

2023 Montana Manufacturing Report

Prepared by the
Bureau of Business and Economic Research
University of Montana



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University of Montana
Missoula, MT

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About the Bureau of Business and Economic Research

The Bureau of Business and Economic Research (BBER) was founded in 1948 as the research arm of the University of Montana's School of Business Administration. The Bureau's mission statement states,

"The purpose of the Bureau is to serve the general public, as well as people in business, labor, and government, by providing an understanding of the environment in which Montanans live and work."

BBER has since developed to become one of the most sought-after sources of information and analysis on the Montana economy. The Bureau has published the *Montana Business Quarterly*, an award-winning business periodical, since 1962, and has conducted the Montana Economic Outlook Seminars, a half-day program on the economic outlook presented in 10 cities statewide, on an annual basis since 1976.

Executive Summary

This report is on the state of Montana manufacturing conducted for the Montana Manufacturing Extension Center (MMEC). The report and analysis were done by the Bureau of Business and Economic Research (BBER) at the University of Montana. This is the 27th year that BBER and MMEC have collaborated to produce reports on Montana's manufacturing climate. The three primary topics are: the state of manufacturing at the state and national level in a general economic context; a survey of Montana manufacturers about the state of Montana manufacturing; and an impact survey of firms which used MMECs consulting services. The report covers the year 2022 for the economic analysis and survey. The MMEC impact survey was conducted throughout 2022.

State of Montana Manufacturing

Montana's manufacturers face different challenges than the nation as a whole because the composition of manufacturing production is different and is primarily concentrated in non-durable production – the Bureau of Economic Analysis defines nondurable goods as goods that have an average life of less than three years. The two largest manufacturing sectors in Montana, petroleum and coal, and wood product manufacturing, are not among the seven largest sectors nationally, demonstrating how the Montana manufacturing sector differs substantially from the experience of the country.

Some summary facts about Montana manufacturing in 2022 are:

- Over 4,400 manufacturing firms are in operation in Montana, including sole proprietors;
- Manufacturing accounts for almost 21% of Montana's economic base;
- Manufacturing jobs paid about \$57,180 in earnings, compared to the state average of just under \$51,000;
- Accounts for 5.5% of total private state labor earnings equaling \$1.95 billion;
- Employs 4.4% of Montana's nonfarm workforce, with about 22,700 employees;
- Produced 6.6% of Montana's inflation adjusted output with a value of \$3.3 billion; and
- Montana manufacturing employment and output growth was a little under double the national average in 2022.

In the aftermath of the 2020 COVID-19 recession, Montana manufacturing employment, particularly durable manufacturing, bounced back relatively quickly from the deep economic drop in the second quarter of 2020. Last year, we predicted that durable manufacturing would be higher than pre-COVID levels with a year or so. Employment in this sector returned to pre-pandemic levels in 2021.

Montana manufacturers are active in global markets as well. The three largest export sectors for Montana in 2022 were: chemicals, machinery and transportation equipment. Food, beverages and tobacco fell out of second place during the pandemic. By far the largest export market is Canada, accounting for almost 30% of Montana's manufactured exports. In

2022, the remaining large export markets were: China (2), South Korea (3), Mexico (4), and Belgium (5).

Montana Manufacturers Survey

This section of the report presents the findings of the 2022 Montana Manufacturers Survey. The purpose of the survey is to capture manufacturers' assessments of their plant's economic performance in 2022 and their outlook for 2023. Manufacturing in Montana remains predominantly driven by small businesses. According to the U.S. Census Bureau, Montana houses 1,415 manufacturing firms with employees, and a significant 68% of Montana manufacturers employ less than ten individuals. Notably, there are no manufacturers with 300 or more workers in the state.

Highlights from the 2022 manufacturing survey:

- In 2022, about 48% of manufacturers saw increased sales and production, though profits declined, with 33% of durable and 42% of nondurable manufacturers reporting lower profits than a year ago.
- A year ago, 55% of nondurable manufacturers increased their capital expenditures. In contrast, in 2022, this proportion decreased to 42%. Durable manufacturing, on the other hand, saw no significant decrease in capital investment.
- Two-thirds of firms had a stable workforce size compared to 2021. Less than half, particularly 49% of nondurable firms, reported worker shortages in 2022.
- A growing number of Montana-based manufacturers are adopting a more optimistic outlook despite facing challenging economic conditions. Specifically, 32% expect improvements in their supply chains in 2023, which is a notable increase from the 8% who expressed the same sentiment last year.

In summary, the primary challenges faced by manufacturers continue to be largely associated with inputs. These challenges include difficulties in the labor market, high costs of raw materials, supply chain complexities, rising expenses for transportation and fuel, along with concerns about inflation.

Evaluation of Montana Manufacturing Extension Center

The Montana Manufacturing Extension Center works with manufacturers to create and retain jobs, innovate, reduce costs, increase profits, and save time and money. MMEC employees typically make on-site visits to manufacturing clients to assess problems, suggest appropriate solutions and assist with implementation. MMEC closely monitors its performance by welcoming feedback and carefully following an evaluation procedure developed by the National Institute of Standards and Technology (NIST) and administered by an independent third party. The primary NIST survey findings from 2022 are as follows:

- Montana manufacturing clients were very satisfied, with 67% of respondents saying they relied exclusively on MMEC as a business service provider;

- Approximately 91% of respondents said they were highly likely to give a positive recommendation of MMEC to other potential clients;
- Staff expertise was again the most important factor for firms to use MMEC services;
- The most important challenges facing surveyed MMEC clients were employee recruitment and retention, ongoing continuous improvement/cost reduction strategies, and identifying growth opportunities;
- The Montana return on investment for MMEC during 2022 was 7.7 to 1; and
- The ROI for MMEC clients was about 30.3 to 1.

Introduction

This report is on the state of Montana manufacturing conducted for the Montana Manufacturing Extension Center (MMEC). The report and analysis were done by the Bureau of Business and Economic Research (BBER) at the University of Montana. This is the 27th year that BBER and MMEC have collaborated to produce reports on Montana's manufacturing climate. The three primary topics are: the state of manufacturing at the state and national level in a general economic context; a survey of Montana manufacturers about the state of Montana manufacturing; and an impact survey of firms which used MMEC's consulting services. The report is divided into four primary sections:

Section 1: The State of the Overall Economy

This section provides a brief summary of the global, regional, national, and state economies. This section also contains a brief discussion of factors and the potential headwinds that could be problematic for the foreseeable future and highlight how technology is being adopted in current and future manufacturing practices. Lastly, we highlight the national state of manufacturing.

Section 2: Manufacturing in Montana

Here we use the most recent state level data to give an overview of the current state of Montana manufacturing. The section focuses on number of firms, earnings, employees, and exports by the various manufacturing sectors. A forecast of manufacturing output and employment finishes the section.

Section 3: Montana Manufacturers Survey

This section delves into the findings of the Montana Manufacturers Survey, administered by the Bureau of Business and Economic Research (BBER). Completed in the second quarter of 2023, the survey offers valuable insights into the continuing recovery of Montana's manufacturing sector.

Section 4: The Montana Manufacturing Extension Center

The final section contains the results of the client impact survey conducted by an independent third party following a project completed by MMEC. The survey is used to evaluate the effectiveness of MMEC and for calculations of the centers return on investment (ROI) and economic impact.

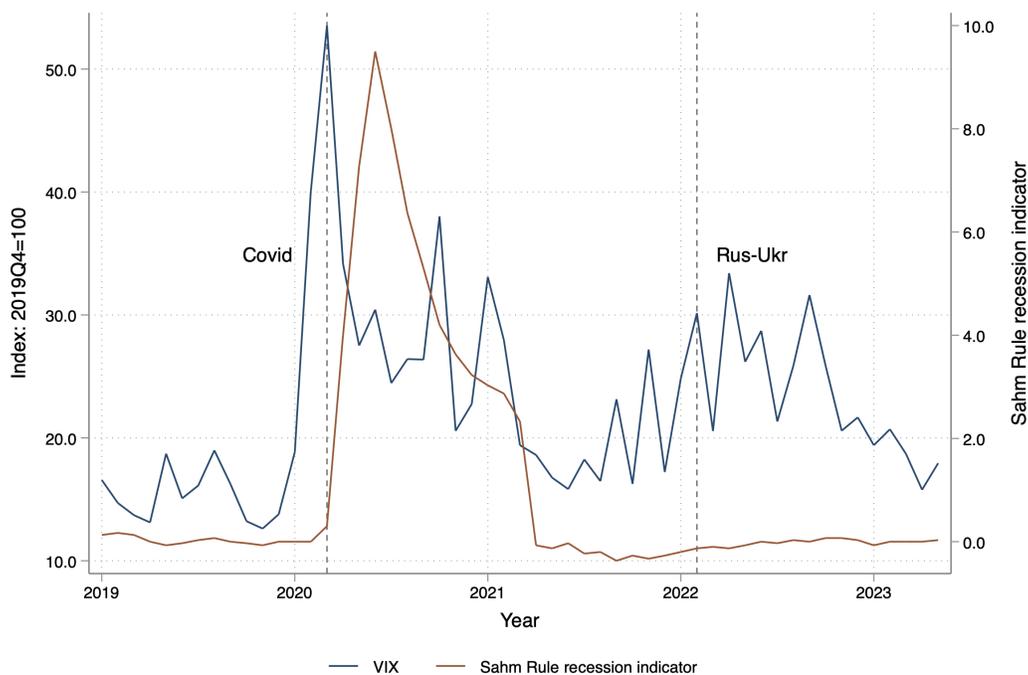
1 The State of the Overall Economy

To get a view of the overall economy from 30 thousand feet, a good place to start is volatility in the financial markets. This is a useful tool as markets tend to react swiftly –although not always precisely– to shifts in global conditions, thereby offering insights into the world’s perceived economic risk and direction.

Our broad view uses the Chicago Board of Options Exchange (CBOE) volatility index, or VIX. Figure 1.1 shows the VIX index from 2017 to 2022 annotated with events that had an impact on the national and global economy. Peaks, and their magnitude, reflect perceived increases in economic risk. Since 2017 the US economy has absorbed a number of economic shocks. The first two came as a result of tariffs introduced by the Trump administration, Tariff 1, and their later expansion to include billions of dollars of Chinese imports, Tariff 2.

The next big economic shock was the Covid pandemic, the top of the peak in 2020 corresponds to the World Health Organization (WHO) declaring a global pandemic. On March 16, 2020 the index hit its highest level ever, 82.7, surpassing even the highest point during the 2008 financial crisis by roughly two points. The last great economic shock captured in this figure is Russia’s invasion of Ukraine in February of 2022. While less significant when compared to the Covid pandemic, it still represents an increase in perceived risk. As of July, this sentiment has lingered, with the index still registering higher than its baseline levels at the beginning of 2019.

Figure 1.1: CBOE Volatility Index and Sahm Rule Recession Indicator

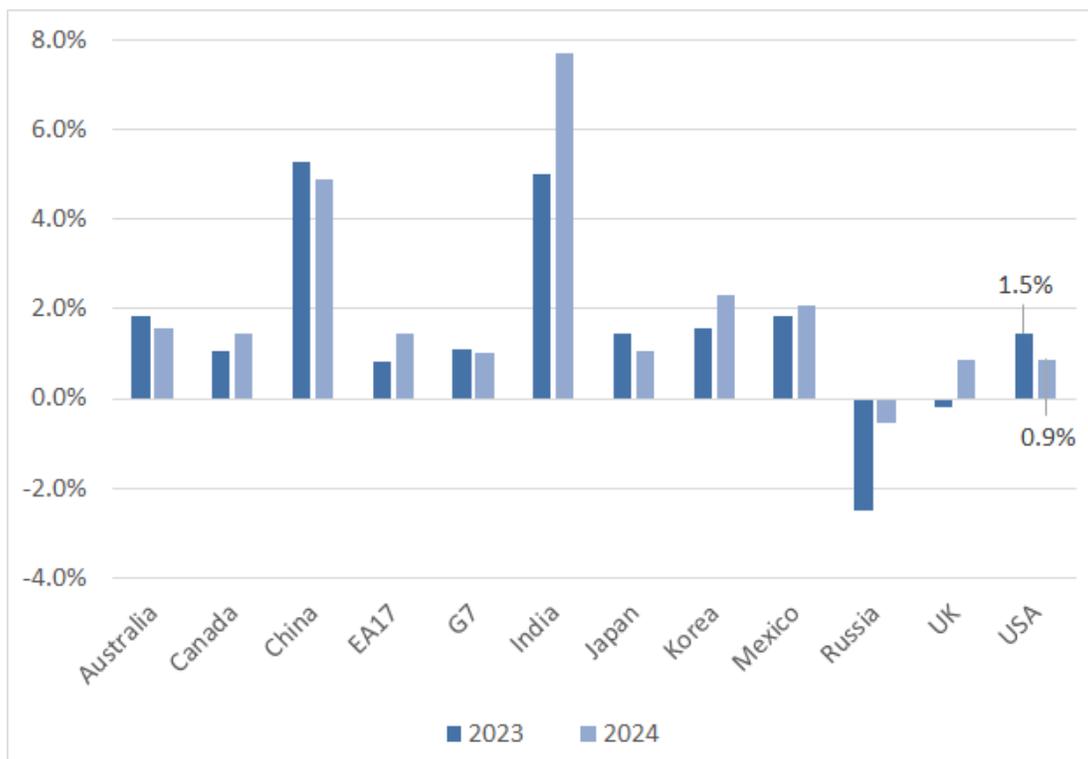


(Source: Chicago Board Options Exchange)

The war's relatively subdued impact on the index can be attributed to the global markets already grappling with surging inflation, partially caused by supply chain disruptions. From the perspective of Western markets, the conflict only exacerbates an already challenging economic landscape. The final economic disruption came when the Federal Reserve hiked its policy interest rate by 2.5 percentage points at the end of July. This move did not cause a significant change in the VIX, likely because it was widely anticipated. However, this rate increase, along with expected future tightening of monetary policy, could have significant repercussions on the U.S. economy over the coming 2-3 years.

The net effect of these obstacles, and the war in particular, has caused many international economic institutions to re-consider previous forecasts of national, regional, and global economies. Figure 1.2 shows real GDP growth projections for the largest economies in the world from the Organization of Economic Cooperation and Development (OECD).¹ The majority of the countries are expected to experience slower economic growth than previously anticipated – notably, the 2023 forecast for Japan was revised upward. For the US economic growth is forecast to fall to 1.2% in 2023. The International Monetary Fund (IMF) has a rosier revised forecast. In the US they anticipate growth in 2022 and 2023 to be 3.7% and 2.3% respectively, though it should be noted their estimates were done 2-3 months before those done by the OECD.²

Figure 1.2: Projected Economic Growth



(Source: OECD, *Economic Outlook*, March 2023)

¹A *Fragile Recovery*, OECD Economic Outlook, Interim Report March 2023.

²IMF, *World Economic Outlook: War Sets Back the Global Recovery*, April 2022.

1.1 The United States

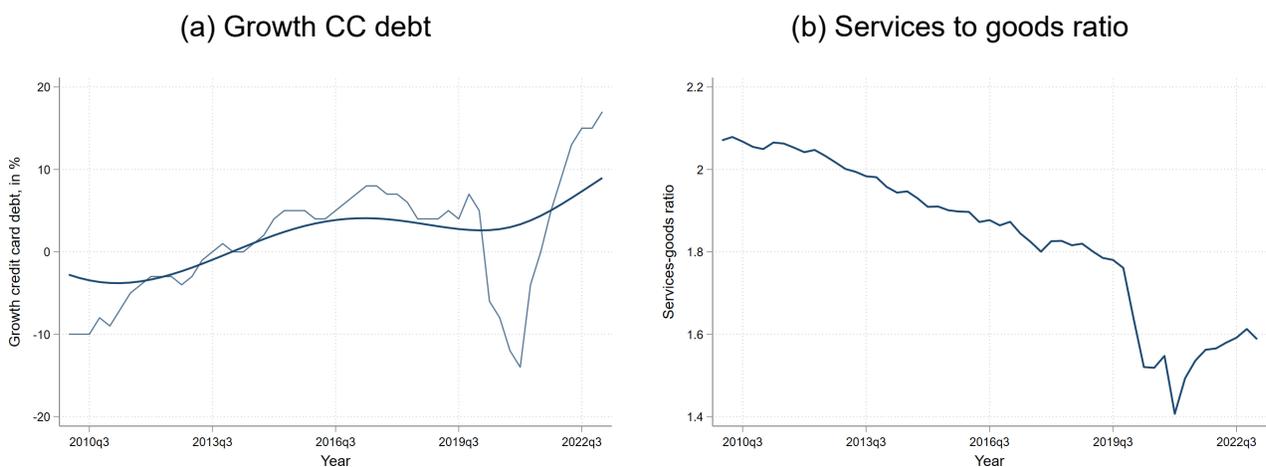
At the time of this writing, the discussion of whether or not the US will experience a recession in the next 18 months or so has taken on new relevance. Since January the Dow Jones Industrial Average has fallen about 13%, inflation – driven by supply side effects but exacerbated by past demand side fiscal stimulus – has reached levels not seen in 40 years, and bond yields are rising as a hedge against risk. All this has prompted the Federal Reserve (Fed) to tighten monetary policy. This has prompted the “will we, or won’t we?” recession discussion. And while a recession is not a forgone conclusion, there are nevertheless several headwinds, discussed in more detail below, that will adversely affect the US economy over the short and medium term. And/or there could be some unforeseen negative shock which is enough to upset the apple cart.

What are the likely drivers for the economy over the next year or so? Briefly, they are:

Household behavior During the pandemic, households shifted expenditures away from services towards manufactured durable and nondurable goods. Pre-pandemic services accounted for roughly 65% of household expenditures, but by mid-2021 this share had fallen to about 58%, putting additional pressure on final manufactured goods already facing supply shortages. As personal consumption re-balance expenditures, we will see demand for merchandise return to pre-pandemic levels.

Caveat, high growth also due to declines in cc debt during pandemic, so part of this is recovery.

Figure 1.3: Household expenditures



(Source: Federal Reserve Bank of NY and Bureau of Economic Analysis)

Housing and financial markets As housing markets and financial markets cool down personal consumption expenditures will similarly slow as household wealth cools. This could be exacerbated as personal savings fall and individual consumption slows with continuing high inflation rates.

Alternatively, though housing price growth is beginning to slow, parts of the country, such as in parts of Montana, continue to struggle with supply shortages keeping housing prices relatively high.

Investment Investment is a function of interest rates and as these rates rise, investment in new physical capital tends to decline. As discussed below, Montana firms are more interest rate sensitive than the national average, so the effects could be more pronounced in the state.

Economic policy National budget politics have returned to pre-pandemic norms causing increased policy and regulatory uncertainty. The US Congress and President managed to pass a debt ceiling package in the 11th hour in May 2023 easing concerns over debt repayment, a government shutdown, and ensuring social program spending would not cease. It also reduced the likelihood that financial markets would respond with higher interest rates if the Federal government reneged on its debt commitments easing concerns over a recession.

The end of pandemic-era support has been supplanted, in part, by rising household debt, discussed above. This has the effect of ensuring that aggregate demand remains relatively constant *today*. However, looking forward, the sharp increase in interest rates will lead to rising credit card rates which could lead to lower spending in the future and/or increased delinquency rates. In 2021 the economy also received some much needed federal investment in infrastructure. Given the long term nature of this funding, its effects are beginning to have an impact on the overall economy helping to ameliorate supply chain issues.

Technology As with all sectors of the economy manufacturing is also adopting new computer hard and software technologies, so-called Industry 4.0. A laundry list of technologies currently being used by manufacturers includes: the industrial internet of things, robotics, blockchain, artificial intelligence, 3D printing, local 5G networks, and more. Applying more technology reduces costs for worker safety and productivity while improving efficiency. Introducing technology is not without its repercussions: for many manufacturing practices traditional methods and skills will slowly phase out, subsequently requiring workers with different training, such as data analytics and computer programming. Cybersecurity and the protection of intellectual property rights are also concerns.

The Rest of the World Global recovery from the pandemic has been uneven, at best. Europe is on the cusp of entering a recession, meanwhile Asia, despite ongoing pandemic related issues in China, is set to be the global leader in terms of economic growth. Latin America and Canada are both slowing as inflation remains stubborn forcing policy makers hands to slow demand. More details can be found in Section 1.5.

1.2 Headwinds

This section summarizes the headwinds introduced above and provide some context as to how they may, or continue to, impact the state and national economies.

Tariffs Throughout 2018 the Trump administration imposed a number tariffs targeting appliances, solar panels, steel and aluminum across a broad range of countries, including some of America's closest trading partners. Also part of the package were tariffs imposed on Chinese imports. Altogether the US imposed about \$285 billion of tariffs on imports, with rates ranging from 10-25%. While the Biden administration has removed some of these tariffs, roughly \$350 billion worth of restrictions on Chinese imports remain in place. There is no consensus for how much the tariffs are contributing to higher import costs, but it is sector specific. For manufacturers requiring substantial amounts of tariffed intermediate goods, this continues to be an issue. However, the impacts of these tariffs are overshadowed by larger health and geo-political risks.

Covid and the Russo-Ukrainian War The World Health Organization (WHO) announced the end of the Covid health emergency in May of 2023. However, the WHO does caution that "risk remains of new variants emerging that cause new surges in cases and deaths." With China completely re-opening its economy after roughly 18 months of lockdown, WHO warnings have additional gravity. Fortunately, most of the world has some form of immunity which will likely ameliorate any new outbreaks.

The war, now in its second year, remains somewhat contained to the region. However, this does not mean that its economic impact is not being felt globally. Ukraine, and to a lesser extent Russia, is one the leading global grain producers, with most of its exports going to Africa. Oil and gas exports from Russia have been curtailed, but mineral exports are still finding their way to European and Asian economies

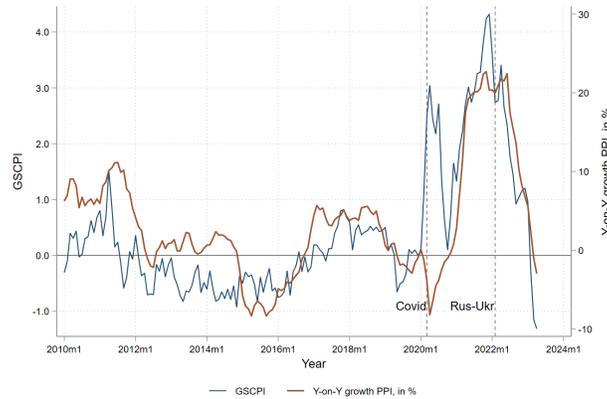
The invasion of Ukraine by Russia last February caused re-evaluations of all economic forecasts. Commodity prices, in particular grains and oil, have had negative impacts on both households and firms. A recent agreement between Russia and Ukraine has resulted in the resumption of Ukrainian grain exports leading to lower global agricultural commodity prices. The war has had a dramatic effect on European natural gas prices which may encourage policy makers to raise interest rates more sharply to control inflation by slowing demand growth.

Manufacturing in Asia, which is a net importer of oil, has driven up production costs for manufactured final intermediate good exports, further exacerbating supplies and prices of inputs. As the world's biggest manufacturing region, the impacts of the war on Asian producers undermine pre-existing pandemic induced supply bottlenecks. The Ukrainian war also threatens to curtail global supplies of steel. The subsequent rise in oil prices is increasing transport and production costs. War tactics, such as cutting off transportation routes, have led to logistics firms suspending services and air freight pushing up sea and air shipping rates. Shipping container prices remain \$5,500 higher than pre-pandemic levels.

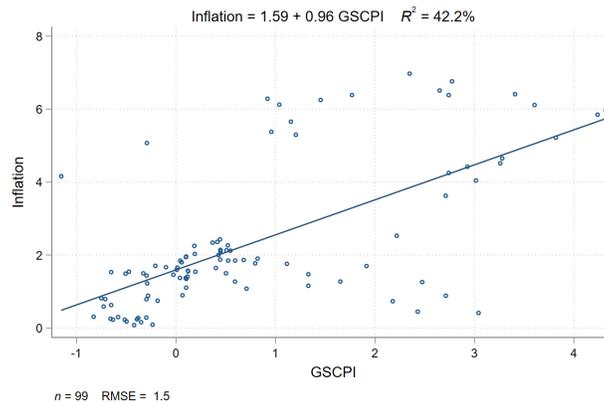
Fiscal Policy While not a headwind, per se, relatively loose fiscal policy over the past three years has added considerable, though somewhat short lived, demand for final durable and nondurable goods. Concurrently, because of the pandemic, there was a dramatic shift in household consumption behavior away from services towards durable and nondurable goods.

Figure 1.4: Global supply chain pressure, PPI, and inflation

(a) GSCPI and PPI



(b) Inflation and GSCPI



(Source: FRB of New York, Bureau of Labor Statistics, & Bureau of Economic Analysis)

Supply Chain, labor markets and inflation The confluence of the above events is driving the highest rate of consumer inflation in over 40 years. The Federal Reserve Bank of New York constructs a supply chain index called the “Global Supply Chain Pressure Index” (GSCPI) which tracks stress in global supply chains. This is then translated into higher intermediate good production costs, proxied by the producer price index (PPI), and then consumer inflation. Figure 1.4(a) shows the relationship between the PPI and the GSCPI. According to the data, supply chain pressures have eased considerably over the past year or so falling from the apex, that occurred when Russia invaded Ukraine which, as is shown, has resulted in lower producer costs. Figure 1.4(b) shows the relationship between the cost index and consumer inflation and as can be seen there is a close relationship between the two. Between 2020 and 2022 inflation was closely aligned with cost pressures, however, beginning in 2023 inflation has been driven by other factors, such as demand and firm mark-ups.

Labor markets Labor markets are in a state of flux. While the unemployment rate has dropped to pre-pandemic levels an alternative labor market indicator, the employment-population ratio, has not. The difference between these two data points is explained by the still consid-

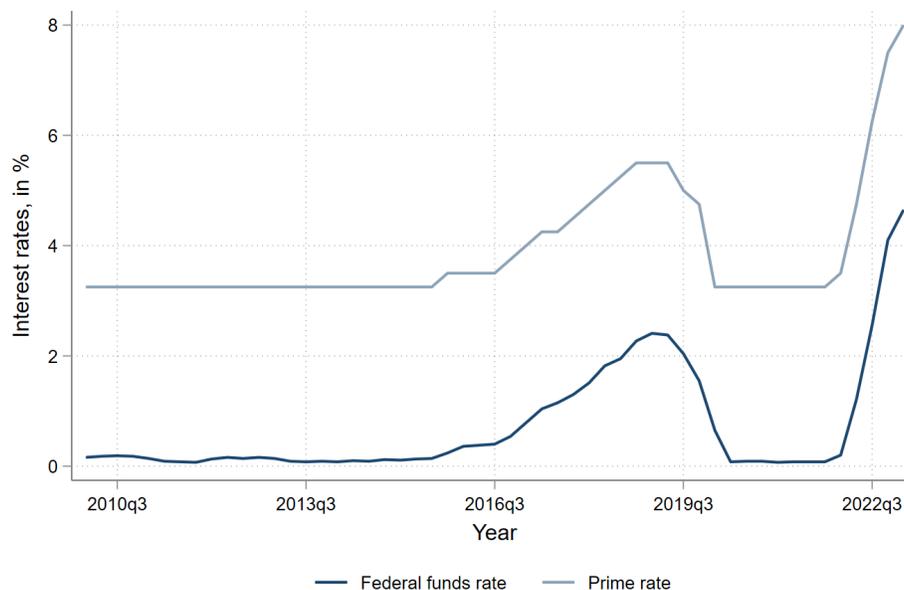
erable number of potential workers who have yet to re-enter the labor force. The reasons include: the impacts of the Covid unemployment insurance, fear of rejoining the labor force because of the pandemic, and difficulties obtaining child care – which is particularly acute for women in the workforce. Longer term, an aging population is contributing to a shrinking labor force participation rate.

Montana firms are more interest rate sensitive than the national average, so the effects could be more pronounced in the state.

Monetary policy and Banking In a delayed attempt to curb inflation, the Federal Reserve has aggressively raised its key policy rate, the federal funds rate, by 5 percentage points since April 2022. This increase has led to corresponding increases in other short-term interest rates, including the prime rate, as shown in Figure 1.5. These higher rates are then passed on to borrowers, notably manifesting in higher credit card interest rates as well as increased rates for other forms of short-term financing like car loans and appliance financing.

The ripple effects of these rate increases have been substantial on the broader economy. Recently, the higher interest rates have been cited as a factor in a series of corporate bankruptcies, particularly affecting companies that have relied heavily on borrowing for new investments and operational costs. Additionally, the swift uptick in rates has had a detrimental impact on several large regional banks, both in the U.S. and around the world. Notably, Silicon Valley Bank and First Republic Bank are among the most high-profile financial institutions to be affected.

Figure 1.5: Interest rates



(Source: Board of Governors of the Federal Reserve System)

Collectively, these policy changes will dampen demand and will likely lead to a slowing of the economy, despite strong labor markets.

This could continue to undermine future investment by Montana manufacturers. In Montana about half of manufacturing firms have less than 10 employees. Because small firms rely more heavily on borrowing from commercial banks, they are more responsive to changes in interest rates. Nationally, a one percent rise in borrowing rates is associated with a 5% decline in manufacturing output, but in Montana this decline more than doubles. Firms which rely on traditional bank financing are likely to face higher borrowing costs as the Fed applies the brakes to slow core inflation to its long run target level of 2%.

Another consequence of monetary policy is its effects on the exchange rate. Last year, the US dollar underwent a significant appreciation. Over the past year, because other central banks have been raising rates and intra-Federal government squabbling over the debt ceiling has reduced global confidence in the US debt, the dollar has depreciated by about 6.5%. This is a double edged sword. First, a weaker dollar improves manufactured exports by reducing their price in terms of other currencies. On the other hand, it raises the price of imported intermediate goods, raising production costs.

Wildcards One or more “wildcard” events could further impact the economy. A non-exhaustive list worth mentioning includes:

- Natural disasters and climate change: flooding, wildfire, drought, etc. For example, the recent fires in eastern Canada and the impacts of smoke in the NE of the US;
- A more contentious and polemic US Congress could potentially have an impact on interest rates by raising the risk premium; and
- China-US relations and global political and social uncertainty.

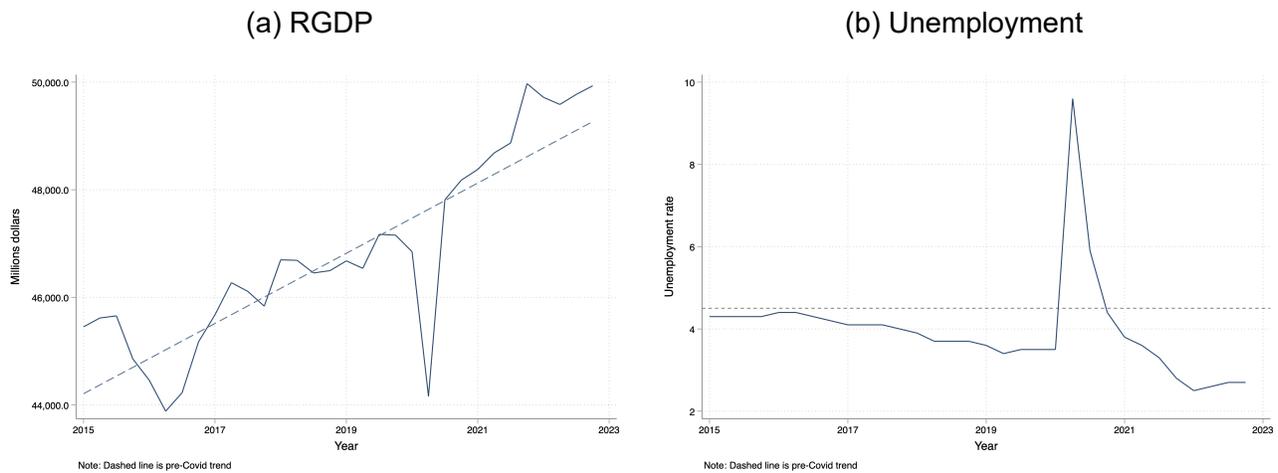
1.3 Montana Economy

Montana’s recovery from the Covid recession was robust. Real gross domestic product (GDP) returned to the pre-Covid trend in the first quarter of 2021, Figure 1.6(a) as did Montana’s unemployment rate, Figure 1.6(b). And the recovery has yet to lose much steam. Real GDP remains above the pre-Covid trend and the unemployment rate is the lowest it has ever been since the state level unemployment rate was first published in 1976.

Montana has also been enjoying a rapid increase in its population. While the natural population growth rate of the state is zero, there have been substantial net inflows of people from other states. According to the US Census Bureau, between 2020 and 2022 Montana netted over 39,000 new domestic residents, or 36 per 1,000 residents, placing Montana second behind Idaho as the state with highest percentage of new households. We can see from Figure 1.7(a) that since mid-2020 nonfarm employment has accelerated sharply and the state currently has about 20,000 more workers than the pre-Covid trend (dashed line). This labor growth is particularly acute in Flathead, Gallatin, Missoula, Ravalli, and Yellowstone counties.

This migration has not come without repercussions as there has been considerable pressure on housing markets. Figure 1.7(b) shows a sharp inflection point in statewide housing prices

Figure 1.6: Montana output (Real GDP) and unemployment rate

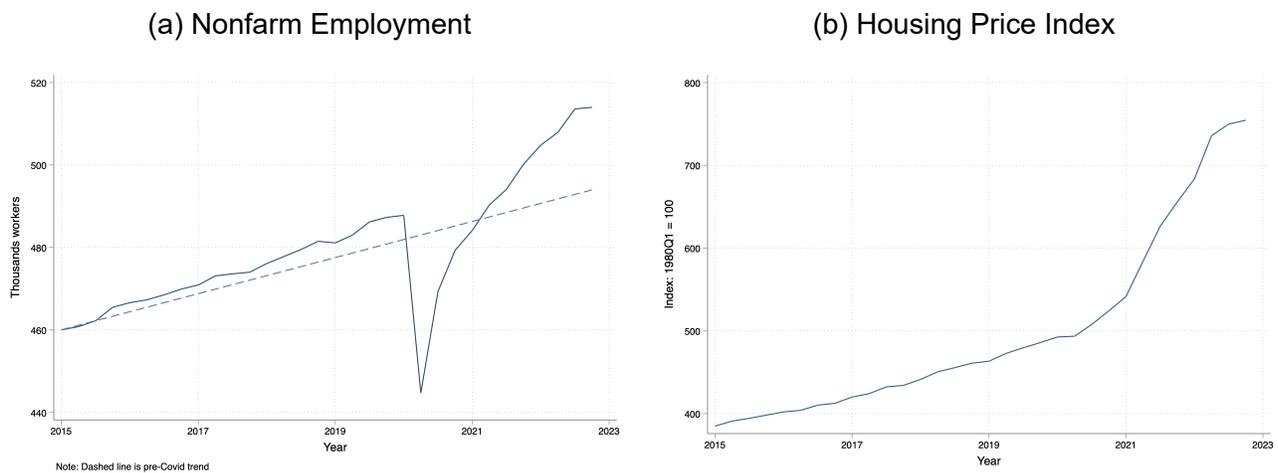


(Source: Bureaus of Economic Analysis and Labor Statistics)

in the second quarter of 2021. This rise is largely attributed to the inability of housing supply to meet the growing demand. Although the escalation in housing prices has begun to moderate somewhat —due in part to increasing mortgage rates and a boost in construction— housing costs have not yet started to decline.

The continued net migration into Montana is likely to bring both challenges and opportunities for the state’s economy. The challenges will mostly arise in the short run and are familiar to issues the state faces today: high housing prices, insufficient infrastructure, inadequate health and childcare, etc. – though these are not issues unique to Montana.

Figure 1.7: Montana employment and housing



(Source: Bureau of Economic Analysis and Bureau of Labor Statistics)

Indeed, positive net migration flows can offer a range of benefits, especially if the incoming population includes a skilled and educated workforce. A more qualified labor pool can contribute to higher productivity levels, which in turn can lead to economic growth. Moreover, a growing population can attract more businesses and investment to the area, creating a cycle

of economic development. So, while challenges like housing and infrastructure strains are immediate concerns, the long-term economic prospects could be promising.

Over the last year, the number of professional, scientific, and technical service workers grew roughly 6%, increasing by 1,600, making it the third fastest growing sector in Montana. This sector uses both specialized inputs and, itself, is an input to other downstream sectors. For example, manufactured goods are used in the technology sector, but also use computer software for production. While this rapid inflow of highly skilled workers does create short term bottlenecks, over time the benefits accrued will diffuse throughout the economy.

The two fastest growing sectors over the past year are private educational services, with 11,000 employees, and construction, up 6.1% to 38,200 workers. Manufacturing is the fifth fastest growing sector, adding 1,100 jobs, an annual growth rate of 5%. If we decompose manufacturing into durable and nondurable goods, employment growth was 6.8% and 2.3% respectively.



A craftsman at West Paw meticulously applies the finishing touches to the latest line of durable plush toys.

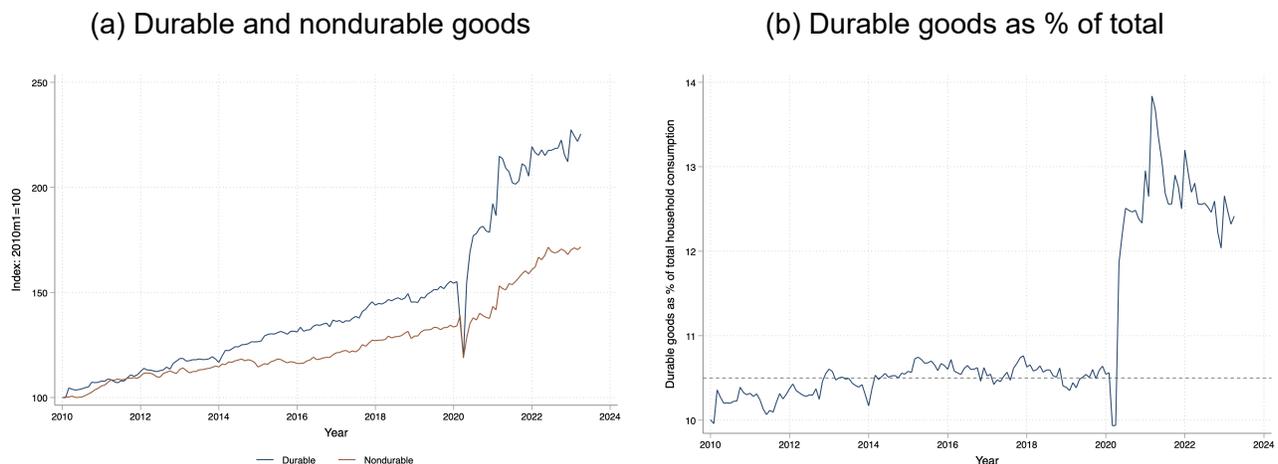
Manufacturing is the fifth fastest growing sector with 5% overall employment growth.

1.4 National and State Manufacturing Overview

Overview of National Manufacturing

In the aftermath of Covid, manufacturing is undergoing an almost paralleled shift. During the pandemic, households shifted expenditures toward durable manufactured goods, first discussed on page 4. Figure 1.8 shows how household spending patterns shifted during the pandemic. Panel (a) is an index, 2010 = 100, of household durable and nondurable spending. As the figure shows both durable and nondurable consumption rose at roughly the same pace. In panel (b) we can see durable's share of total consumption, which includes durable and nondurable goods and services, increase to roughly 12.5% after the beginning of the pandemic, after remaining at roughly 10.5%, the dashed line, from 2010 to 2020 – and it has remained elevated since mid-2020.

Figure 1.8: Household consumption behavior

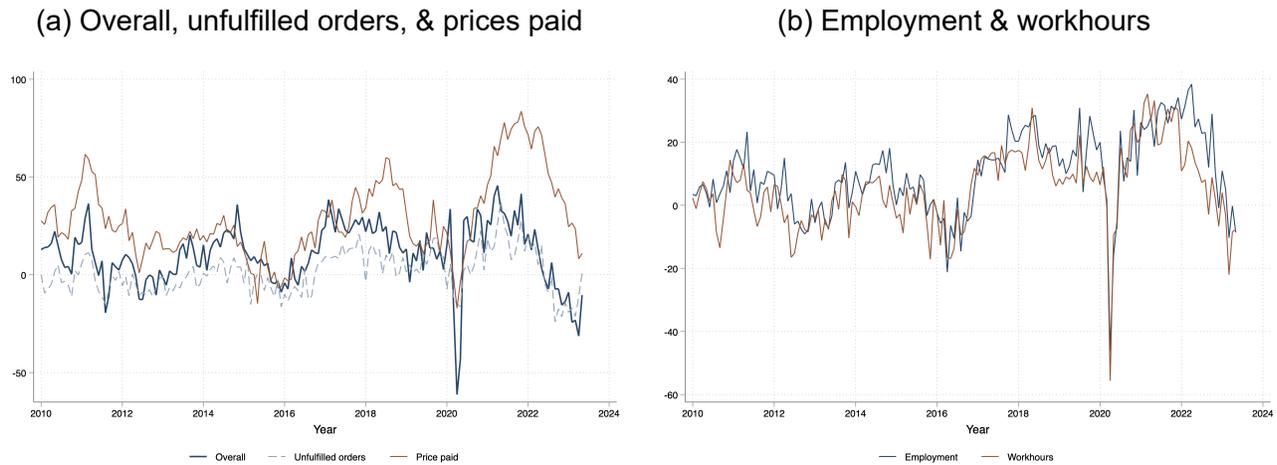


The pandemic shock and its associated realignment of spending towards durable goods has caused many sectors to rethink their strategies. This has been particularly acute in manufacturing which has substantial supply chains and considerable labor requirements. During the pandemic supply chains slowed considerably undermining production just when demand was accelerating. Now, however, as manufacturers catch up with demand there is potential for a reduction in output. This complication is compounded by a rising interest rate environment as central banks struggle to get inflation under control. Whether or not households adjust their consumption back to pre-pandemic norms is unanswerable at this time, but thus far household spending patterns have experienced a shift towards durable goods.

Despite ongoing pandemic related issues and the war in Ukraine, at the national level, manufacturers remain relatively upbeat. The National Association of Manufacturers 2023Q2 *Manufacturers' Outlook Survey* finds that almost 67% of respondents are optimistic about their own

firm's outlook, down 7% from the first quarter. For small manufacturers this decline is even more dramatic, in 2023Q1 80% of small manufacturers were optimistic about the near future, by the second quarter 67% had a positive outlook. Expected sales growth has slowed from last year's report to 1.6% the lowest in three years.

Figure 1.9: Manufacturing Business Outlook Survey



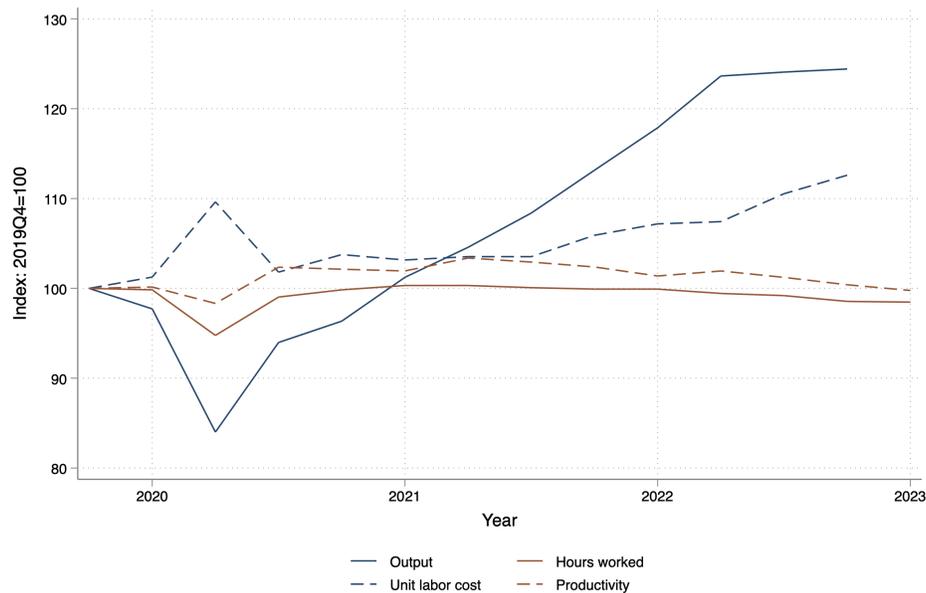
(Source: Federal Reserve Bank of Philadelphia)

According to the survey workforce challenges continue to be an issue. More than 74% of producers cited difficulties to not only attract but also *retain* employees as their primary challenge. Firms also voiced concern about a weakening US economy (56%), the rise of health care costs (53%), a complicated regulatory and tax environment (52%), rising raw material costs (50.8%) and continuing supply chain challenges (44.9%).

However, many of the survey's respondents are less pessimistic about supply chain bottlenecks. Roughly 53% expect supply chains to improve by the year's end. Indeed, almost one-third of respondents believe that supply chain disruptions had either already abated or would do so by mid-year.

Figure 1.9 shows five indices of national manufacturing activity. For this index 0 is neutral or average. Figure 1.9(a) shows the overall index, unfulfilled orders and prices paid. All the figures follow a similar pattern. The effects of both Covid and the Russia-Ukraine war remain evident, overall costs remain somewhat high, reflecting continuing supply chain issues, and activity seems to be experiencing an uptick following several months of decline. Similarly, Figure 1.9(b) indicates a deceleration in both employment and work hours, echoing the concerns expressed earlier about labor shortages among manufacturers. The trend lines for both metrics provide empirical evidence of these challenges.

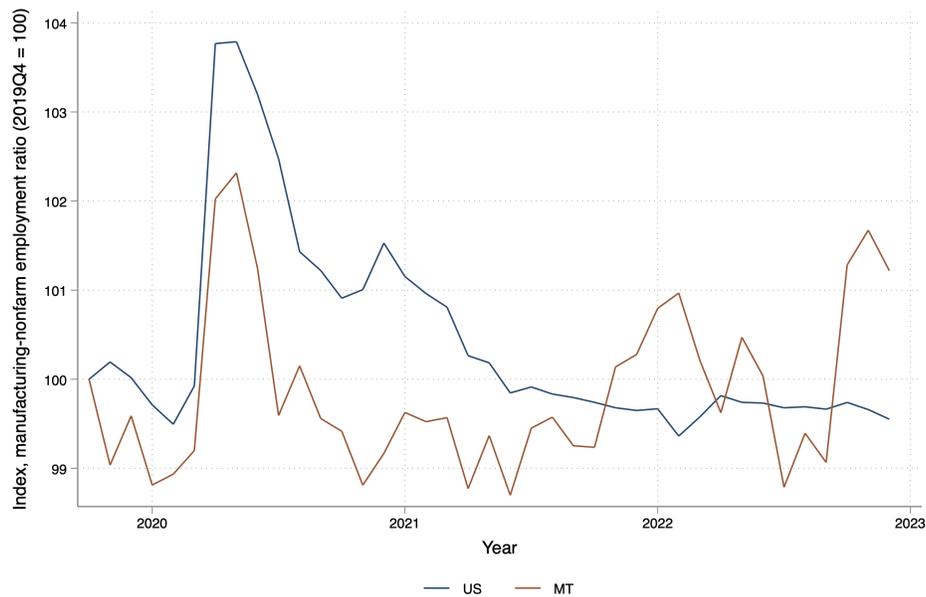
This observation is made clearer by considering the manufacturing output indices shown in Figure 1.10 which illustrates changes to weekly hours worked and output, which are measures of economic activity, and labor productivity and unit labor costs (dashed lines) which show labor effectiveness and costs. Both output and costs have climbed since the end of Covid. However, labor productivity and hours worked have remained largely unchanged since mid-2020. Productivity is of particular concern as with a tight labor market manufacturers will

Figure 1.10: Manufacturing metrics

(Source: BLS)

need to produce more with the workers they do have. We cover this discussion more in the “trends in manufacturing section” on page 15 below. Manufacturers will need to rely more on technology, AI, machine learning, etc. if labor markets continue to tighten – as shown in Figure 1.11 which shows the ratio of manufacturing to nonfarm employees – or employers face skill gaps, both of these are reflected in higher labor costs, as shown in Figure 1.10.

Several important caveats emerge from the national survey data. First, a majority (57%) of manufacturers expressed concern that the persistent inflationary pressures could heighten the risk of a recession within the next year. These pressures are making it increasingly challenging for firms to stay competitive. The main contributing factors cited for inflationary pressures include the rising costs of raw materials (97.2%), transportation (83.9%), wages and salaries (79.5%), and energy (55.9%). Additionally, nearly half (49.4%) of the manufacturers pointed to worker shortages as a significant issue. Lastly, these concerns are notably higher than those reported in the Montana Manufacturing Survey, which was conducted around the same time period 3.5.

Figure 1.11: Manufacturing to nonfarm employment ratio

(Source: BLS)

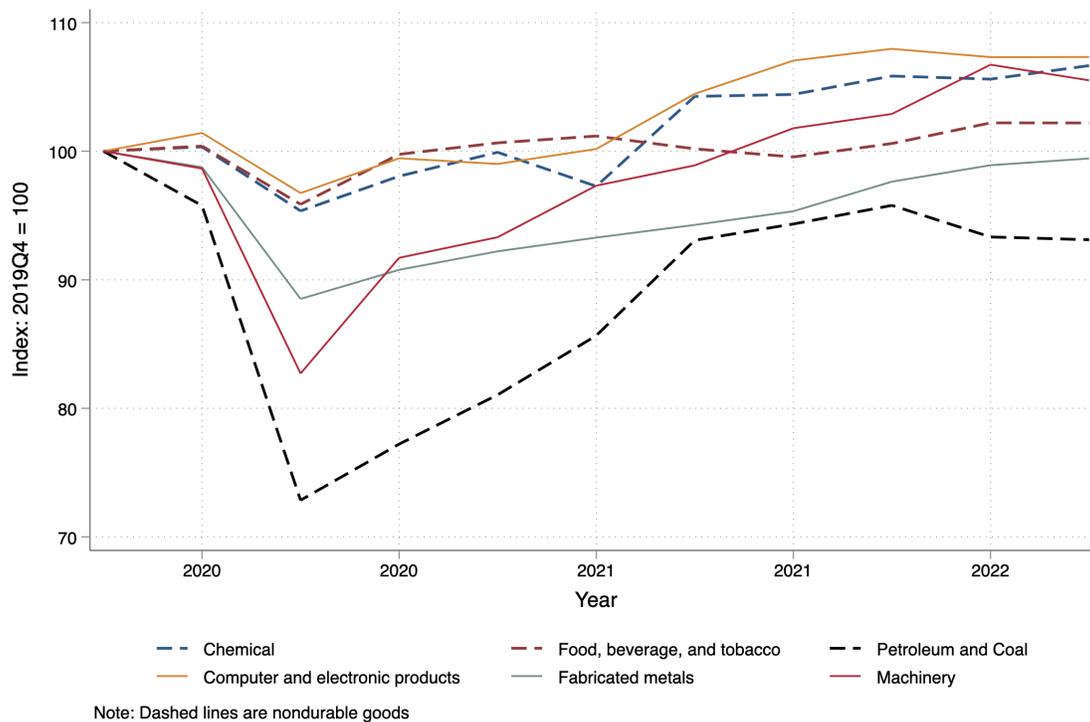
Trends in manufacturing

There are several trends in manufacturing that have gained traction over the past year which look to define the industry for the foreseeable future. While these national trends may not always apply directly to Montanan manufacturers, which tend to be smaller operations and more personal, being aware of the trends could benefit the state's producers by taking advantage of opportunities available in Montanan which may not be possible elsewhere.

Employment & Human capital investment

As stated in the most recent National Manufacturers Association Survey (2023Q3) finding enough workers continues to be the primary concern for US producers. Changing workforce dynamics, on both the supply and demand side, are having an impact on how the labor market functions. On the supply side, workers have emerged from the pandemic with a different sense of the work-life balance as technologies have allowed for different modes of work – e.g. telecommuting is becoming increasingly possible across a wider set of industries. Technology is reducing the need for workers to spend as much time on repetitive tasks, particularly important in the manufacturing industry. However, it does increased the need for skilled and creative workers who can design, build, and work with technology.

If the labor market continues to remain tight, or tighten further, potential employees gain leverage. They, in turn, can improve work environment via higher wages, a more flexible work environment, advancement, and/or other programs. Manufacturers may need to implement new programs and policies or change managing operations to accommodate employees.

Figure 1.12: Manufacturing sectors

(Source: BLS)

Employers are increasingly recognizing the importance of skill-based training and recruitment. The changing landscape suggests that companies may need to pivot their hiring focus toward recruiting employees who are not only motivated and intelligent but also trainable for specialized tasks. Interestingly, in addition to technical competencies, there is a growing acknowledgment of the value of "soft skills" in the manufacturing sector. Skills such as effective communication, creativity, problem-solving, strategic thinking, and conflict resolution. This shift indicates a more holistic approach to employee selection, aiming for a well-rounded workforce.

AI, automation, digital twins, and the internet of things

In our previous year's report, we highlighted the ongoing impact of Industry 4.0 in the manufacturing sector. A noteworthy update in this landscape has been the widespread availability of artificial intelligence (AI), particularly marked by the public introduction of ChatGPT by OpenAI in the last quarter of 2022. The accessibility of such AI technologies suggests that some of the current challenges related to labor shortages and skills mismatches could be partially alleviated through strategic investments in these tools.

In the business context, AI is predominantly linked with machine learning, a subset where algorithms self-improve by learning from data. As these algorithms are exposed to more extensive and better-quality data, they become capable of executing increasingly complex

tasks without human intervention. When these smart, learning machines are interconnected, it gives rise to the Internet of Things (IoT).

For manufacturers, IoT involves a network of physical objects or "things" embedded with sensors, software, and other technologies to collect and exchange data with other devices or systems. These connected systems can dramatically reduce downtime by enabling predictive maintenance. Furthermore, the networked machines can automatically adjust for quality control, enhancing productivity. This not only optimizes operations but also minimizes waste and pollution, making the manufacturing process more sustainable and efficient.

With information collected from sensors and IoT devices, manufacturers can use immersive technology, such as virtual modeling, to help simulate and test the entire manufacturing process, from floor layout to the supply chain. This can allow producers to consider the impacts of various types of "what-if" scenarios. This is referred to as *digital twinning*. By simulating various scenarios, monitoring performance, and predicting failures in the virtual environment, organizations can gain invaluable insights. These insights can then be applied to optimize the actual physical system, thereby sidestepping the costly errors that typically accompany trial-and-error approaches in a real-world setting.

The next few years will be pivotal period for the manufacturing industry as it trends toward more widespread adoption of Industry 4.0 technologies. While the exact timeline for universal implementation remains uncertain, the momentum is clearly building, suggesting a promising horizon of innovation and progress for the sector.

Ongoing supply chain disruption

Despite the official declaration by the WHO of the end Covid global health emergency, challenges to the global economy still persist. Persisting challenges such as inflation, geopolitical issues, a slowing Chinese economy, cybercrime, and climate-related events, will continue to stress the economies ability to adapt.

In terms of supply chain adaptations, manufacturers are increasingly turning to "insourcing." This approach eliminates the need for a middleman which allows firms to tailor supply chain logistics and reduce shipping costs and time. Manufacturers are also replacing the layers of production from a traditional sales model by removing wholesalers and distributors with a direct to consumer model. As with insourcing, this approach removes the producer-consumer middleman given producers more control over the entire product cycle while also developing a better relationship with both up and downstream clients while also reducing overall costs.

The trend of "reshoring" was also gaining traction even before the pandemic. This involves bringing back overseas production to domestic soil. Factors such as lower transportation costs and better inventory management can offset higher domestic labor costs making reshoring less costly overall. It is estimated that between 2010 and 2018, 749 thousand jobs were repatriated to the US, a number eclipsed during the pandemic.

Looking ahead, there are several emerging trends in manufacturing that are poised to help firms adapt to the current complexities and changing environments. Automation and IoT

technology offer a pathway to reducing inefficiencies, minimizing waste, and combating fraud within supply chains. In particular, these technologies allow for real-time monitoring and analytics, enabling quick responses to potential issues.

Digital twinning is another promising development. This technology allows companies to create a virtual replica of their physical systems and processes. By running simulations, they can "game out" different scenarios, identify potential bottlenecks, and develop preemptive solutions.

Although these activities are more common for larger businesses, which can take advantage of economies of scale, the falling cost and increasing availability of technology will allow smaller manufacturers to take advantage of doing more in-house supply chain management.

Environmental, social, and governance and sustainability in manufacturing

Consumers, particularly Gen Z and Millennials, are becoming increasingly interested in sustainability and ethical production and behavior and are basing their decisions on it. 2023 is the year where it is becoming a business priority for companies to factor this into their business practices. The economy is endeavoring to reduce its impact on the environment and reduce the CO2 emissions, and the manufacturing industry is no exception. By reducing reliance on fossil fuels and switching to renewable energy sources, manufacturers can potentially reduce production costs and energy uncertainties while simultaneously accelerating the move towards net zero emissions. In addition, worker conditions should be improved, waste should be minimized while increasing recycling, and minerals mined in a sustainable and responsible way.

Decentralized Manufacturing

Decentralized manufacturing is the concept that products should be constructed close to the location where they will be used – for example, cement plants are often located near large building sites. In addition to removing the manufacturer's environmental footprint, it also improves speed and efficiencies through lower transportation and distribution costs. Being produced near the end user also allows for quickly adapting to customer needs and/or requirements allowing for more "bespoke" output. "Fablabs" (fabrication laboratories) is an example of decentralized manufacturing, where products can be quickly designed, tested, and proto-typed to create small batches of customized products. This type of production generally involves "additive production, such as 3D printing, rather than subtractive process, e.g. machining, which are standard in large scale centralized manufacturing. Generally, subtractive or formative manufacturing requires greater economies of scale to achieve lower costs compared to additive manufacturing. As technology and capital become more available to smaller manufacturers, they too will be able to capture economies of scale with less initial investment.

1.5 Global Regional Overview

The global economic outlook remains uncertain amid financial sector turmoil, e.g. the second and third largest bank failures in US history, stubborn high inflation, the effects of the Russian-Ukrainian, and three years of COVID. The International Monetary Funds (IMF) forecasts global economies to slow from 3.4% in 2022 to 2.8% this year. Advanced economies, in particular, are forecasting a steep growth deceleration. In the event of further financial market distress, global growth falls to 2.5% in 2023 with advanced economy growth falling below 1%. Global inflation is forecast to fall from 8.7% 2022 to 7.0% because of lower commodity prices, however core inflation should prove to be more stubborn.

Europe and the European Union

The Russian invasion of Ukraine continues to have economic consequences for Europe, though not to the extent as in 2022. According to the IMF, Europe's economies are stumbling towards recession, with Germany's economy experiencing two quarters of negative growth, primarily due to declines in the German manufacturing sector which account for almost 10% of employment. Much of this decline has been blamed on higher energy prices associated with the Russo-Ukrainian war. Inflation remains elevated which puts pressure on Europe's various central banks, the European Central Bank in particular, to continue to raise interest rates and this policy has also stressed European financial markets. Bank policy only increases the potential for a recession and while this is not necessarily an inevitable outcome, economists remain somewhat bearish on Europe – which is projected to grow at an anemic 0.8%. Over the longer term, policies should reduce the inflation-growth trade by liberalizing labor markets to incentivize hiring and increase the supply of labor – Germany has recently amended its immigration policy for just that reason. In addition, policies which strengthen energy security and demand efficiency, including lowering the costs of green energy transition, would help Europe's longer term outlook, particularly as the Russian-Ukrainian war enters its second year.

Asia and Pacific

Economic growth in Asia and the Pacific are dominated by the fortunes of China. This year, in contrast to Europe, Asia is poised to experience a relatively strong year – accounting for about 70% of global growth in 2023 – a full 50% of global growth will be contributed by China and India alone. According to the IMF Asian growth will accelerate to 4.6%, up from 3.8% last year, despite monetary tightening and growth in Asian technology and falling exports. China's reopening will provide fresh momentum. Historically, investment goods and government spending have been the primary drivers of Chinese growth, however, as the economy undergoes ongoing structural shifts, household consumption is likely to be strongest driver of economic growth. Growth in India, Asia's second biggest economy, will likely soften over the course of 2023, but is, nonetheless, still forecast to grow by almost 6%.

Latin America and Canada

Growth in Latin America is projected to slow to 1.6% this year as compared to last year's 4%. While price pressures that accompanied elevated economic activity seem to have reached an apex, underlying inflation remains high which disproportionately hurts households on the lower end of the income scale because they spend most of their income on food and other necessities. Mexico, the US's third largest trading partner after Canada and China, is projected to grow at 1.8% this year, but inflation appears to have moderated somewhat – though core inflation, which excludes food and energy, remains roughly 1.5% above the overall inflation rate. Labor markets remain tight and output is at or above potential, which are driving short-term inflation expectations in excess of central banks' target ranges. These factors conspire to increase the risk that inflation in the region could remain unacceptably high.

Canada is likely to experience a similar economic environment as Latin America. Canadian economic growth is projected to slow from 3.4% in 2022 to 0.3%. Concurrent with the decline in economic growth, Canada's unemployment rate is expected to rise to 6.3%. In order to reduce Canada's 8.2% inflation rate in 2022, the Bank of Canada was forced to raise interest rates. Current projections point to an inflation rate of less than 2.0% in Canada which leaves the central bank more wiggle room to promote economic growth after 2023 rather than focus on inflation.

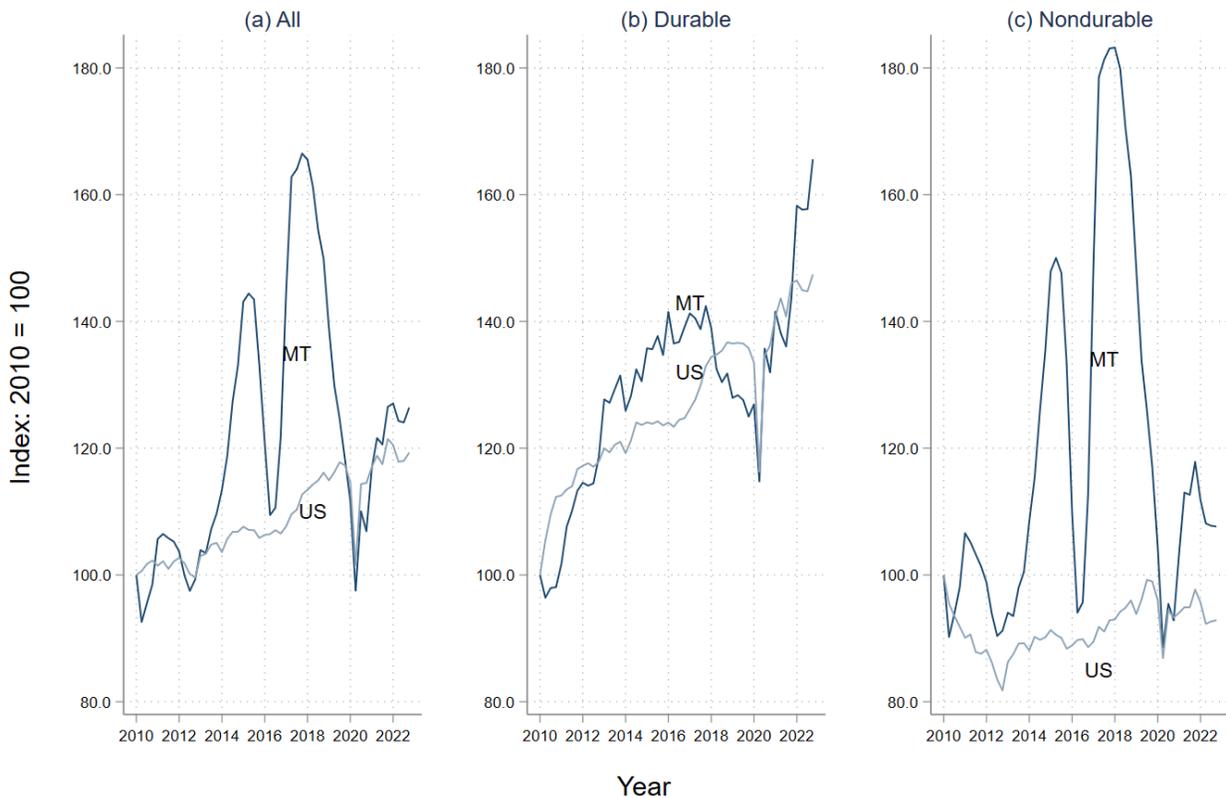
2 Manufacturing in Montana

Manufacturers in Montana remain relatively optimistic compared to the national averages. And for good reason, Montana’s manufacturing sector has generally out performed the nation’s manufacturers in the aftermath of the pandemic induced recession. As such, manufacturing continues to be a stable economic sector. In the last quarter of 2022 manufacturing employment as a share of total nonfarm employment was 4.4%, growing by 1,000 workers over the past year to 22,700 workers. Similarly, manufacturing’s labor earnings as a share of Montana private industry grew 10.7% to \$1.95 billion which is about 5.5% of total state earnings. This translates to an average annual pay of \$57,180 in 2022. In 2022, manufacturing’s share of total state output, gross state product (GSP), remained largely unchanged, adjusted for inflation, \$3.3 billion, and is now about 6.6% of Montana GSP.

In 2022 manufacturing in Montana:

- Accounts for 5.5% of total private state earnings equaling \$1.6 billion
- Employs 4.4% of Montana’s workforce, with about 22,700 employees with an average annual pay of over \$57,000
- Produced 6.6% of Montana’s output with a value of \$3.3 billion

Figure 2.1: US and Montana manufacturing output (RGDP)

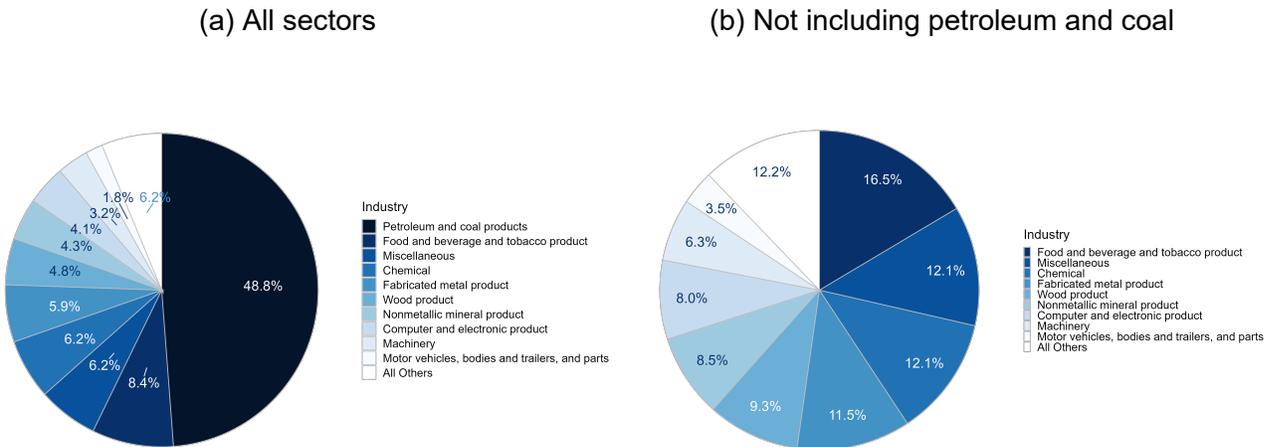


(Source: Bureau of Economic Analysis)

Montana manufacturing has been growing relative to the US as a whole. Comparisons between Montana and nationwide manufacturing output since 2010 can be found in Figure 2.1, which shows an index of all manufacturing production (2010Q1=100). Between 2010 and 2013 Montana’s manufacturing kept pace with the national economy. However, after 2013 Montana’s manufacturing output accelerated relative to the US. Manufacturing in Montana is about 50% larger today than it was in 2010 compared to 22% in the US, shown in Figure 2.1(a).

Montana durable goods manufacturing has mirrored patterns in the national average Figure 2.1(b), and has also outpaced the national economy. Nondurable manufacturing is presented in Figure 2.1(c). US nondurable manufacturing growth shrank between 2010 and the end of 2019, but has grown significantly in Montana, fueled by growth in the petroleum and coal and food and beverage sectors, discussed below. The sharp decline in nondurable manufacturing in 2016 is from declines in the value of manufactured goods in the petroleum and coal sector because of a sharp fall in oil prices.

Figure 2.2: Composition of manufacturing in 2020 (percent of total manufacturing)



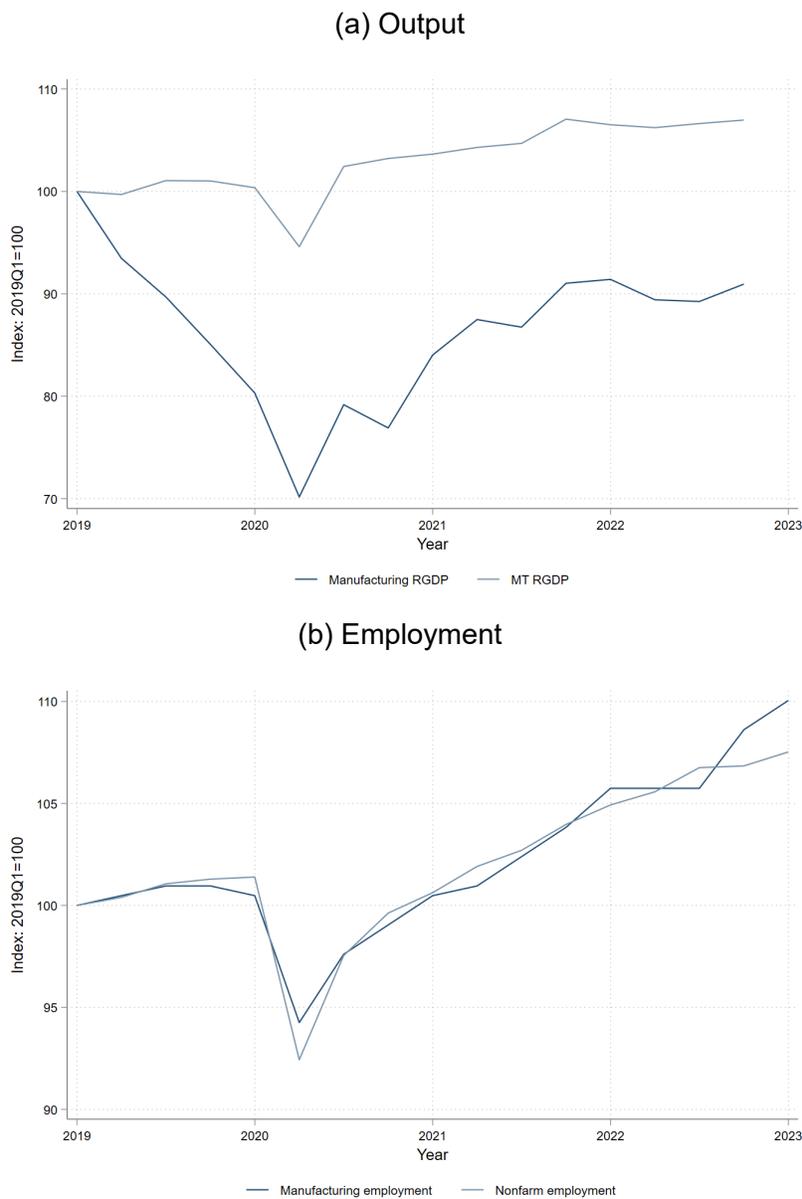
(Source: Bureau of Economic Analysis)

Figure 2.2(a) shows the share of total manufacturing earnings; only sectors with a 1.5% or larger share are presented. The largest Montana manufacturing industries in 2020, the most recent available data, were associated with the processing of crude oil and coal and the hospitality sector. Petroleum and coal products (primarily oil refining) was the largest manufacturing industry accounting for 49% of total manufacturing earnings in 2022, down from 2021. The next largest industry was food, beverages and tobacco, rising from 2019 to 8.4% of earnings. What is notable is the size of the oil and coal manufacturing sector relative to the other manufacturing industries. Removing this sector from the data provides insight into how the remaining sectors are distributed, presented in Figure 2.2(b). Only sectors with a 3% or better share of manufacturing output are included.

Manufacturing in Montana has recovered from Covid much more quickly than in the nation as a whole. Figures 2.3(a)-(b) compares indices of output and employment in Montana for

manufacturing and the overall economy 2019Q1. We start with 2019Q1 to illustrate how the overall state and manufacturing have recovered from the pre-Covid norm. As the figures show, manufacturing *output* has not yet recovered to pre-Covid norms, though this is likely due to fluctuations in the oil and coal manufacturing sector and does not reflect the overall state of Montana manufacturing. This is demonstrated in Figure 2.3(b), which shows overall employment. Because oil and coal manufacturing is capital intensive, it underestimates the recovery in the aggregate manufacturing sector. This figure illustrates that manufacturing’s recovery has been on par with the overall economy.

Figure 2.3: Montana Manufacturing Employment and GDP since 2019

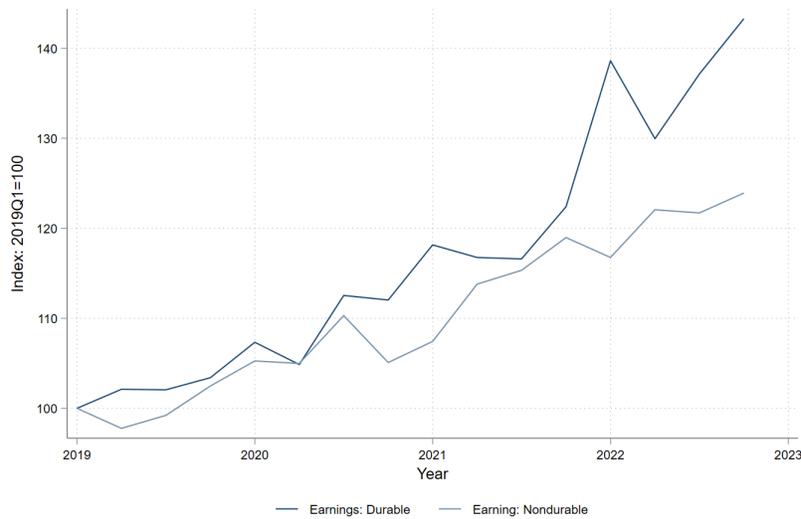


(Source: Bureaus of Business Analysis and Labor Statistics.)

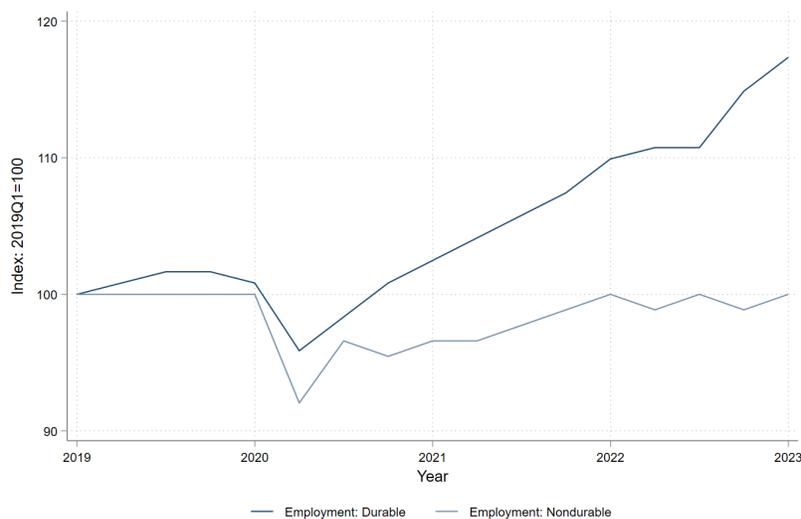
What is driving this growth is the rapid recovery of durable manufactured goods? As shown in Figure 2.4, durable earnings and employment only experienced a one or two quarter downturn in the second and third quarters of 2020. While nondurable earnings also recovered relatively quickly, employment in the nondurable manufacturing sector did not return to pre-pandemic levels until 2022.

Figure 2.4: Montana Durable vs Nondurable

(a) Earnings



(b) Employment



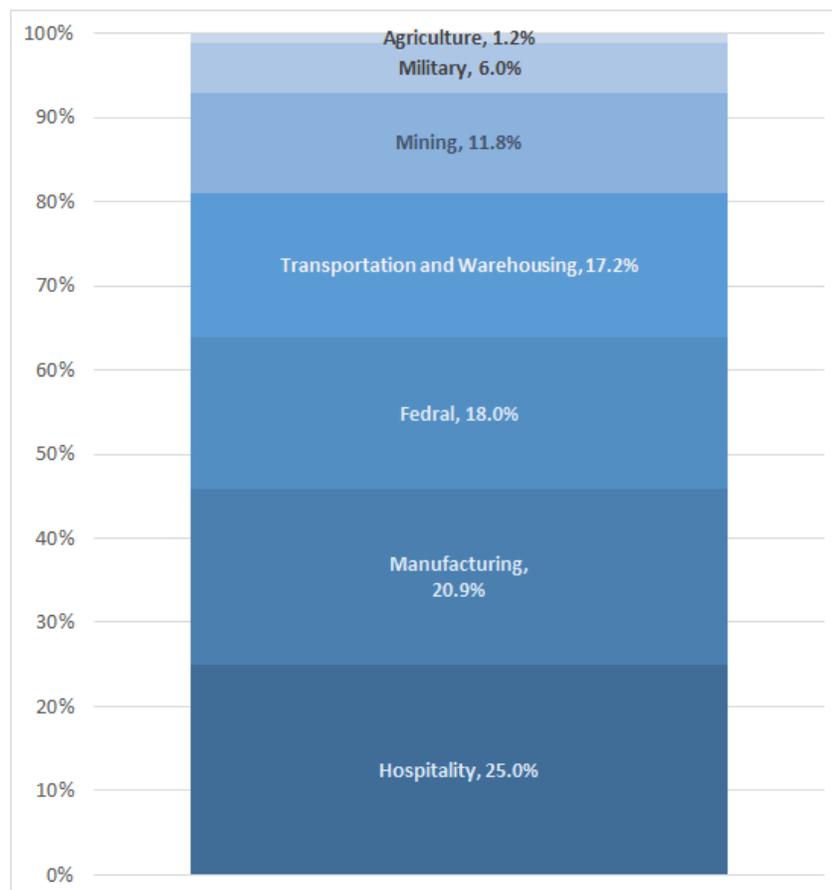
(Source: Bureau of Labor Statistics.)

Base Industries

Trends in the Montana economy are primarily determined by its base industries. Base industries are those which sell most of their products out of state or are otherwise influenced by factors beyond the state's borders. Base industries inject new funds into the state economy and are responsible for creating income and jobs. To quantify the role base industries play in the Montana economy we consider labor earnings for each base sector.

Labor earnings data is more appropriate for analyzing trends from one year to the next and for periods of a decade or more. The share of basic earnings over the period 2009-21 in each of Montana's base industries are shown in Figure 2.5. Collectively, the federal government, which includes the military, accounts for about 24% of base industry earnings. Manufacturing as a share of base industries is up to 20.9% from 20.1% last year. Tourism, proxied by the hospitality sector is showing signs of post Covid recovery and now is 25.0%.

Figure 2.5: Share of base earnings in Montana, 2022



(Source: Bureau of Economic Analysis)

Manufacturing output in Montana is about 50% larger than it was in 2010, compared with 22% in the US.

2.1 Manufacturing Establishments

According to the Bureau of Labor Statistics, 1,839 Montana manufacturing establishments in 2022 have employees. Dunn and Bradstreet lists over 4,400 manufacturers in Montana. This latter number includes sole proprietors, as well as those with employees.

To better understand structural changes in Montana manufacturing, we first look at the one-year average and ten-year average growth rate for manufacturing firms from 2012 to 2022 from the BLS data (see Table 2.1). The ten-year average growth rate is a better way of gauging each sector as global market conditions change considerably year to year, particularly in the food and energy markets. Sectors such as petroleum and oil require significant capital investments making changes to the number of firms less likely.

Table 2.1: Number of Private Firms in 2022

NAICS	Commodity	Firms		2021-22	Mean
		2012	2022	growth	2012-22 growth
312†	Beverage & Tobacco	61	154	9.7%	9.9%
334	Computer & Electronic	42	93	8.3%	8.5%
315†	Apparel	8	16	7.2%	8.1%
336	Transportation Equipment	36	61	5.4%	5.8%
332	Fabricated Metal	193	304	4.6%	4.7%
333	Machinery	48	75	4.6%	4.9%
316†	Leather & Allied	19	29	4.3%	4.8%
323†	Printing & Related Activities	84	115	3.2%	3.3%
325†	Chemical	51	70	3.2%	3.3%
339	Miscellaneous	155	198	2.5%	2.5%
327	Nonmetallic Mineral	89	108	2.0%	2.0%
326†	Plastics & Rubber	25	30	1.8%	2.3%
321	Wood	137	162	1.7%	1.7%
311†	Food	172	197	1.4%	1.5%
335	Electrical Equipment	20	23	1.4%	1.7%
337	Furniture & Related	123	142	1.4%	1.5%
324†	Petroleum & Coal	11	11	0.0%	0.3%
331	Primary Metal	15	15	0.0%	0.3%
314	Textile Product Mills	39	32	-2.0%	-1.7%
322†	Paper	3	2	-4.0%	-3.3%
313†	Textile Mills	5	2	-8.8%	-6.7%

(Source: Bureau of Labor Statistics, †denotes nondurable manufactured goods.)

The fastest-growing industries in terms of firm creation are beverages and tobacco, and computer and electronic products with an average 10-year growth rate of 9.7% and 8.3%, respectively. These sectors are nearly three times that of all manufacturing. Much of the growth in Beverages and Tobacco occur from the formation of breweries, wineries and distilleries. One of Montana's traditional industries, wood products returned to positive growth over the past decade. Rounding out the bottom is an industry not known for growth in the US, Textile Prod-

uct Mills, losing an average of 8.8% of firms every year over 10 years, and is one example of an industry that has not rebounded from the pandemic recession.

Montana's manufacturing firms tend to be small businesses following a similar trajectory to the U.S. as a whole. Table 2.2 breaks down manufacturing by sector and the number of employees. As the table shows, most firms, 68.0%, have less than ten employees, 83.9% have less than twenty employees. The largest number of firms are in fabricated metals, 242, and over 70% are small-scale operations. The majority of firms that have over 100 employees are situated within four key sectors: wood products, food, petroleum and coal, and transportation equipment.

Table 2.2: Firms by the number of employees in 2021

NAICS	Commodity	<10	10-19	20 – 49	50 – 99	≥ 100	Total	Unknown
Nondurable Goods								
311	Food	105	31	24	5	4	170	1
312	Beverage & Tobacco	77	23	11	3	0	114	0
313	Textile Mills	0	3	0	0	0	5	2
314	Textile Product Mills	26	5	3	0	0	35	1
315	Apparel	10	0	0	0	0	12	2
316	Leather & Allied	22	0	0	0	0	24	2
323	Printing & Related Activities	71	11	6	0	0	91	3
324	Petroleum & Coal	0	0	0	0	3	6	3
325	Chemical	23	14	0	0	3	43	3
326	Plastics & Rubber	11	3	3	3	0	20	0
Durable Goods								
321	Wood	85	26	16	8	8	143	0
327	Nonmetallic Mineral	50	20	14	5	0	90	1
331	Primary Metal	8	0	0	0	4	15	3
332	Fabricated Metal	175	34	26	5	0	242	2
333	Machinery	32	8	6	4	0	52	2
334	Computer & Electronic	11	0	7	0	0	21	3
335	Electrical Equipment	4	0	0	0	0	8	4
336	Transportation Equipment	29	6	5	0	3	45	2
337	Furniture & Related	83	18	4	0	0	105	0
339	Miscellaneous	111	11	7	5	5	139	0
	Total	940	219	135	47	40	1381	34

(Source: U.S. Census Bureau)

2.2 Manufacturing Annual Earnings by Industry

Table 2.3 provides insights into sector earning growth using the same 10-year annual averages as in Table 2.1. Price volatility in some sectors distorts the value of output measures, such as GSP, for specific industries, such as petroleum refining. Consequently, worker earnings are the best measure of the composition of manufacturing because it is the amount earned by manufacturing workers in the state.

While the apparel and beverage and tobacco industries are the fastest growing in Montana in terms of the number of firms, due largely to their relatively low entry costs, it's a different story when it comes to earnings. The computer and electronics and transportation equipment sectors have seen earnings grow at rates nearly double that of overall manufacturing over the past decade.

The largest sectors in terms of earnings are also the most capital-intensive industries, petroleum and coal, wood, and fabricated metal products. Petroleum and wood continue to have slower than average manufacturing growth rates of between 3 and 5%. Whereas, Montana's third-largest, by earnings sector was fabricated metal which grew at a relatively rapid 6% per year over 10 years.

Table 2.3: Annual Earnings in 2022

NAICS	Commodity	Earnings (millions)		2020-22 growth	Mean 2012-22 growth
		2012	2022		
334	Computer & Electronic	\$22,629	\$67,467	11.5%	11.8%
331	Primary Metal	\$4,651	\$11,830	9.8%	10.8%
326†	Plastics & Rubber	\$12,558	\$28,330	8.5%	9.4%
325†	Chemical	\$36,997	\$76,231	7.5%	7.9%
339	Miscellaneous	\$57,490	\$117,540	7.4%	7.7%
333	Machinery	\$57,354	\$112,480	7.0%	7.2%
312†	Beverage & Tobacco	\$25,822	\$49,945	6.8%	7.1%
332	Fabricated Metal	\$82,936	\$148,090	6.0%	6.1%
316†	Leather & Allied	\$1,448	\$2,500	5.6%	7.0%
324†	Petroleum & Coal	\$121,517	\$198,185	5.0%	5.1%
337	Furniture & Related	\$19,564	\$31,135	4.8%	4.9%
323†	Printing & Related Activities	\$32,533	\$50,932	4.6%	4.8%
311†	Food	\$81,084	\$126,064	4.5%	4.5%
335	Electrical Equipment	\$7,875	\$12,064	4.4%	5.2%
314†	Textile Product Mills	\$4,262	\$6,415	4.2%	4.6%
321	Wood	\$105,900	\$159,306	4.2%	4.2%
327	Nonmetallic Mineral	\$60,904	\$88,283	3.8%	3.9%
315†	Apparel	–	\$695	–	-7.7%
336	Transportation Equipment	\$20,324	\$64,753	12.3%	12.6%
	Total	\$756.3	\$1,352.2	6.0%	6.0%

(Source: Bureau of Labor Statistics, †denotes nondurable manufactured goods.)

2.3 Manufacturing Employment by Industry

Finally, we turn our attention to manufacturing employment in Table 2.4. Given the fast growth of firms in aerospace equipment manufacturing, over the past few years, it is not surprising that the broader transportation equipment industry leads in terms of longer-term employment growth trends. Computer and electronic product manufacturing, a similarly sized and rapidly growing industry grew at almost half the rate as transportation equipment in terms of employment.

Table 2.4: Employment in 2022

NAICS	Commodity	2022	Share 2022	2021-22 growth	Mean 2012-22 growth
336	Transportation Equipment	444	1,020	8.7%	8.8%
312†	Beverage and Tobacco	870	1,692	6.9%	7.2%
331	Primary Metal	141	231	5.1%	6.0%
334	Computer and Electronic	522	835	4.8%	4.9%
326†	Plastics and Rubber	354	549	4.5%	5.2%
325†	Chemical	784	1,102	3.5%	3.9%
333	Machinery	1,127	1,497	2.9%	3.1%
332	Fabricated Metal	2,136	2,773	2.6%	2.7%
339	Miscellaneous	1,629	2,093	2.5%	2.6%
316†	Leather and Allied	65	81	2.2%	2.8%
335	Electrical Equipment	151	187	2.2%	2.9%
324†	Petroleum and Coal	1,075	1,317	2.1%	2.1%
314†	Textile Product Mills	184	215	1.6%	1.8%
337	Furniture and Related	577	679	1.6%	1.8%
311†	Food	2,511	2,718	0.8%	0.8%
323†	Printing and Related Activities	919	992	0.8%	1.0%
327	Nonmetallic Mineral	1,221	1,264	0.3%	0.4%
321	Wood	2,610	2,673	0.2%	0.3%
313	Textile Mills	26	–	–	0.2%
315†	Apparel	–	36	–	8.1%
	Total	17,346	21,954	2.4%	2.4%

(Source: Bureau of Labor Statistics, †denotes nondurable manufactured goods.)

As discussed above, growth has been strong in the transportation equipment and computer and electronic product industries. The growth of these industries is in part due to the combined concerns of national security, decarbonization, the growth in smart factories, and artificial intelligence. These concerns have led to large public and private investments in domestic research, development and in these broad industries nationally and within Montana.

In 2022, fabricated metal products and food manufacturing both now employ more people in the state than the historically largest, wood products manufacturing. Wood products manufacturing employment increased just 63 employees since 2012, whereas fabricated metal and food manufacturing increased by 637 and 207 employees respectively.

The computer and electronics and transportation equipment sectors have seen earnings grow at rates nearly double that of overall manufacturing over the past decade.

2.4 Montana's Manufacturing Exports

After a burst of growth in the mid-2000s, the value of Montana exports has remained relatively stable since 2012. In 2022, Montana manufacturers exported \$1.2 billion worth of goods, a 1.7% increase from 2021 reflecting the return to health of the global economy since the pandemic recession. Montana manufacturing exports by industry are reported in Table 2.5, ranked by export value in constant 2022 dollars for the years 2020 to 2022, the share of total exports by sector, and the annual growth of exports for the years 2020 to 2021 and 2021 to 2022. Given the unique economic environment in 2020, growth from 2021 to 2022 represents a return to normal.

The largest export sector continues to be Chemicals (NAICS 325) in 2022, accounting for more than one-third of Montana exports, closely followed by Machinery (333), with an export value of \$247 million. Next was Transportation Equipment (336) accounting for about 12% of total exports after a substantial, 56%, increase in export in 2022. It's worth noting that the previously large export category, beverages and tobacco exports growth rates declined from 30% to 0.6% in 2022.

Table 2.5: Manufacturing exports by sector ranked, 2022 (millions of \$s)

Rank	NAICS	Industry	Share 2022	% Change 2022	% Change 2012-22	% Change 2021-22
1	325†	Chemical	\$361.36	30.3%	26.5%	-7.3%
2	333	Machinery	\$247.23	20.7%	49.6%	8.0%
3	336	Transportation Equipment	\$145.18	12.2%	-2.1%	55.2%
4	331	Primary Metal	\$65.94	5.5%	26.0%	42.8%
5	327	Nonmetallic Mineral	\$60.23	5.1%	17.9%	-11.7%
6	311†	Food	\$56.62	4.8%	-5.4%	-2.0%
7	312†	Beverage & Tobacco	\$43.75	3.7%	30.0%	0.6%
8	334	Computer & Electronic	\$38.83	3.3%	6.6%	-14.5%
9	321	Wood	\$37.68	3.2%	19.0%	-8.3%
10	339	Miscellaneous	\$36.36	3.1%	41.9%	-8.5%
11	324†	Petroleum & Coal	\$31.66	2.7%	34.6%	-36.2%
12	335	Electrical Equipment	\$30.83	2.6%	5.4%	-7.7%
13	332	Fabricated Metal	\$14.05	1.2%	20.8%	27.8%
14	326†	Plastics & Rubber	\$7.98	0.7%	21.4%	-7.4%
15	316†	Leather & Allied	\$6.67	0.6%	-10.0%	-18.3%
16	315†	Apparel	\$2.09	0.2%	12.9%	2.8%
17	337	Furniture & Related	\$2.08	0.2%	9.1%	34.8%
18	314	Textile Product Mills	\$0.96	0.1%	19.2%	-5.3%
19	313†	Textile Mills	\$0.90	0.1%	16.3%	44.8%
20	323†	Printing & Related Activities	\$0.64	0.1%	74.5%	-28.9%
21	322†	Paper	\$0.63	0.1%	20.7%	67.8%
		Total	\$1,191.68	100.0%	23.3%	1.7%

(Source: USATrade, US Census. †denotes nondurable manufactured goods.)

Table 2.6 reports the same statistics as Table 2.5 organized by the top 20 destinations of Montana manufacturing exports. These 20 countries account for about 90.4% of Montana exports. In 2022, Canada was the primary export market accounting for almost 30% of Montana exports. The next two export destinations, China and South Korea, have 12.8% and 6.2% shares respectively. After Canada, nine of the remaining 19 export destinations are in Europe, seven in Asia, two in Latin America, and Australia.

Table 2.6: Top 20 export markets, 2022 (millions of \$s)

Rank	Country	2022	Share Share 2022	% Change 2020-21	% Change 2021-22
1	Canada	\$312.23	26.2%	24.9%	-11.5%
2	China	\$152.02	12.8%	20.0%	36.5%
3	South Korea	\$75.72	6.4%	48.2%	-13.2%
4	Mexico	\$75.55	6.3%	41.9%	4.8%
5	Japan	\$60.32	5.1%	11.4%	3.3%
6	Taiwan	\$54.11	4.5%	26.2%	-3.2%
7	Switzerland	\$48.77	4.1%	-12.2%	1 570.5%
8	Belgium	\$47.78	4.0%	25.0%	-28.9%
9	United Kingdom	\$37.91	3.2%	9.1%	8.1%
10	Singapore	\$32.52	2.7%	101.6%	-12.0%
11	France	\$31.27	2.6%	30.2%	34.2%
12	Germany	\$25.53	2.1%	-7.9%	10.0%
13	Netherlands	\$24.75	2.1%	50.2%	-11.4%
14	Australia	\$19.44	1.6%	30.0%	7.3%
15	Malaysia	\$14.93	1.3%	15.2%	1.8%
16	Denmark	\$11.94	1.0%	76.3%	26.5%
17	Sweden	\$11.25	0.9%	147.0%	-47.0%
18	Chile	\$9.92	0.8%	-27.2%	28.6%
19	Vietnam	\$9.81	0.8%	210.4%	21.9%
20	Norway	\$9.72	0.8%	95.2%	-12.8%
	Rest of World	\$126.19	10.6%	-9.3%	-0.4%

(Source: USATrade, US Census. Rest of World includes *all* other countries.)

3 Montana Manufacturers Survey

Montana's manufacturing industry is comprised of small- to medium-sized firms producing everything from wood products to aerospace parts. The Bureau of Business and Economic Research surveys manufacturers each year to gain insight into the previous year and inquire about their expectations for the upcoming year. Responses to the survey fell to about 143, a decrease of about 18%, in 2023, with a majority of respondents being in the durable manufacturing sector. Montana manufacturers were queried about a number of indicators covering a range of topics, including: financial, workforce, capital investment and major challenges. The results of the survey have been divided into durable and non-durable manufacturers to gauge what challenges and the environment in each of the manufacturing sub-sectors. Surveys were completed in early September 2023 and therefore offer a glimpse into the economic recovery following COVID-19 and continuing conflict between Russia and Ukraine.

3.1 Year in Review

Montana manufacturers were asked to report on their plant's performance in 2022. Montana manufacturers characterized the period as steady. As the table shows, less than half of the companies indicated that they had a better year relative to 2021 across all measures. Durable good manufacturers reported a relatively better year than non-durable manufacturers in terms of profits but not in terms of sales and production.

Questions 1–3 asked manufacturers to compare their performance in 2022 against that of 2021, as presented in Table 3.1. The findings suggest that only 26% of firms witnessed a decline in sales, yet a larger proportion, 36%, reported decreased profits. This percentage is also slightly higher than the corresponding data from 2021, underlining the enduring issue of high production input costs.

In 2022, 67% of durable goods manufacturers reported the same or better profits compared to last year. For nondurable manufacturers just 58% reported the same or better.

Generally speaking, economies at the local, national, and international levels are gradually reverting to the conditions that existed before the COVID-19 pandemic. However, as indicated in Figure 2.3(b), the manufacturing sector in Montana has not fully regained its pre-pandemic stability. Consequently, the survey data from 2022 reveal considerable variations in the pace of recovery, differing significantly from the more optimistic trends observed in last year's survey.

Questions 1–3 asked how Montana manufacturers fared in 2022 relative to 2021 (Table 3.1). Overall, we can see that in 2022 roughly 48% of producers saw an increase in their sales and production compared to 2021. Profits fell off a bit with 33% of durable and 42% of nondurable manufacturers reporting lower profits relative to 2021.

In 2022, about 43% of firms made new major capital investment (Table 3.2), down from 48% a year ago. A majority of this change is reflected in nondurable manufacturing. A year ago,

Table 3.1: Survey questions: Sales, production and profit.

*For calendar year 2022, did your plant's **GROSS SALES** increase, stay about the same, or decrease from 2021?*

	Durable	Nondurable	Overall
Increase	43.3%	54.7%	47.6%
Stay about the same	30.0%	20.8%	26.6%
Decrease	26.7%	24.5%	25.9%
Count	90	53	143

*For calendar year 2022, did your plant's **PRODUCTION** increase, stay about the same, or decrease from 2021?*

	Durable	Nondurable	Overall
Increase	38.9%	43.4%	40.6%
Stay about the same	31.1%	28.3%	30.1%
Decrease	30.0%	28.3%	29.4%
Count	90	53	143

*For calendar year 2022, did your plant's **PROFITS** increase, stay about the same, or decrease from 2021?*

	Durable	Nondurable	Overall
Increase	37.8%	30.2%	35.0%
Stay about the same	28.9%	28.3%	28.7%
Decrease	33.3%	41.5%	36.4%
Count	90	53	143

55% of the firms in the nondurable sector made significant increases in their capital expenditures. This year, that proportion fell to 42%. The decrease in capital investment was not seen in durable manufacturing with 43% responding yes. Production capacity remained at 2021 levels for most of the state's manufacturers. Fully 96% of respondents reported that no production capacity was eliminated during the year.

A year ago, 55% of the firms in the nondurable sector made significant increases to their capital expenditures. This year that proportion fell to 42%.

3.2 Employment

Employment for Montana's manufacturers was positive given the state of the economy (Table 3.3). Roughly two-thirds of firms reported the number of workers stayed about the same as 2021, although fewer firms reported either an increase or decrease in the number of workers. Similar to last year, less than half of firms recorded a worker shortage in 2022, 49% of nondurable employers had difficulty finding employees.

Table 3.2: Survey questions: Investment and Product Lines

In calendar year 2022, did your plant make any major capital expenditure in facilities or equipment during the year?

	Durable	Nondurable	Overall
Yes	43.3%	41.5%	42.7%
No	56.7%	58.5%	57.3%
Count	90	53	143

5. In calendar year 2022, did your plant introduce any new product lines?

	Durable	Nondurable	Overall
Yes	3.3%	5.7%	4.2%
No	96.7%	94.3%	95.8%
Count	90	53	143

Table 3.3: Survey questions: Employment

Over calendar year 2022, did your plant's number of employees ...?

	Durable	Nondurable	Overall
Increase	15.6%	17.0%	16.1%
Stay about the same	67.8%	64.2%	66.4%
Decrease	16.7%	18.9%	17.5%
Total	90	53	143

Did your plant have a significant shortage of workers at any time during 2022?

	Durable	Nondurable	Overall
Yes	41.6%	49.1%	44.4%
No	58.4%	50.9%	55.6%
Total	90	53	143

3.3 Ongoing Challenges

As previously mentioned, the conclusion of the COVID-19 health crisis this year, coupled with the ongoing geopolitical tensions in Ukraine, continues to affect the worldwide availability of some commodities and contribute to escalating costs in oil, energy, and transportation. According to Table 3.4, a growing number of Montana-based manufacturers are adopting a more optimistic outlook despite these challenging economic conditions. Specifically, 32% expect improvements in their supply chains in 2023, a notable increase from the 8% who felt the same way last year. However, it's worth mentioning that the road to recovery still seems uncertain, as 68% of manufacturers anticipate that supply chain issues will either remain unchanged or deteriorate compared to last year.

In light of the economic disruptions, the 2022 BBER manufacturing survey included queries aimed at understanding the challenges facing Montana's manufacturing sector. According to the findings, manufacturers within the state did experience some disruptions, though they

Table 3.4: Survey questions: Supply chain

What do you anticipate will happen with your plant's supply chain in 2022?

	Durable	Nondurable	Overall
Get worse	11.5%	13.5%	12.2%
Stay about the same	56.3%	55.8%	56.1%
Will improve	32.2%	30.8%	31.7%

were not as severe as one might have anticipated. The responses to the open-ended question, "What were the major issues that impacted your facility in 2022?" have been quantified and are presented in Table 3.5.

Roughly 47.2% of nondurable manufacturers reported having difficulty finding workers compared to 35.6% of durable firms.

In summary, the primary challenges confronting manufacturers are mostly related to inputs: labor market difficulties, high costs of raw materials, supply chain complications, and increasing expenses for transportation and fuel, along with inflation.

When scrutinizing the disparities between manufacturers of durable and nondurable goods, it's clear that various challenges disproportionately affect the two sectors. Generally, nondurable manufacturers report higher frequencies of challenges across nearly all categories. For instance, about 47% of nondurable manufacturers cite difficulties in finding employees, compared to around 36% of those in the durable goods sector. The one area where durable manufacturers reported at higher rates was the issue of rising operational costs due to inflation.

Table 3.5: Major issues that affected individual manufacturing plants: % responding yes

Issue	Durable	Nondurable
Inability to find employees	35.6%	47.2%
Availability or cost of raw materials	31.1%	37.7%
Transport problems fuel cost, shipping	5.6%	11.2%
Inflation increased operational costs	10.0%	5.7%
Decreased demand	3.3%	9.4%
Internal issues or issues unrelated to business	3.3%	5.7%
Increased demand	1.1%	3.8%
Unclassifiable	1.1%	3.8%
Government restrictions, general government	0%	0%

3.4 How will 2023 turn out?

The concluding section of the survey sought manufacturers' forecasts for the coming year, as presented in Table 3.6. The prevailing sentiment among respondents is that the upcoming year is likely to resemble the past year in many aspects. One significant divergence lies in the expectations around the cost of major inputs; notably, about 46% of durable manufacturers predict a rise in these costs.

Given the high interest rates at the time of the survey, it's not surprising that manufacturers generally do not foresee making significant investments in capital expenditures, facilities, or equipment in 2023.

Additionally, the issue of human resources and employment is expected to continue being a challenge. A mere 15% of manufacturers believe that this will not be a problem in 2023. Overall, the outlook for the manufacturing sector appears to be one of cautious stability, with some exceptions such as rising input costs and ongoing workforce challenges.

Table 3.6: In 2023 do you anticipate ...*...the number of employees in your plant to?*

	Durable	Nondurable	Overall
Increase	21.3%	15.4%	19.1%
Stay about the same	66.3%	65.4%	66.0%
Decrease	12.4%	19.2%	14.9%
Total	90	53	143

...major capital investment expenditures?

	Durable	Nondurable	Overall
Yes	31.5%	45.1%	36.4%
No	68.5%	54.9%	63.6%
Total	90	53	143

...the cost of your plant's major inputs to?

	Durable	Nondurable	Overall
Increase	46.0%	15.4%	19.1%
Stay about the same	42.5%	37.3%	40.6%
Decrease	11.5%	5.9%	9.4%
Total	90	53	143

...the human resources/employment challenges you will face?

	Durable	Nondurable	Overall
Recruitment	39.1%	38.5%	38.8%
Retention	2.3%	11.5%	5.8%
Recruitment and retention	39.1%	42.3%	40.3%
Neither will be a challenge	19.5%	7.7%	15.1%
Total	90	53	143

4 The Montana Manufacturing Extension Center

The Montana Manufacturing Extension Center (MMEC) is a statewide manufacturing outreach and assistance center staffed by full-time professionals with extensive experience in manufacturing and business in a variety of industries. MMEC's mission is to grow Montana's economy by helping manufacturers succeed.

MMEC serves the manufacturers of Montana by helping them assess and improve their manufacturing operations, providing trainings and workforce development, and leveraging research and technological developments to keep manufacturing competitive in the state.



MMEC Business Advisers hold workshops to help manufacturers improve their operations.

Established in 1996, MMEC is housed in the Norm Asbjornson College of Engineering at Montana State University in Bozeman, with remote offices in Billings, Missoula, Kalispell, Great Falls, Butte and Sidney. The Center's staff has a combined experience of hundreds of years in manufacturing and offers expertise on a broad range of topics.

MMEC is also part of the National Institute of Standards and Technology's Manufacturing Extension Partnership (MEP) National Network. NIST is a non-regulatory agency of the U.S. Department of Commerce that promotes U.S. innovation and industrial competitiveness. The MEP National Network is a unique public-private partnership with centers in all 50 states and Puerto Rico dedicated to serving only small and medium-sized manufacturers, who pay fees for services provided.

Since 2000, MMEC’s clients have reported project impacts to their businesses through an independent third-party survey. Results of these surveys show that MMEC has strengthened Montana’s manufacturing economy between 2000 and 2022 by generating:

\$375.7 million	<i>new investment</i>
\$1.5 billion	<i>new and retained sales</i>
7,245	<i>new and retained jobs</i>
188.5 million	<i>cost savings</i>

The MMEC evaluation process follows guidelines developed by the National Institute of Standards and Technology (NIST) as part of its management information reporting procedures. NIST specifies the timing of the evaluation and provides a standardized questionnaire distributed to manufacturing firms served by MMEC. The analysis of the surveys and a written report are provided by an independent analyst.

Manufacturing clients are asked to evaluate the effectiveness of MMEC and to quantify the economic impact of MMEC’s activities on their business and its effects on the Montana economy. Clients are surveyed six months after a project is complete and asked about their satisfaction with the services they received. These respondents are also asked to quantify certain economic impacts and outcomes associated with the MMEC project. MMEC sent the independent analyst preparing this report the questionnaires for the 2022 evaluation period. There were 99 responses in the 2022 evaluation. These responses provided the largest sample size since the evaluations began, eclipsing the 90 responses in 2021.

4.1 Overall Satisfaction

Manufacturing clients said they relied on MMEC and were very satisfied with the services received. In 2022, about 33% percent of the respondents said they relied on external services (Table 4.1), roughly the same as in from 2021 when 34% of respondents relied on external services.

Table 4.1: Have you used any external providers for business performance services?

	Frequency	Percent
Yes	33	33.3%
No	66	66.7%

Montana manufacturers were asked if they would recommend MMEC to other potential clients. They were asked to rate the likelihood of a positive recommendation with one being the least likely and 10 being the most likely. As shown in Table 4.2, about 94% of 2022 respondents chose a score between 8-10. Five did not respond to this question. The net promoter score, which is the percent of respondents choosing nine or 10 minus the percent of respondents with scores of six or below is 90.9, up from 2021.

Table 4.2: Would You Recommend To Other Companies (Scale 0 – 10)

Score	Frequency	Percent	Cumulative
NA	5	5.1%	5.1%
3	1	1.0%	6.1%
8	2	2.0%	8.1%
9	5	5.1%	13.1%
10	86	86.9%	100.0%
	99	100.0%	

Client Comments

The NIST questionnaire provides a number of opportunities for Montana manufacturers to provide suggestions and comments to MMEC. These responses were edited slightly to preserve anonymity and grouped by topic. These comments provide insight into the many ways manufacturers are benefited by MMEC services. The vast majority of the comments are highly positive and detailed. As in the past, respondents made several specific suggestions concerning ways in which MMEC may further tailor its services in the future.

Professionalism and Relevance

- Fantastic and well run organization. MMEC is a huge help to Montana Manufacturing.
- The partnership with the Center is energized thanks to our trust in [MMEC employee] and his willingness to help [Company] work to become a manufacturer of excellence. Our teams have grown skillsets, improved culture, reduced costs, and retained sales. I'm very grateful for the Center and know it made a tremendous impact on [Company].
- [MMEC employee] is extremely knowledgeable and does a great job breaking down complex business concepts and transferring this knowledge to all levels within the organization. Whether it be front line workers or C-level executives [MMEC employee] is an invaluable asset for any organization that is looking to improve their overall performance.
- It was a good experience and would certainly do it all over again. Thanks for all the great advice and look forward to working with you all and will share with others of how great of an experience was had.
- MMEC offers incredible resources for improving operations and we are much better off as a result of their help. We will continue to work with them as much as possible.
- As a new manufacturer [MMEC employee] met me at the level that I was at and helped guide me to become a higher performing manufacturer. I am more cognizant of work flow/work processes which help me better plan product development and growth. I appreciated the level of respect [MMEC employee] consistently showed me through this initial start up phase.
- I prefer to work with local resources so I was excited to learn of your services. I would suggest finding a way to be more visible/available. I learned of this service from a rep that stopped at our booth at a trade show.

Suggestions for MMEC

- Continue to proactively share information and/or upcoming opportunity and services. It helps to keep me ahead of the competition in knowledge and business activity.
- As always we really appreciate your help this year. Topics that will be particularly important for us next year include cybersecurity compliance management market research and business development and efficiency improvements in an engineer-to-order business. There are so few resources for ETO companies so anything you could provide to help us sell and operate better would be beneficial.
- additional growth in participation/services for workforce development in conjunction with the University of Montana for stackable credentials etc. Pay [MMEC employee] more
- adding an additional [Montana city] business advisor to the team would benefit the local MMEC in our area.

4.2 Why Choose MMEC

The NIST questionnaire provided eight factors for choosing MMEC and the respondents were asked to identify the two most important. The responses are reported in Table 4.3, with responses from 2019 – 2021 for comparison. Staff expertise remains the primary reason respondents choose to use MMEC, up about 7 percentage points to 71% from last year.

The second most important factor for firms choosing MMEC was fair and unbiased advice, with 29%, up from third and higher from the previous two years. Reputation for results claims the third position, with 23% responding positively. MMEC's costs with about 22% of the respondents mentioning this factor is now the fourth most important factor. Also slightly down is knowledge of the respondent's industry. Up in 2022 are the responses to specific knowledge, down to 15%. Only 2% responded that they used MMEC because no other nearby providers were available.

Table 4.3: Important factors for your firm choosing MMEC

Factor	2019	2020	2021	2022
Center staff expertise	69.8%	67.6%	63.3%	70.7%
Fair and unbiased advice services	25.4%	25.0%	25.6%	29.3%
Reputation for results	17.5%	22.1%	22.2%	23.2%
Cost price of services	36.5%	33.8%	28.9%	22.2%
Knowledge of your industry	11.1%	19.1%	20.0%	18.2%
Specific services not available from other providers	7.9%	20.6%	13.3%	15.2%
Other	11.1%	4.4%	6.7%	6.1%
Lack of other providers nearby	9.5%	5.9%	4.0%	2.0%

4.3 Future Challenges

The NIST questionnaire provided two opportunities for the respondents to identify future challenges they may face. The first opportunity instructed the respondents to pick three of nine categories of potential future challenges and the second was an open-ended question. Given the unique circumstances surrounding the COVID pandemic throughout this section, as before the report includes responses in 2019 – 2021 as well.

As shown in Table 4.4 in descending order of 2022 responses, the most often mentioned future challenges were employee recruitment and retention (56%) – similar to those found at the national level discussed above. This reflects an overall tightening of the labor market, and edges out ongoing continuous improvement/cost reduction strategies (56%), which had been the greatest challenge for the years 2019–2021. Identifying growth opportunities is the third most frequently mentioned challenge, down slightly from last year. Issues surrounding supply chains are reflected in the responses to concerns surrounding managing partners and suppliers, up 7% from 2021. Sustainability is the last challenge with over 20% of respondents agreeing with this statement. The least mentioned were exporting/global engagement, but more of a concern compared to last year, rose to 7%. Technology needs (10%) and financing as a challenge is up to 12% in 2022 – this is likely the response to tightening interest rates as the Fed has been fighting inflation.

Table 4.4: Important future challenges facing your business

Factor	2019	2020	2021	2022
Employee Recruitment and Retention	46.0%	54.4%	60.0%	58.6%
Ongoing Continuous Improvement/Cost Reduction Strategies	71.4%	70.6%	61.1%	55.6%
Identifying Growth Opportunities	36.5%	45.6%	44.4%	42.4%
Product Innovation/Development	42.9%	45.6%	27.8%	33.3%
Managing partners and suppliers	20.6%	16.2%	24.4%	31.3%
Sustainability in products and processes	20.6%	14.7%	21.1%	20.2%
Financing	11.1%	17.6%	11.1%	12.1%
Technology Needs	12.7%	10.3%	7.8%	10.1%
Exporting/Global Engagement	12.7%	7.4%	5.6%	7.1%

4.4 Quantitative Estimates of MMEC Visit Outcomes

The NIST survey asked Montana manufacturers to quantify outcomes of their MMEC services. They were asked the number of new and retained jobs, the amounts of cost savings, new and retained sales, capital and workforce investments and avoided unnecessary investments during the previous 12 months. Starting in 2009, the respondents were queried further about four detailed investment categories.

Table 4.5 shows the results for the 2022 responses to the quantitative outcomes. There was a slight decline in outcomes in the 2022 survey over several categories – despite the 10% increase in the number of survey participants. The 2022 respondents said that there were 367 new or retained jobs as a result of working with MMEC. New and retained sales were about \$73.5 million. Cost savings totaled approximately \$5.8 million. Capital and workforce investments were roughly \$4.9 million down. On the other hand, avoided unnecessary investment increased about 45% to \$4.8 million. The final column totals all the survey responses from 2013 to 2022.

4.5 Economic Impacts of MMEC Visits and Services

MMEC clients were queried about the number of new jobs created and the number of jobs retained as a result of working with MMEC. The 2022 respondents reported 115 new jobs created and 252 job retained for a total of 367 jobs.

The preliminary data suggest that average wages for Montana manufacturing jobs were about \$57,179 in 2022 – compared to the state average income of \$50,752. Total wages associated with the new and retained jobs were approximately \$20.1 million. Using an average tax rate of 4.95%, the new and retained workers paid approximately \$1.04 million in Montana individual income taxes.

The Montana Department of Labor and Industry estimates that the employment multiplier of manufacturing is 3.58. This suggests that about 2.58 new jobs will be created in other sectors as a result of one new manufacturing job. This agency also reports that the wage multiplier is 2.72, implying that an additional \$1.72 in wages is created elsewhere in the Montana economy for each \$1 in new manufacturing wages.

Table 4.5: Total sales, costs, investments and jobs earned or saved in 2022

	2020	2021	2022	Total: 2013-2021
Total jobs saved/retained	310	479	367	4,309
Retain jobs amount	234	269	115	-
Create jobs amount	76	210	252	-
Total sales increased/retained	\$55,245,202	\$74,502,332	\$73,503,080	\$724,250,927
Increase sales amount	\$20,783,401	\$39,056,836	\$37,059,140	-
Retain sales amount	\$34,461,801	\$35,445,496	\$36,443,940	-
Total Investment	\$14,060,502	\$21,534,252	\$17,266,674	\$216,074,735
New products	\$4,226,000	\$2,734,879	\$2,530,417	\$17,120,753
Human capital	\$842,484	\$1,380,794	\$792,749	\$8,456,727
Plant or equipment	\$4,008,760	\$9,823,817	\$11,712,765	\$75,520,114
Information systems/software	\$637,971	\$725,420	\$652,803	\$6,390,902
Other areas	\$4,345,287	\$6,869,342	\$1,577,940	\$108,586,239
Avoid unnecessary investment	\$2,355,038	\$3,290,337	\$4,778,000	\$13,921,382
Cost savings amount	\$10,297,945	\$8,496,615	\$5,847,830	\$77,284,001

Calculations based on employment and wage multipliers are reported in Table 4.6. The 367 new and retained jobs associated with MMEC services reported in 2022 led to a total of 1,681 new jobs in Montana and approximately \$78.1 million in statewide wages. The additional wages generated roughly \$3.8 million in Montana individual income tax revenue.

Table 4.6: Economic impacts of MMEC services, 2022

Sector	Jobs	Wages	Montana individual income taxes
Manufacturing	367	\$20,984,693	\$1,038,742
Other industries	1,314	\$57,078,365	\$2,825,379
Total	1,681	\$78,063,058	\$3,864,121

4.6 Return on Investment and Fees

MMEC is a public-private partnership that was awarded \$764,900 in 2022 from the National Institute of Standards and Technology with a match requirement. In 2022, MMEC matched the federal funds with \$500,000 from the state of Montana and \$628,937 in project fees that were charged to Montana manufacturers who requested MMEC services. The benefits of these investments may be estimated by calculating a return on investment (ROI) for each.

The ROI for the state of Montana is calculated by comparing the estimated increase in Montana individual income tax payments associated with the reported jobs created or saved due to working with MMEC. The ROI for MMEC clients is estimated by comparing the cost savings, plus avoided unnecessary investment, plus a portion of the increased sales to the amount paid by clients.

In 2022

- MMEC’s ROI to the Montana taxpayer was **7.7 to 1**.
- ROI for private firms was **30.3 to 1**

As shown in Table 4.6, MMEC projects generated approximately \$3.8 million in Montana individual income taxes from both direct and indirect jobs. Based on \$500,000 calendar year funding for MMEC, Montana’s return on investment during 2022 was approximately 7.7 to 1.0, a considerable rate of return for Montana taxpayers.

As presented in Table 4.5, MMEC clients reported \$5,847,830 in costs savings, \$4,778,000 in avoided unnecessary investments and \$73,503,080 in new or retained sales. Assuming a modest 10% gross margin, the net gain to clients of the new or retained sales was \$8,412,891.

Cost savings + avoided investments + gross margin associated with new and retained sales equals \$19,038,721. Based on the \$628,937 in fees paid by MMEC clients, their return on investment in 2022 was approximately 30.3 to 1.0. This is a considerable ROI, however it comes with the caveat that 2022 continues to be a unique year. It should be noted in the years prior to 2020 the adjusted cost savings was used in the ROI calculations, whereas this year the actual data is being used.