovery after the 2001 recession, manufacturing employment did not increase at all, but, after reaching a trough in 2010, it had increased by 1.6 million jobs by 2016.

One might speculate that this recent jobs performance indicates that US manufacturing is becoming more internationally competitive. That jobs are returning (“on-shoring”) as a result of lower US energy prices, higher Chinese wages, and innovations such as 3-D printing. But recent US trade performance does not support this interpretation. Between 2010 and 2016, the US trade deficit in manufactured goods actually increased from \$412 billion to \$639 billion—by about 0.7 percent of GDP.¹² While care should be taken when providing causal interpretations to trade deficits after the fact,¹³ this increase in the trade deficit suggests that trade, if anything, was probably a drag on manufacturing employment.

Instead, slow productivity growth appears to be the source of the relative strength in manufacturing employment growth. As is illustrated in figure 4, since 2010 the rapid productivity growth in manufacturing has ground to a halt: Between 2010 and 2016, output per full-time employee in manufacturing declined by 2.2 percent. This pace is far below the manufacturing labor productivity growth of 4.3 percent achieved annually between 2000 and 2010.¹⁴ Moreover, according to the more comprehensive measure of productivity growth—multi-factor productivity growth (MFP)—manufacturing's productivity growth increased at an annual average rate of 1.3 percent between 1987 and 2008 and by just 8/10ths of a percent between 2008 and 2010, then declined by 5.8 percent between 2010 and 2015, falling by 2.8 percent in 2015 alone.¹⁵

The relative prices of manufactured goods are consistent with the productivity data. Information technology products led the surge in productivity growth in manufacturing that began in 1995 (Jorgenson 2001). But that

12. Since value-added per full-time equivalent employed in manufacturing has increased from \$162,993 to \$180,577 per worker over the same period, the employment equivalence of the manufacturing trade deficit has increased by a million, up from 2.5 million to 3.5 million jobs.

13. For a discussion of the pitfalls of assuming trade deficits necessarily lead to employment loss, see Edwards and Lawrence (2013, 33–42).

14. The computer industry was a major driver of manufacturing productivity, and as emphasized by Baily and Bosworth (2014), a major part of that industry has moved abroad, inevitably reducing average output and productivity growth, both because measuring productivity growth in computers is difficult and because its share in output is declining.

15. Bureau of Labor Statistics, Multifactor Productivity News Release, July 12, 2017, www.bls.gov/news.release/pdf/prod5.pdf (accessed on October 31, 2017).

surge peaked in 2005 and lasted through about 2010 and more recently the rate at which producer prices of semiconductors and computers have been falling has decelerated.¹⁶

A similar story is reflected in broader price measures of manufactured goods. As shown in figure 5, the deflator for the manufacturing industry relative to the GDP deflator declined at an annual rate of 2.1 percent between 1997 and 2010, but between 2010 and 2016 it actually increased by 2.8 percent. Similarly the GDP deflators for finished goods prices compared with services declined at an annual rate of 3 percent between 2000 and 2010 but by just 1.7 percent per year between 2010 and 2016.

The recent behavior of spending on goods has also been unusually strong. Over the long run (1947 to 2015), nominal (final) spending on goods has fallen by about 1 percent per year relative to nominal spending on services (figure 2). But the ratio of consumer spending on nonenergy goods to spending on services was quite similar in 2010 and 2016 (figure 6).

In sum, in recent years we have seen (1) slower declines in the share of manufacturing employment; (2) slower productivity growth in manufacturing; (3) higher relative prices for manufacturing value-added rather than lower prices; and (4) relative prices for goods at the consumer level falling more slowly. In response, spending on goods compared with services is also falling much less rapidly than before. These outcomes are all predictable if there is a relative slowdown in productivity growth in manufacturing and demand for goods is price inelastic.

INTERNATIONAL EVIDENCE

Similar negative trends in the share of workers in manufacturing are evident in all industrialized countries (table 1). Between 1973 and 2010 the average decline of the US employment share in manufacturing of 0.40 percentage points is just about the same as the average decline of 0.39 percentage points for all the countries in the sample, and the 2.4 percent annual decline in the share is close to the 2.0 percent decline in the average share.

Moreover, it is noteworthy that the sample showing downward trends in manufacturing employment includes countries such as Germany, Japan, and Italy, which have had trade surpluses in manufacturing trade that between 1973 and 2010 averaged 7.6, 6.2, and 4.2 percent of their GDPs, respectively (Lawrence and Edwards 2013). The experience of these countries shows that an increased trade surplus in manufactured goods can lead to an increase in the level of manufacturing employment—Germany, Italy, and Japan, for example, clearly have higher shares of manufacturing employment than the other countries—but as productivity growth increases over time, the employment content of a given surplus (or deficit) will decline and eventually the long-run trends that reflect the interaction between productivity growth and demand will tend to dominate the outcomes.

16. For example, the producer price index for microprocessors, which had been declining at approximately 10 percent annually between 1990 and 1995, fell by an astounding 53 percent annually between 1995 and 2000, and by 37 percent between 2000 and 2005, 21 percent between 2005 and 2010 and just 4 percent annually from 2010 to 2014, respectively. See Inflation and Prices Data, Bureau of Labor Statistics, www.bls.gov/data/#prices (accessed on March 19, 2017).

It is also noteworthy that the United States is not unique in having had a slower decline in the share of manufacturing employment between 2010 and 2016 than it experienced earlier. As shown in table 1, on average the percentage point decline in manufacturing in all nine of the industrialized countries in the sample has been just 35 percent of the average annual decline between 1973 and 2010, and the average annual percentage decline in the manufacturing employment share in the nine countries has been about half that recorded between 1973 and 2010. Indeed, only in Australia has the annual percentage decline between slightly faster.

The international evidence also shows that the United States is not unique in having a declining share of consumer spending on goods. As shown in table 2, in a sample of nine OECD countries—data on Australia are not available—between 1995 and 2010, for example, the average annual rate of decline in the share of consumer spending on goods was 0.56 percent per year. By contrast, between 2010 and 2014 (the latest OECD data currently available) the share of consumer spending on goods in the sample actually increased by an average of 0.15 percent and in five of the nine countries the share increased by an average of .50 percent.

WHAT ARE THEY DOING WITH THE ROBOTS?

The changed spending responses can also help shed light on another controversy that relates to productivity growth (Feldstein 2017; Fernald 2012; Baily, Manyika, and Gupta 2013; Branstetter and Sichel 2017). On the one hand, many productivity experts claim we are living in period of very slow productivity growth. Robert Gordon (2012), a leading techno-pessimist, has vividly described how the information technology revolution that stimulated productivity growth between 1995 and 2005 has run its course and that our ability to sustain strong economic growth has run into significant headwinds. Tyler Cowen (2011) agrees that we have already picked the low-hanging fruit that can improve living standards. These views are consistent with data and the consensus of professional forecasters. For example, as noted by Byrne, Oliner, and Sichel (2017, 24), a survey of professional forecasters shows that while in 2007 they had projected that the United States would achieve long-run growth in labor productivity of 2.3 percent, by 2012–13, their projections had declined to an average of 1.9 percent.

On the other hand are claims that we are going through a new era in which the pace of change is so rapid that it deserves a new name such as “the fourth industrial revolution” (Schwab 2016) or “the second machine age” (Brynjolfsson and McAfee 2014). These techno-optimists see a world that is awash in new technologies that will bring about fundamental economic and social changes. They point to improvements in information processing that are revolutionizing areas such as artificial intelligence, big-data analytics, precision medicine, machine learning, robotics, 3-D printing, cloud computing, the internet of things, and autonomous vehicles that are capable of unleashing a surge in productivity and accelerate economic growth.¹⁷ Indeed, many now view the luddites more favorably and are concerned that the ability to digitize technology will displace both skilled and unskilled workers and make it increasingly difficult to earn a living wage. This has prompted proposals to

17. For additional discussion of emerging technologies in manufacturing, see Baily and Bosworth (2014, 19–22).

deal with these prospective inequities either by having the workers own the machines (Freeman 2016) or by slowing their progress through the taxation of capital (Piketty 2013).

The productivity facts, thus far, are on the side of the techno-pessimists, but some techno-optimists claim that the official data understate the quality of recent innovations and the improvements they have enabled. But it has always been difficult to measure productivity growth, especially when it involves radically new products and technologies, so that to make the case for mismeasurement, it is necessary to claim not simply that there is mismeasurement but also that mismeasurement has become increasingly worse.¹⁸

One response to mismeasurement is developing better methodologies for measuring prices.¹⁹ But another is to examine the data on spending. Ultimately the buyers are the best judges of quality. Buyers will respond to true prices rather than nominal prices. If true prices are actually lower than official prices, and demand is inelastic, nominal spending should fall in response to productivity improvements. Many advances such as robotics, 3-D printing, the internet of things, big data, and the cloud should be improving productivity in the production and distribution of goods. If, in reality, these have accelerated the relative productivity growth in goods production, the share of nominal spending on goods should fall even faster than before. The share of total US nominal spending on goods (C + I + G) declined from 36.5 percent in 2000 to 32.8 percent in 2008. However, in 2016 the share was 32.9 percent, almost exactly what it was in 2008. Similarly, in 2016 the share of nominal spending on goods in total consumption spending was 32.1 percent compared with 33.7 percent in 2008 and 36.1 percent in 2000.²⁰ This suggests that the recent relative slowdown in manufacturing productivity is real.

CONCLUDING COMMENT

Manufacturing has played a special role in economic growth and it is not surprising that many governments currently have major initiatives that aim at promoting advanced manufacturing technology. Ultimately economic progress rests upon technological innovation, and if they prove successful these initiatives could provide a much needed boost to economic growth. But these initiatives are also often motivated by the claim that they will increase blue collar employment and the evidence in this paper suggests a painful tradeoff. Faster productivity growth generated by advanced manufacturing technology may lead to more rapid growth, but it is unlikely to be inclusive.

18. Feldstein (2017, 153–56) emphasizes the problems that result from understating productivity growth when new goods or services are introduced. This could mean that productivity growth will be measured as slowing down especially during innovative periods when more new products are being introduced.

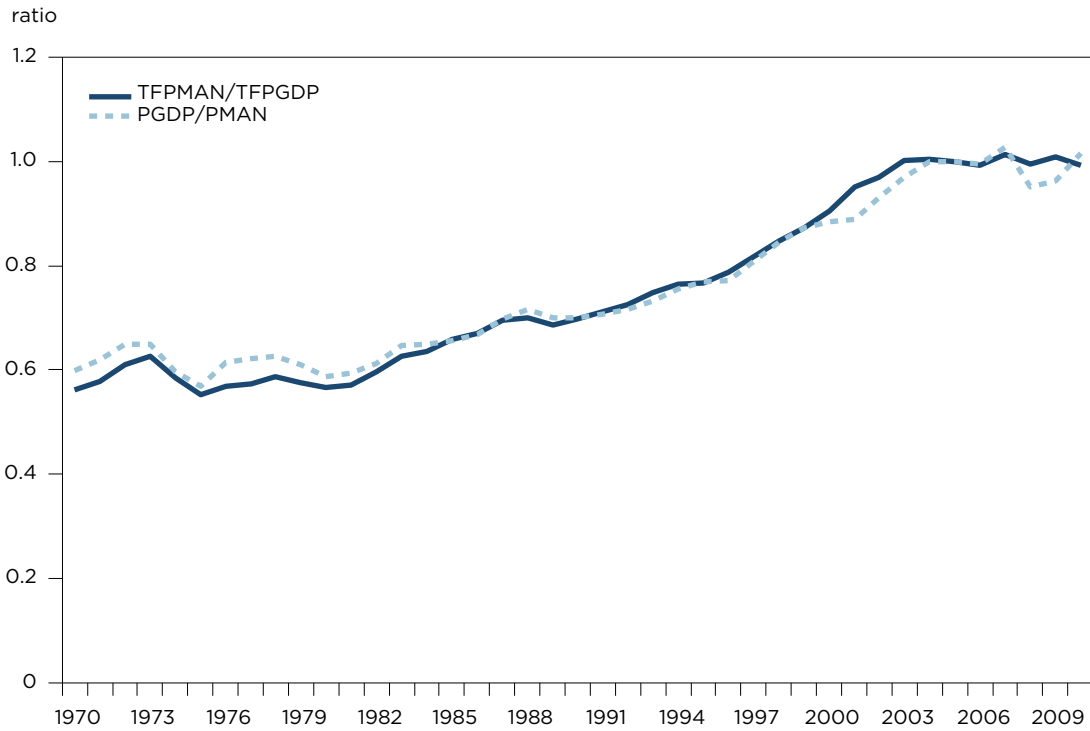
19. Byrne, Oliner, and Sichel (2017) argue that the official producer price index has understated recent improvements in information technology and develop new hedonic price measures that take account of improvements in the performance of a given set of tasks valued by users based on tests undertaken by the Standard Performance Evaluation Corporation. Between 2009 and 2013, for example, while the producer price index for microprocessors declined annually by just 6 percent, the authors estimate annual declines (i.e., improvements in performance) of 42 percent using their measures based on performance. Byrne and Corrado (2017) estimate that between 2004 and 2014 similar improvements took place in computer servers and storage (26.1 percent annual price declines), PCs (23.7 percent annual price declines), and data networking (12.1 percent annual price declines).

20. See footnote 7 for methodology and source.

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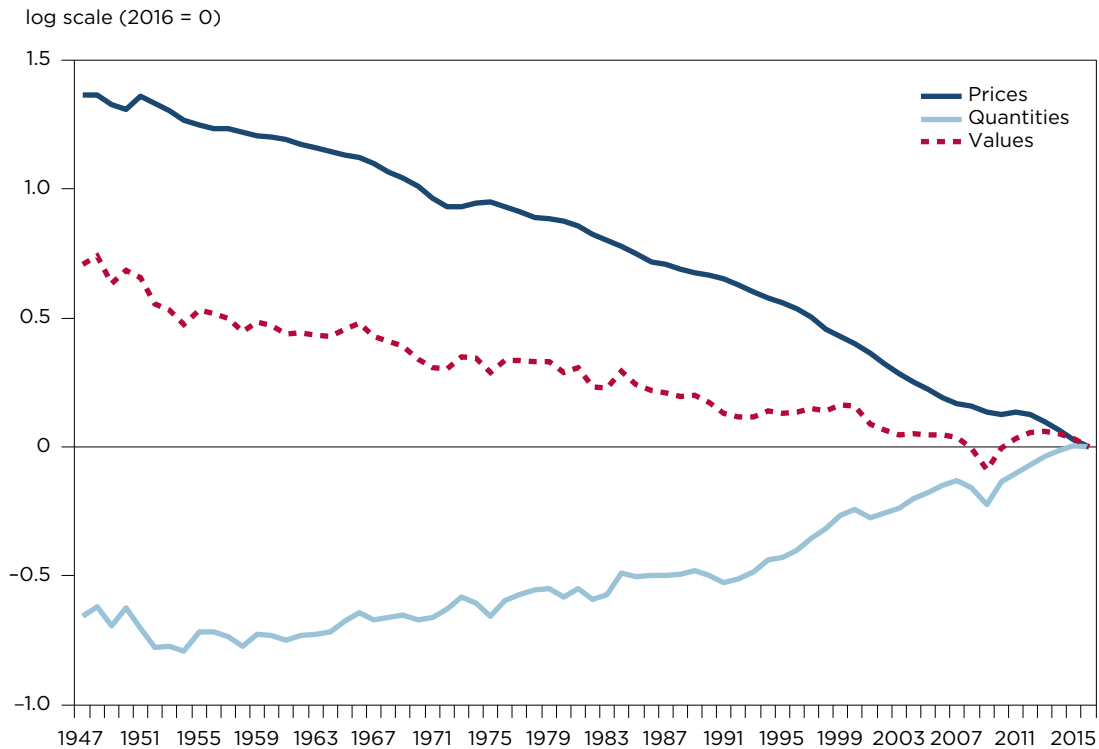
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Figure 1 Relative productivity of manufacturing and prices compared with GDP, 1970 to 2010



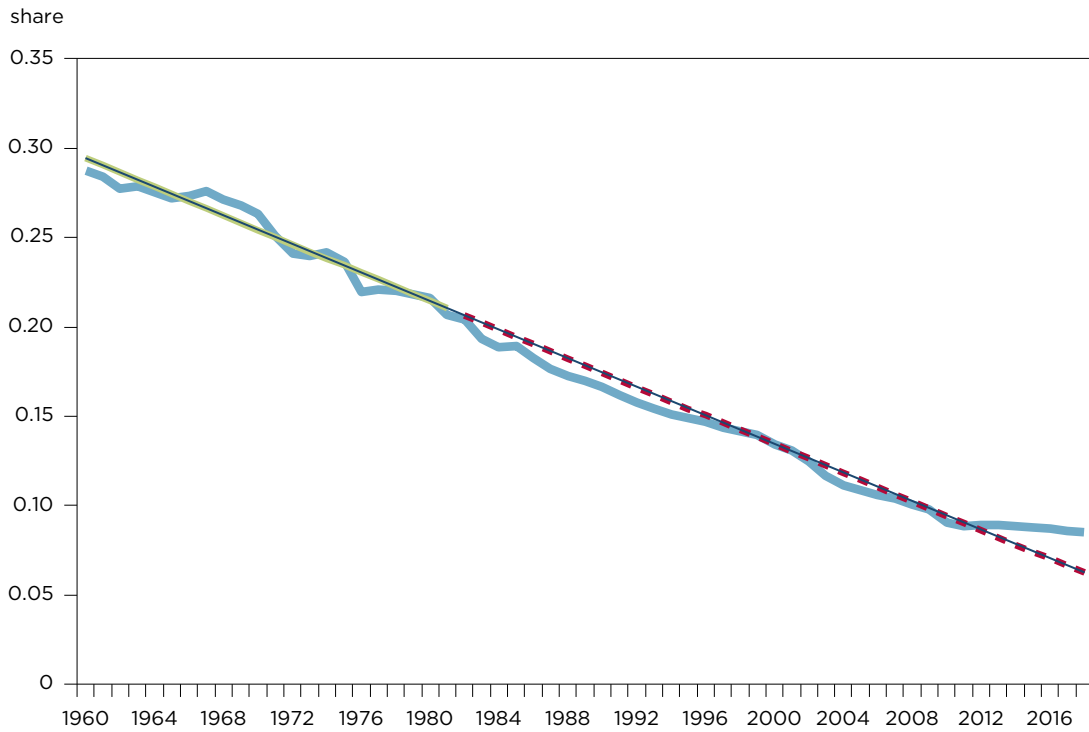
Source: Jorgenson, Ho, and Samuels (2012).

Figure 2 US nominal spending on goods relative to services and structures, 1947-2016



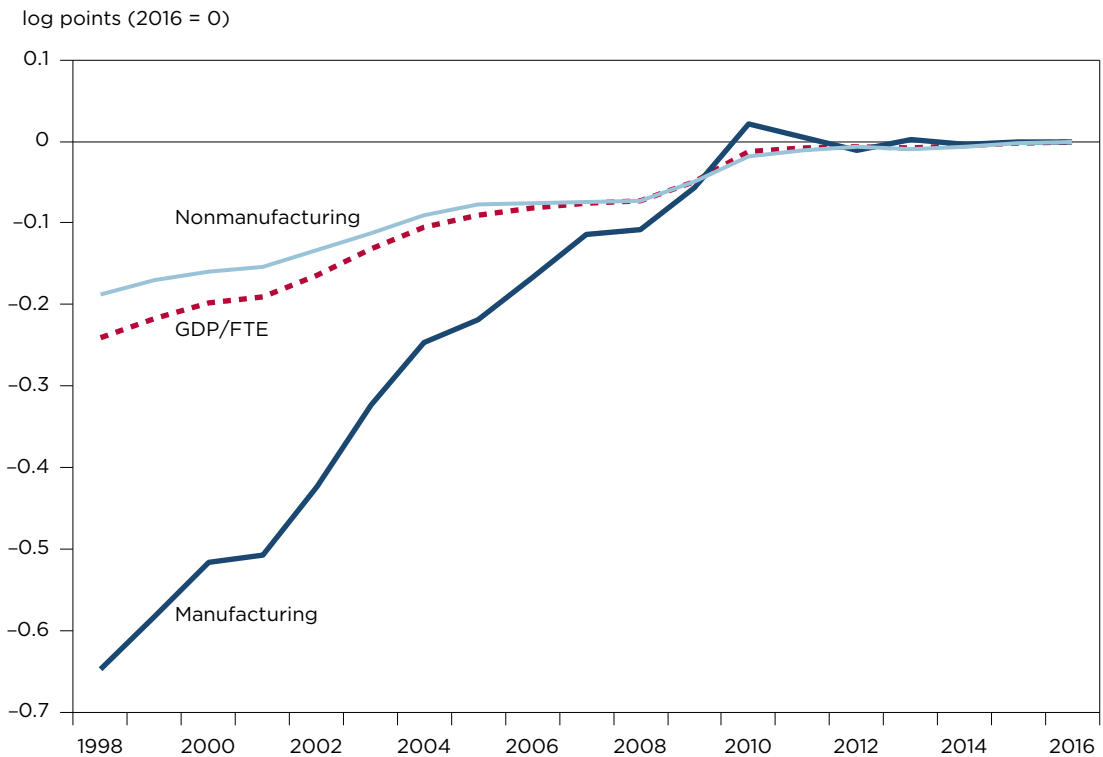
Source: Bureau of Economic Analysis, National Income and Product Accounts.

Figure 3 Share of manufacturing in US nonfarm employment, 1960–2017



Source: Bureau of Labor Statistics, Current Employment Survey.

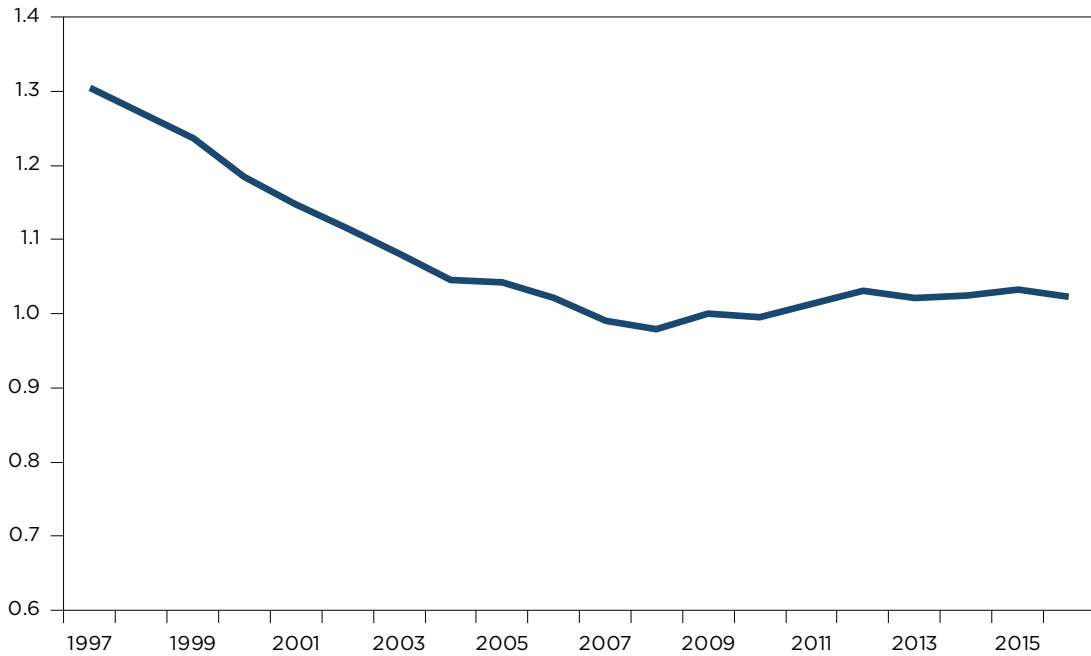
Figure 4 Output per full-time employee (FTE) in manufacturing and the rest of the economy



Source: Bureau of Economic Analysis, National Income and Product Accounts.

Figure 5 Ratio of manufacturing to GDP price deflators, 1997 to 2016

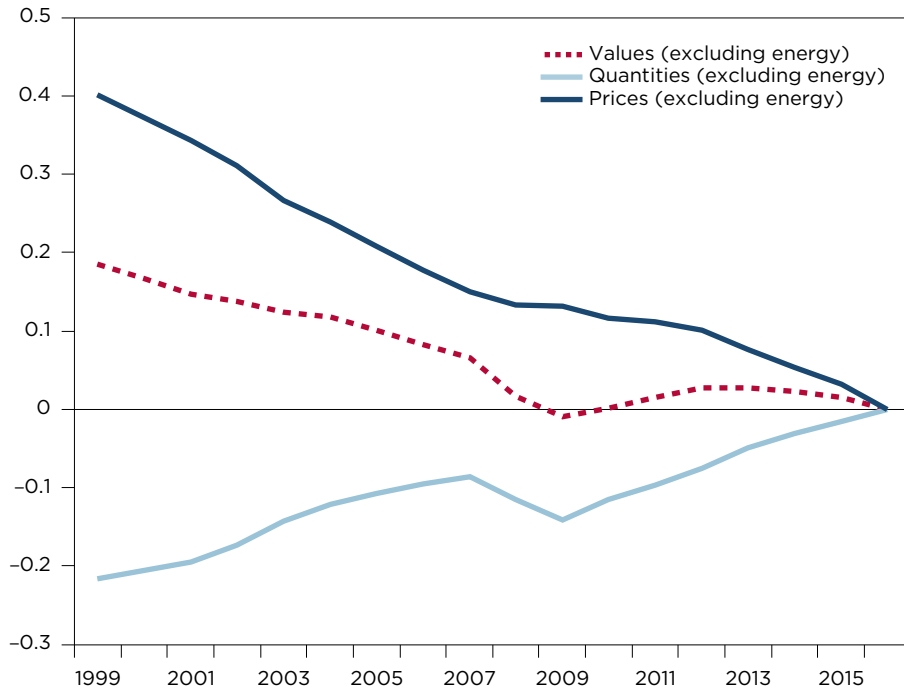
ratio (2009 = 1)



Source: Bureau of Economic Analysis, GDP by Industry, <https://bea.gov/iTable/iTable.cfm?ReqID=51&step=1#reqid=51&step=51&isuri=1&5114=a&5102=11>.

Figure 6 US spending on nonenergy goods relative to services, 1999-2016

log scale (2016 = 0)



Source: Bureau of Economic Analysis, National Income and Product Accounts.

Table 1 Share of employment in manufacturing, selected advanced economies (percent)

Year	United States	Australia	Canada	France	Germany	Italy	Japan	Netherlands	United Kingdom	Average
1973	24.75	23.35	22.00	28.88	36.74	27.86	27.78	25.29	32.06	27.63
1990	16.77	14.42	15.79	21.27	31.62	22.56	24.33	19.08	22.13	20.88
2000	14.35	12.05	15.26	17.87	23.86	22.91	20.66	14.85	14.82	17.40
2010	10.13	8.90	10.27	13.32	20.10	18.87	16.95	10.64	9.85	13.23
2016	10.17	7.51	9.37	12.15	19.15	18.23	16.10	9.52	9.46	12.41
Average annual change in employment share (percentage points)										
2010-1973 (1)	-0.40	-0.39	-0.32	-0.42	-0.45	-0.24	-0.29	-0.40	-0.60	-0.39
2016-2010 (2)	0.01	-0.23	-0.15	-0.19	-0.16	-0.11	-0.14	-0.19	-0.07	-0.14
Ratio (2)/(1)	-0.02	0.59	0.47	0.46	0.35	0.44	0.49	0.47	0.11	0.35
Average annual change in employment share (percent)										
2010-1973 (1)	-2.4	-2.6	-2.0	-2.1	-1.6	-1.0	-1.3	-2.3	-3.1	-2.0
2016-2010 (2)	0.1	-2.8	-1.5	-1.5	-0.8	-0.6	-0.9	-1.8	-0.7	-1.1
Ratio (2)/(1)	-0.0	1.1	0.7	0.7	0.5	0.5	0.6	0.8	0.2	0.5

Sources: Organization for Economic Cooperation and Development; Bureau of Labor Statistics.

Table 2 Share of spending on goods in total consumption spending, selected advanced economies (percent)

Country	1995	2010	2014	Average annual change	
				1995-2010	2010-2014
United States	37	34	35	-0.62	0.59
Canada	47	43	43	-0.64	0.05
France	45	43	46	-0.25	1.35
Germany	49	47	47	-0.25	-0.20
Italy	46	40	40	-0.97	0.37
Japan	58	50	49	-0.90	-0.54
Korea	51	47	47	-0.46	-0.02
Netherlands	51	47	47	-0.60	0.15
United Kingdom	47	45	44	-0.37	-0.36
Average	48	44	44	-0.56	0.15

Source: Organization for Economic Cooperation and Development, National Accounts Statistics.