

Economic Impact of Changes in Passenger Air Service at Houghton County Memorial Airport

AUGUST 2022

Authored by:

Laura Connolly
Jenny Apriesnig
Emanuel Oliveira



Michigan
Technological
University



Table of Contents

Executive Summary	1
Purpose of Report.....	1
Overview of Methodology	1
Summary of Findings	1
Disclosure of Future Projections.....	1
Economic Overview: Houghton County.....	2
Houghton County Memorial Airport	4
Economic Impact of Changes in Passenger Air Service	6
Methodology.....	7
Scenarios.....	8
Forecasted Results.....	10
Benchmark.....	10
Output	11
Employment	12
Population	14
Rest of the Upper Peninsula.....	15
Conclusion.....	16
References	18
Appendix	19

List of Tables

Table 1. Top 10 Industries for Employment, 2020.....	3
Table 2. Top 10 Industries for Output, 2020.....	4
Table 3. Scenario Assumptions.....	9
Table 4. Average Benchmark Values, 2015-2037	10
Table A1. High-Tech Companies Alternative Forecast and Shocks	19
Table A2. State and Local Government Alternative Forecast and Shocks..	20
Table A3. Benchmark Values	21
Table A4. Forecasted Changes for Houghton County	22
Table A5. Forecasted Changes for the Rest of U.P.....	23

List of Figures

Figure 1. CMX Enplanements, 2006-2021	6
Figure 2. Change in Output Across Scenarios	11
Figure 3. Average Annual Change in Output by Sector	12
Figure 4. Change in Employment Across Scenarios	13
Figure 5. Average Annual Change in Employment by Sector.....	14
Figure 6. Change in Population Across Scenarios	15

Executive Summary

Purpose of Report

Michigan Technological University (MTU) retained Drs. Connolly, Apriesnig, and Oliveira to determine the economic impact of potential changes in passenger air service at Houghton County Memorial Airport (CMX). We provide a brief overview of Houghton County's economy and Houghton County Memorial Airport and estimate the economic impact of changes in passenger air service at CMX, accounting for direct and indirect impacts to Houghton County.

Overview of Methodology

We used REMI PI+ (version 2.5) to evaluate the economic impact of changes in passenger air service at CMX on Houghton County for the 15-year period (2023-2037) following the end of SkyWest's current service contract. We evaluated three scenarios to model:

1. Elimination of passenger air service at CMX;
2. A 50% reduction of passenger air service at CMX; and
3. A 25% enhancement of passenger air service at CMX.

The three scenarios vary in the magnitude of output shocks across the industries most likely to be impacted by changes at CMX. Scenario assumptions are based on conversations with local business and economic development leaders and economic data for Houghton County.

Summary of Findings

The elimination or reduction in passenger air service at CMX hinder Houghton County's future economic growth, while enhanced air service boosts economic growth. The changes are modest in size initially, less than 1% in 2023, but grow in magnitude over the 15-year period across all scenarios. In 2037, relative to future benchmark forecasts, no air service decreases output by \$145 million (-5.5%), employment by 900 (-5.1%), and population by nearly 1,000 (-2.5%); a 50% reduction in service decreases output by \$75 million (-2.8%), employment by 465 (-2.6%), and population by 525 (-1.3%); the enhancement of air service increases output by \$205 million (7.7%), employment by 1,200 (6.8%) and population by 1,450 (3.7%). Given Houghton County's distance from major modes of transportation, 200+ miles to the closest medium or large hub airport, train station, or interstate highway, the county's economic growth trajectory is heavily dependent on access to high-quality passenger air service at CMX.

Disclosure of Future Projections

This report projects future economic conditions. All future projections and forward-looking statements are inherently subject to risk and uncertainties. These risks and uncertainties may lead the actual results to differ from the projected results in this report.

Economic Overview: Houghton County

Houghton County Memorial Airport (CMX) is located in Houghton County in Michigan’s Upper Peninsula (U.P.). Changes in passenger air service at CMX are likely to impact the local economy in many ways, particularly business development and economic growth. We first provide a brief overview of Houghton County’s economy, then turn to the airport specifically.

The 2020 Decennial Census estimates the county’s population at over 37,000 (U.S. Census Bureau, 2022), making it the second most populous county in the U.P. (out of 15 counties). The county’s gross domestic product, a measure of the size of the economy, was over one billion dollars in 2020, making up nearly 10.5% of the U.P.’s overall economy (REMI , 2022). Further, Houghton County was the only U.P. county to experience population growth from 2010 to 2020 (Broadway & Broadway, 2021). This population growth is partially attributed to the county’s ability to attract and retain young workers via high-quality employment, which is essential for economic growth (Broadway & Broadway, 2021). In 2020, over 35% of the county’s adult population, those age 18 and up, was between ages 18 and 30, which translates to nearly 45% of the adult working-age population, those ages 18-65 (Broadway & Broadway, 2021).

“What explains Houghton’s younger age profile? The drawing power of Michigan Tech University, whose excellence in STEM attracts students and faculty from abroad.”

--- Broadway & Broadway (2021)

The Michigan Tech Enterprise Corporation (MTEC) SmartZone and Michigan Technological University (MTU) are both key contributors to the county’s success in talent attraction and retention (Broadway & Broadway, 2021). The MTEC SmartZone was founded in 2003 to help attract new high-tech businesses to the area and expand operations for existing businesses. Over 800 high-tech jobs in the area are attributed to the MTEC SmartZone (TV6 News Team, 2021). The SmartZone is also directly linked with MTU, a four-year public research institution that focuses on STEM education (Science, Technology, Engineering, and Mathematics). The SmartZone facilitates the commercialization of technology from university research and the university is a consistent source of skilled workers for the local economy.

The county’s total employment in 2020 was approximately 16,000 (REMI , 2022). Table 1 lists the top 10 industries of employment for Houghton County. The largest industry of employment is state and local government, which includes employment at MTU. The

Table 1. Top 10 Industries for Employment, 2020

<i>Industries</i>	<i>Emp</i>
<i>State and Local Government</i>	3,468
<i>Retail Trade</i>	1,897
<i>Food Services and Drinking Places</i>	1,177
<i>Construction</i>	985
<i>Hospitals; Private</i>	794
<i>Religious Organizations; Grantmaking & Giving Services; Social Advocacy Orgs</i>	632
<i>Architectural, Engineering, and Related Services</i>	515
<i>Individual & Family Services; Community & Vocational Rehabilitation Services</i>	509
<i>Real Estate</i>	473
<i>Monetary Authorities, Credit Intermediation, and Related Activities</i>	413

Source: REMI Projections for 2020.

university is the largest employer in the county, employing over 1,500 individuals in 2020 (Michigan Technological University, 2022). The second and third largest industries, retail trade and food services and drinking places, reflect the importance of tourism to the local economy. From snow skiing and snowmobiling to mountain biking and kayaking, the county is a year-round destination for tourists. The top five industries of employment also include construction and hospitals. The prominence of technology companies in the area is also reflected in the list via architectural, engineering, and related services, which ranks 7th.

The county’s total output in 2020 was nearly \$2 billion (REMI, 2022). Table 2 lists the top 10 industries for output in 2020. Although the order differs some, the list of industries is similar to those for employment. State and local government is again the top industry for output, making up nearly 23% of the county’s total output, followed by real estate, retail trade, hospitals (private), and construction. The prominence of high-tech companies and tourism in the area are also reflected in the list via agriculture, construction, and mining machinery manufacturing; architectural, engineering, and related services; and food services and drinking places.

Although the county’s history is heavily rooted in copper mining, which continues to influence the area today, the local economy has diversified over time. Houghton County is home to over 800 business establishments (U.S. Census Bureau, 2022). Prominent employers include:

- Michigan Technological University
- Finlandia University
- UP Health System Portage
- Aspirus Keweenaw Hospital
- Walmart
- Superior National Bank
- Midwest Loan Services
- Calumet Electronics Corporation
- Somero Enterprises Inc.
- Northern Hardwoods
- GS Engineering Inc.
- ThermoAnalytics

Table 2. Top 10 Industries for Output, 2020

	Industries	Emp
	<i>State and Local Government</i>	3,468
	<i>Real Estate</i>	1,897
	<i>Retail Trade</i>	1,177
	<i>Hospitals; Private</i>	985
	<i>Construction</i>	794
	<i>Agriculture, Construction, and Mining Machinery Manufacturing</i>	632
	<i>Architectural, Engineering, and Related Services</i>	515
	<i>Food Services and Drinking Places</i>	509
	<i>Offices of Health Practitioners</i>	473
	<i>Wholesale Trade</i>	413

Source: REMI Projections for 2020.

The county’s economic diversification, growth, and more recent emphasis on high-tech companies and entrepreneurship efforts have been successful, in part, due to access to first-tier air service. Local businesses and universities noted their reliance on CMX to fly in potential customers, fly to customers and business engagements, and attract and retain workers and students, which all drive economic growth and development.

Houghton County Memorial Airport

Houghton County Memorial Airport (CMX), owned and operated by Houghton County, is located 4 miles north of Houghton/Hancock, MI and 7 miles south of Calumet, MI. CMX provides service for commercial passenger air service, general aviation, and air cargo transport as well as rental car services. The Houghton/Keweenaw County Veteran’s Affairs Office is also located in the main terminal of the airport. CMX largely services passengers from Houghton, Keweenaw, Baraga, and Ontonagon Counties. “The airport serves as the gateway to the Keweenaw providing reliable service, capable of meeting needs of the community, while providing a foundation for economic development and future expansion” (Houghton County, 2022).

SkyWest Airlines, in partnership with United Airlines, has provided passenger air service to the airport for the last 12 years with direct flights to Chicago O’Hare (ORD). CMX is an Essential Air Service (EAS) airport, a federal program through the U.S. Department of Transportation (DOT) that connects small communities to large or medium hub airports to ensure access to the national air transportation system (U.S. Department of Transportation, 2022). SkyWest’s most recent EAS contract with the DOT for service at CMX was issued on February 3, 2020 and expires on January 31, 2023. Per the contract, SkyWest receives an annual subsidy of \$2,204,520 and must provide 14 round trips per week (U.S. Department of Transportation, 2020). SkyWest notified the DOT in March 2022 of their intent to end service at CMX, and 28 other cities, due to a pilot shortage (Wolfstellar, 2022).

“The region is particularly dependent on commercial scheduled air service and vulnerable to a loss of that service. Given the limited transportation modes available, passenger air service in Michigan’s Upper Peninsula assumes even greater importance as the means to maintain the region’s connection to the nation.”

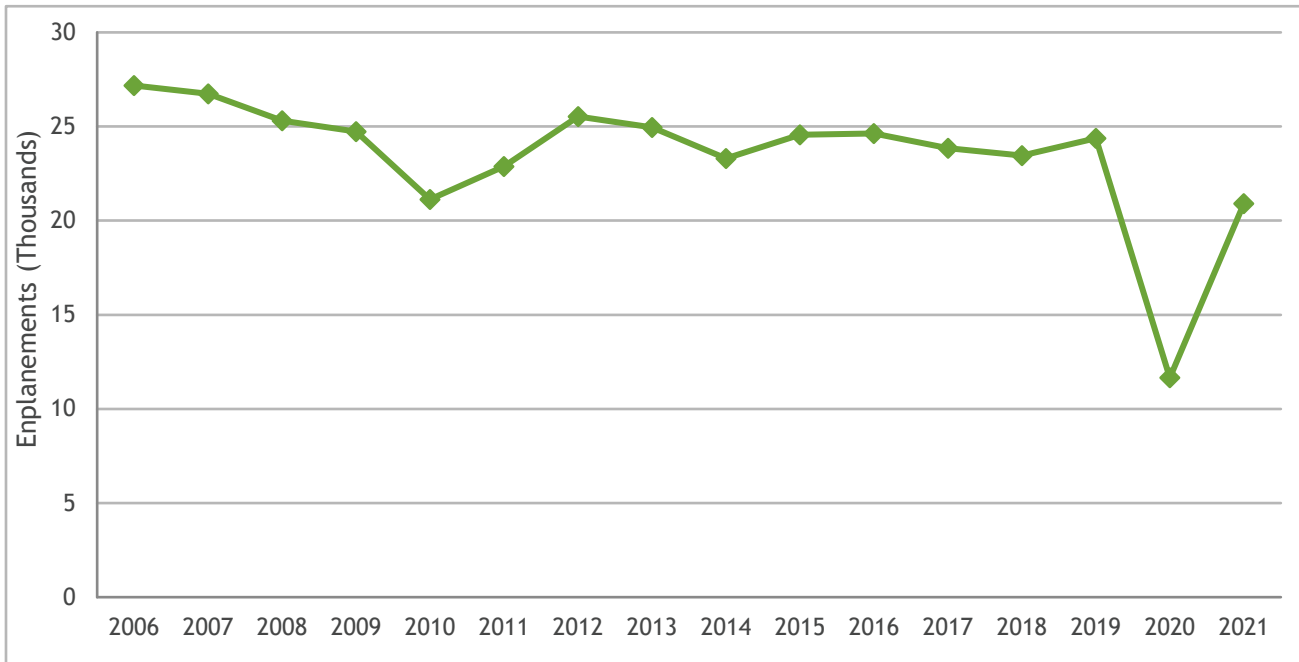
--- Kotler (2012)

In order to be eligible for the EAS program, an airport within the contiguous US must be at least 70 miles from a large or medium hub airport, among other requirements. Of the five U.P. commercial passenger airports, CMX is the farthest from the closest medium or large hub airport, passenger rail service, and interstate highway (Kotler, 2012). CMX is over 300 miles from the closest large or medium hub airport (Milwaukee, WI), does not have direct access to passenger rail service (the closest Amtrak Station to CMX is also in Milwaukee), and is over 200 miles from the closest interstate highway, I-43 in Green Bay, WI. Houghton County’s distance to the three major transportation modes is high, and well above the national average for comparative communities, those with populations between 10,000-500,000 and at least 90 miles from a medium or large hub airport (Kotler, 2012). This makes the county particularly reliant on commercial passenger air service and vulnerable to a loss or reduction in air service (Kotler, 2012).

Figure 1 presents enplanement data, passenger boarding numbers, for years 2006-2021. From 2006-2021, average annual enplanements at CMX were approximately 23,500. This includes the expected drop off for 2020 from the COVID-19 pandemic. If 2020 is excluded, the annual average increases slightly to 24,200. With the exception of the pandemic, enplanements have been relatively stable since SkyWest began service at CMX in 2012. Enplanements declined to under 12,000 in 2020, and recovered to 86% of 2019 levels in 2021, reaching almost 21,000. Since 2018, CMX consistently ranks second among U.P. airports for enplanements, behind Sawyer International Airport (MQT) outside of Marquette, MI.

SkyWest’s passenger air service at CMX is associated with 12 jobs: one full-time position and 11 part-time positions. These employment numbers do not account for the flight crews needed to operate SkyWest flights, typically one flight attendant and two pilots per flight. CMX also offers rental car services through National Car Rental/Enterprise Rent-A-Car, associated with four jobs. The airport has two paved runways; the main runway (13/31) is 6,500 feet long and 150 feet wide and the second runway (7/25) is 5,201 feet long and 100 feet wide.

Figure 1. CMX Enplanements, 2006-2021



Source: (Keweenaw Economic Development Alliance, 2022)

Economic Impact of Changes in Passenger Air Service

The main purpose of this report is to assess the economic impact of changes in passenger air service at CMX on Houghton County in light of SkyWest's request to end service at the airport. Business and economic development hinge on access to transportation, particularly in regional economies (Cassotis, 2019). Given Houghton County's distance to other major modes of transportation, access to the nation's air transportation system is imperative for the area. CMX serves both business, university, and individual interests - connecting businesses and local universities to the rest of the world, allowing travelers to easily visit friends and family, and providing access to services not available in the area, such as certain healthcare services (Regional Airline Association, 2019).

As local business, university, and economic development leaders noted, Houghton County's population growth, business and university development, and talent attraction and retention successes were only possible due to the area's access to high quality passenger air service via CMX. Reductions in or complete elimination of passenger air service at CMX will directly and indirectly impact businesses, universities, and economic growth in the area, particularly in Houghton County. For example, student and employee recruitment and retention, hosting business development and conference events, and personal travel, among others, will be more difficult in the absence of high quality passenger air service at CMX.

Methodology

We used REMI PI+ (version 2.5), a regional input-output economic modeling software, to evaluate the possible outcomes of changes in passenger air service at CMX. We chose REMI PI+ for the analysis over alternative software programs due to REMI's ability to forecast year-by-year estimates into the future and user-friendly interface. REMI includes historical data for years 2001 to 2019 and projected data for years 2020 to 2060. For the analysis, we focus on Houghton County, the county most likely to be impacted by changes at CMX. Prior to conducting any economic analyses, we interviewed several local business, university, and economic development leaders. Interviews served to gather information regarding local business operations, growth expectations, reliance on and use of CMX, and local economic development efforts and trends. We interviewed individuals representing: MTU, Calumet Electronics Corporation, Somero Enterprises Inc., MTEC SmartZone, Keweenaw Economic Development Alliance (KEDA), and Keweenaw Convention and Visitors Bureau.

While each interviewee had a unique perspective on the ramifications of a reduction in passenger air service at CMX, there were some common concerns. Multiple interviewees expressed that ease of access to a major airport hub is necessary for employee recruitment and retention given Houghton County's remote and rural location. Not only did business, economic, and university leaders expect that reduced air service would hinder retention and recruitment of skilled employees, but they also anticipated a compounding effect between the private and public sectors. One interviewee described the regional economy as an "economic ecosystem," where Michigan Tech's ability to hire faculty from around the world, train quality students, and collaborate with the SmartZone all contribute to the success of local companies. The interviewees anticipate a loss or reduction in air service to hinder Michigan Tech's ability to attract faculty and students to the area, which further limits recruitment and expansion efforts in the private sector.

"The university's efforts to spin off high tech companies from ongoing research in conjunction with SmartZone services have led to the creation of local jobs and offers a blueprint for future economic development."

--- Broadway & Broadway (2021)

Interviewees also anticipate a reduction in air service to diminish their ability to attract new clients to high-tech businesses in the area. A reduction in air service would make it more difficult for existing and potential clients to visit the area and may spur those clients to take their business to alternative companies. Last, interviewees representing the local tourism

sector believe a reduction in air service will dampen the number of visitors traveling by air. While most visitors travel to the region via car, the number of tourists traveling by air has increased over time and this segment of travelers generally spends more on average than tourists that drive to the area. The next section describes how we use information from interviews with local business, economic, and university leaders to inform our analysis.

Scenarios

We evaluated three scenarios to get a more nuanced understanding of the possible impacts of changes in passenger air service at CMX. The scenario assumptions were driven by interviews with local business, university, and economic development leaders and the county's economic trends. For each scenario, we shock the projected level of output for a particular set of industries, those most impacted by changes in passenger air service, for a 15-year period (2023-2037) following the end of SkyWest's contract at CMX in January 2023.

The three scenarios include a worst-case scenario: elimination of passenger air service at CMX (Scenario 1); a middle-case scenario: 50% reduction in passenger air service at CMX (Scenario 2); and an optimistic scenario: 25% increase in passenger air service at CMX (Scenario 3). The reduction of air service captures several possible changes, including: one flight per day, smaller planes, or a less-connected travel network. The enhancement in passenger air service also reflects several possibilities, such as offering more flights per day, using larger planes, connecting directly to more than one destination, or connecting directly to a more in-demand location. The scenarios vary in the magnitude of the output shocks across industries; scenario assumptions are detailed in Table 3.

Interviews with local business leaders and economic data for the prior 10 years revealed that REMI most likely underestimates projected growth for high-tech companies in Houghton County, those in the manufacturing sector and professional, scientific, and technical services industry. For example, local high-tech companies noted a projected growth rate of 5-15% per year, compared to REMI's projected average growth rate of less than 0.5% per year for the manufacturing sector and 1.55% for the professional, scientific and technical services industry, both for the next 15 years. Historical growth rates for the high-tech industries in Houghton County are also significantly higher than REMI projected growth rates. From 2010-2019, average output growth was approximately 6.6% per year for the manufacturing sector and approximately 6.25% for the professional, scientific, and technical services industry. The growth for the most recent five years of historical data, 2014-2019, is even more pronounced for the manufacturing sector at an average of 13% per year, and consistent for the professional, scientific, and technical services industry at an average of 6.25% per year.

Therefore, we adjusted the magnitude of the economic shocks for the manufacturing sector and the professional, scientific, and technical services industry to better account for anticipated growth; this process included four steps. First, we forecasted an alternative

Table 3. Scenario Assumptions

Category	Industries	Year	Scenario 1: No Service	Scenario 2: 50% Reduction	Scenario 3: 25% Increase
High-Tech Companies	Manufacturing; Software Publishers; Data Processing, Hosting, Related Services; Architectural, Engineering, and Related Services; Specialized Design Services; Computer Systems Design and Related Services; Management, Scientific, and Technical Consulting Services	Year 1	Growth rate* declines 5%	Growth rate* declines 2.5%	Growth rate* increases 25%
		Year 2	Growth rate* declines 10%	Growth rate* declines 5%	Growth rate* increases 25%
		Year 3	Growth rate* declines 15%	Growth rate* declines 7.5%	Growth rate* increases 25%
		Year 4 - 15	Growth rate* declines 15% per year	Growth rate* declines 7.5% per year	Growth rate* increases 25% per year
Airport	Air Transportation; Scenic and Sightseeing Transportation; Support Activities for Transportation; Automotive Equipment Rental and Leasing	Year 1 - 15	Level declines 80% per year	Level declines 40% per year	Level increases 25% per year
Tourism	Museums, Historical Sites, and Similar Institutions; Amusement, Gambling and Recreation; Accommodation; Food Services and Drinking Places	Year 1 - 15	Level declines 7% per year	Level declines 3.5% per year	Level increases 2% per year
University	State and Local Government	Year 1 - 15	Growth rate* declines 25% per year	Growth rate* declines 12.5% per year	Growth rate* increases 25% per year

*Notes: All shocks are applied to output. *Changes to growth rates are relative to expected growth rates by local business, university, and economic leaders as opposed to growth rates indicated by REMI. Table A1 and Table A2 in the appendix show forecasts and shocks for high-tech companies and state and local government.*

growth scenario: beginning in 2020, the first year of projected data in REMI, we modeled output for manufacturing and professional, scientific, and technical services assuming a 5% growth rate in output per year. Second, we adjusted the growth rate over the previous year by -15% to +25% pending the scenario and year (specified in Table 3). Third, we calculated the percent difference between this adjusted output level and the benchmark REMI forecast for these industries. Last, we applied the calculated percent differences as the annual shocks to manufacturing and professional, scientific, and technical services output in REMI.

Table 4. Average Benchmark Values, 2015-2037

	2015-2019	2020-2022	2023-2027	2028-2032	2033-2037
Output (Millions of Dollars)	1,971	2,077	2,244	2,399	2,576
Employment (Jobs)	16,180	16,633	17,035	17,261	17,627
Population (Individuals)	36,070	36,081	36,682	37,769	39,188

Notes: Data from 2015-2019 are historical; values for all other years are projections from REMI.

We followed a similar process for the state and local government sector to capture MTU’s future growth expectations, with a few differences: 1) the baseline 2020 alternative growth for state and local government was calculated at 50% of the 2019 value to reflect that MTU only makes up approximately 50% of the state and local government sector in the county, 2) we forecasted alternative growth of 2.2% per year, and 3) adjusted the state and local government alternative growth rate over the prior year by -25% to +25% pending the scenario (specified in Table 3). The growth rates, alternate output levels, and calculated percent changes for the high- tech industries and the state and local government sector are shown in Table A1 and Table A2 in the appendix.

Forecasted Results

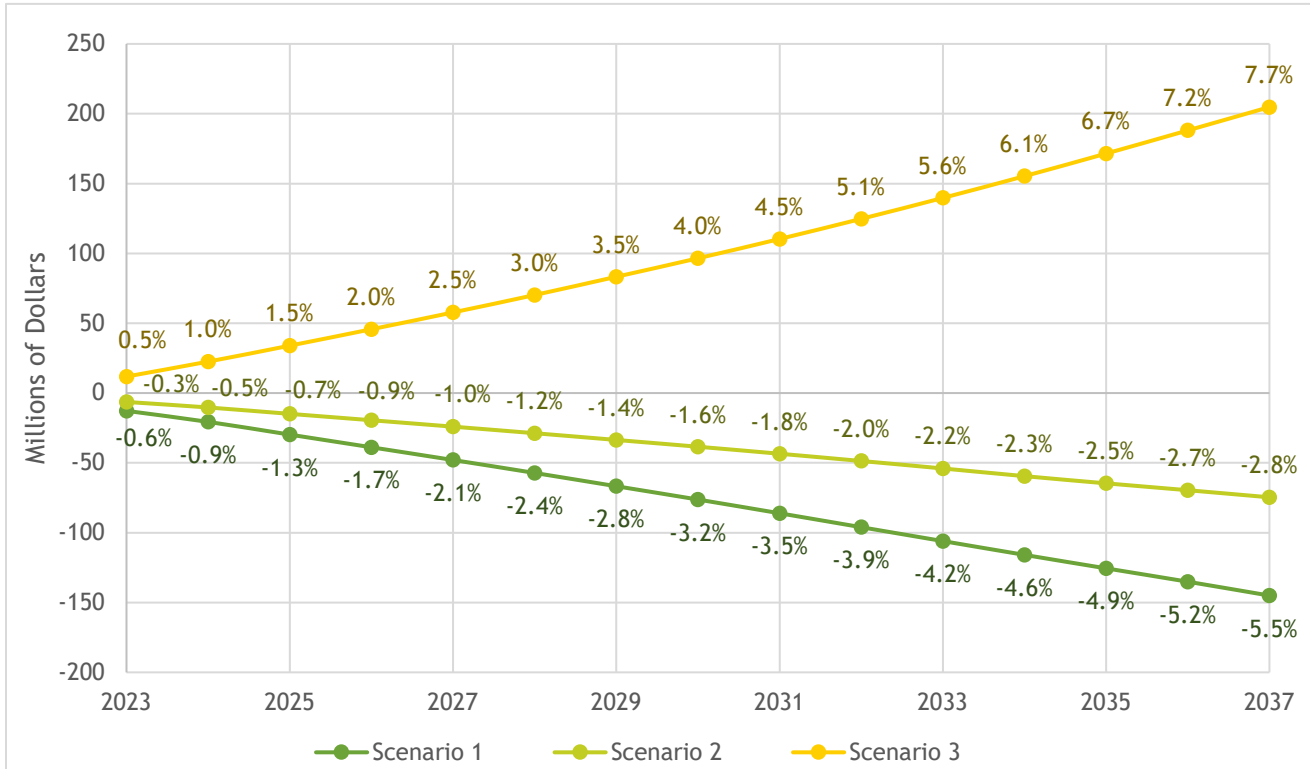
We now present the results of the three scenarios. Among the variety of economic variables in the model, we focus on employment, output, and population as these variables are the most representative of concerns expressed by local business leaders and stakeholders.

Benchmark

Prior to discussing the results, it is helpful to first illustrate the benchmark scenario, which reflects the levels of economic activity in Houghton County in the absence of any shocks (e.g. no changes in passenger air service). Table 4 presents the average values of output, employment, and population in the REMI benchmark scenario for Houghton County. For the sake of presentation, we present average values for five time frames: 2015-2019, 2020-2022, 2023-2027, 2028-2032, and 2033-2037.¹ All of the proceeding results are presented as differences from these benchmark values.

¹ Our evaluation period is 2023 - 2037. The 2015-2022 time frame illustrates prior economic trends, which are broken down into two time periods: 2015-2019 illustrates the last five years of historic data, while 2020-2022 illustrates the years of projected data in REMI prior to our time period of study. See Table A3 in the appendix for benchmark values for each year.

Figure 2. Change in Output Across Scenarios



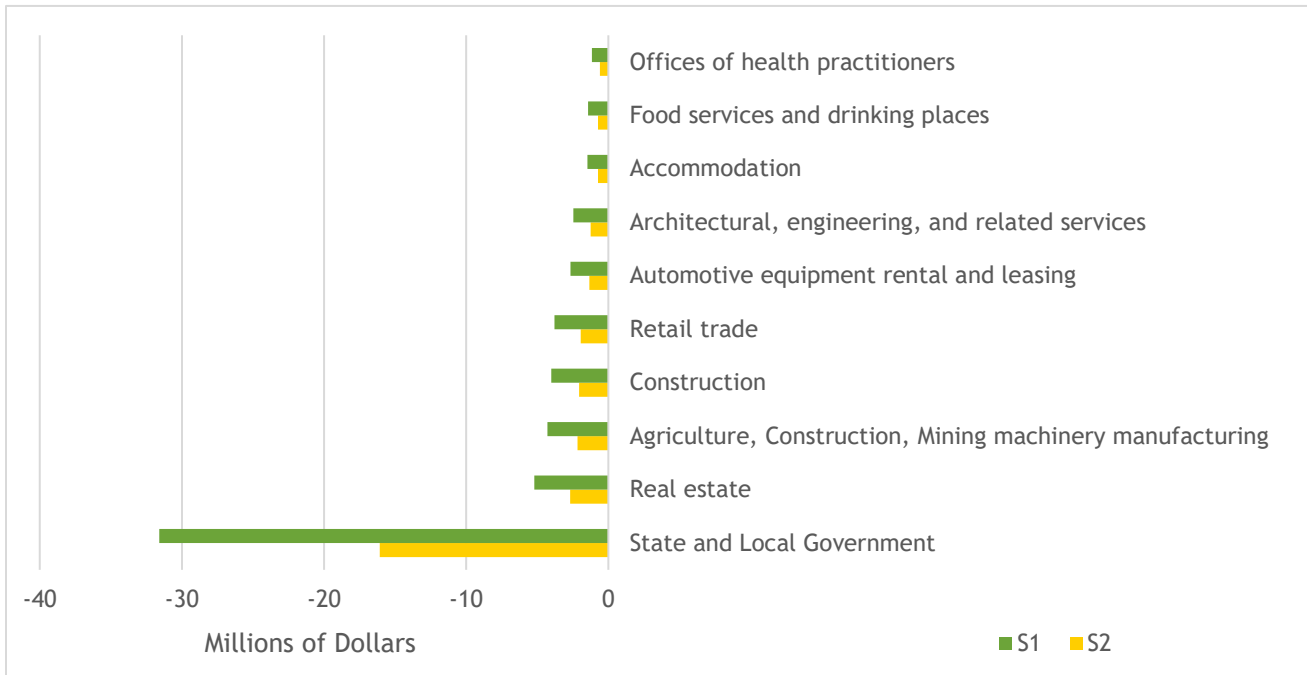
Notes: Numerical values are reported in Table A4; changes are relative to benchmark REMI forecasts in Table A3.

Output

Figure 2 presents the projected change in output per year across all industries in Houghton County for the three scenarios. Compared to REMI’s benchmark forecasts from 2023-2037, output decreases by \$13 to \$145 million per year in Scenario 1 and by \$6 to \$75 million per year in Scenario 2 over the time period. In Scenario 3, we see an increase in output of \$12 to \$205 million per year over the 15-year period. This means that for year 2023, output is projected to be 0.6% lower in Scenario 1, 0.3% lower in Scenario 2, and 0.5% higher in Scenario 3. The trend over time clearly shows output steadily declining in Scenarios 1 and 2 and steadily increasing in Scenario 3. For the year 2037, output is projected to be 5.5% lower in Scenario 1, 2.8% lower in Scenario 2, and 7.7% higher in Scenario 3 relative to the benchmark REMI forecast for that year. Thus, the impact of changes in passenger air service become more pronounced over time.

Figure 3 shows the average annual loss of output over the evaluation period for the 10 most impacted sectors. As expected, many sectors that we directly shocked in the simulations are included in the list: state and local government; agriculture, construction, and mining machinery manufacturing; automotive equipment rental and leasing; architectural, engineering, and related services; accommodation; and food services and drinking places. Overall, state and local government experiences the largest change in output over the time

Figure 3. Average Annual Change in Output by Sector



Notes: Average values calculated from 2023-2037 and shown for the top 10 sectors.

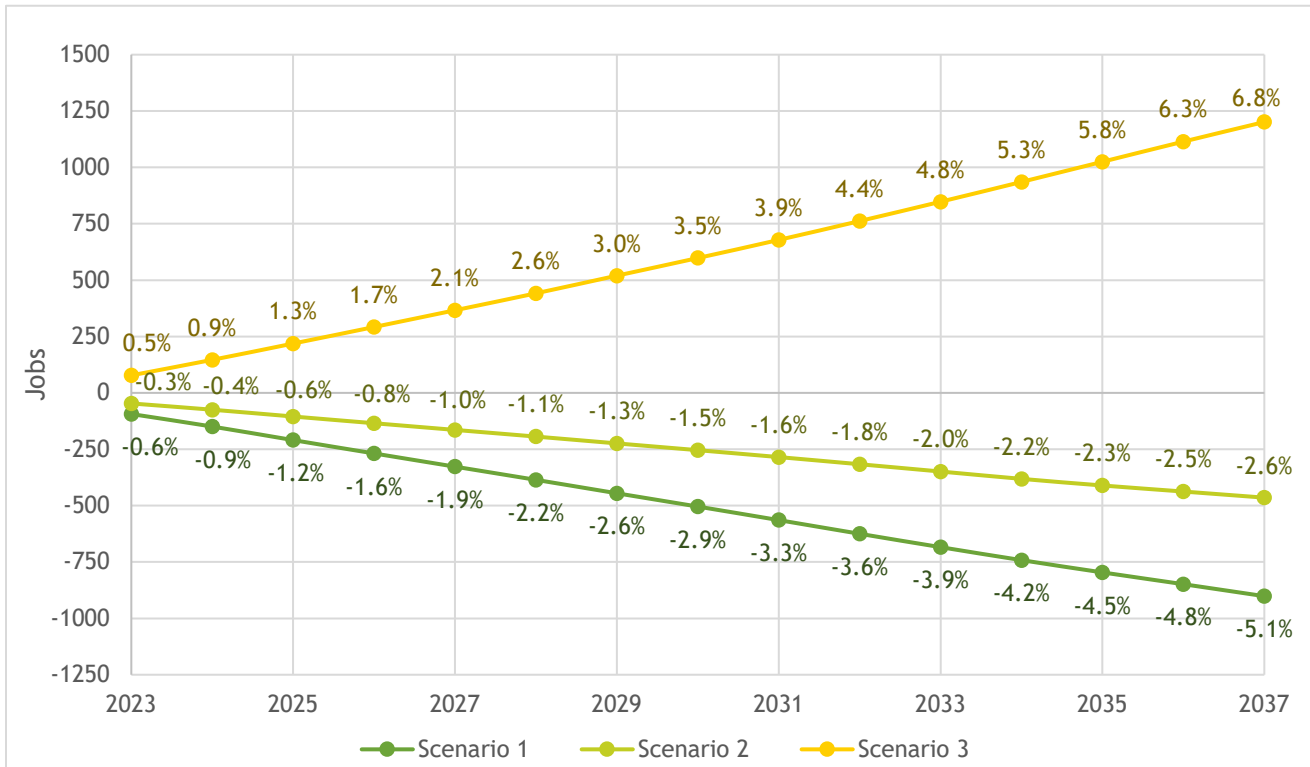
period, an average of approximately \$32 million per year in Scenario 1 and \$16 million per year in Scenario 2.

Perhaps more interesting are the sectors included in Figure 3 that were not directly manipulated in the simulations: offices of health practitioners; retail trade; construction; and real estate are projected to see declines in output of approximately \$1 to \$5 million in Scenario 1 and \$500,000 to \$3 million in Scenario 2, with real estate seeing the second largest decline amongst all of the sectors. Changes in passenger air service will not only affect the industries with direct reliance on the airport, but it will also have significant indirect effects on other industries in the area. Two sectors that directly reflect activity at the airport, air transportation and scenic and support activities for transportation (includes airport operations), both just missed the top 10 industries. Each has an expected loss in output of approximately \$1 million in Scenario 1 and \$500,000 in Scenario 2.

Employment

Next, we turn to employment; Figure 4 shows the annual changes in total employment for Houghton County across the scenarios relative to REMI’s benchmark forecast for 2023-2037. Annual changes in employment relative to the benchmark ranges from approximately 94 to 902 jobs lost per year in Scenario 1, 47 to 465 jobs lost per year in Scenario 2, and 78 to 1,201 jobs gained per year in Scenario 3. For year 2023, the projected change in annual employment relative to the REMI benchmark forecast translates to a decline of 0.6% in Scenario 1, a decline of 0.3% in Scenario 2, and an increase of 0.5% in Scenario 3. The employ-

Figure 4. Change in Employment Across Scenarios



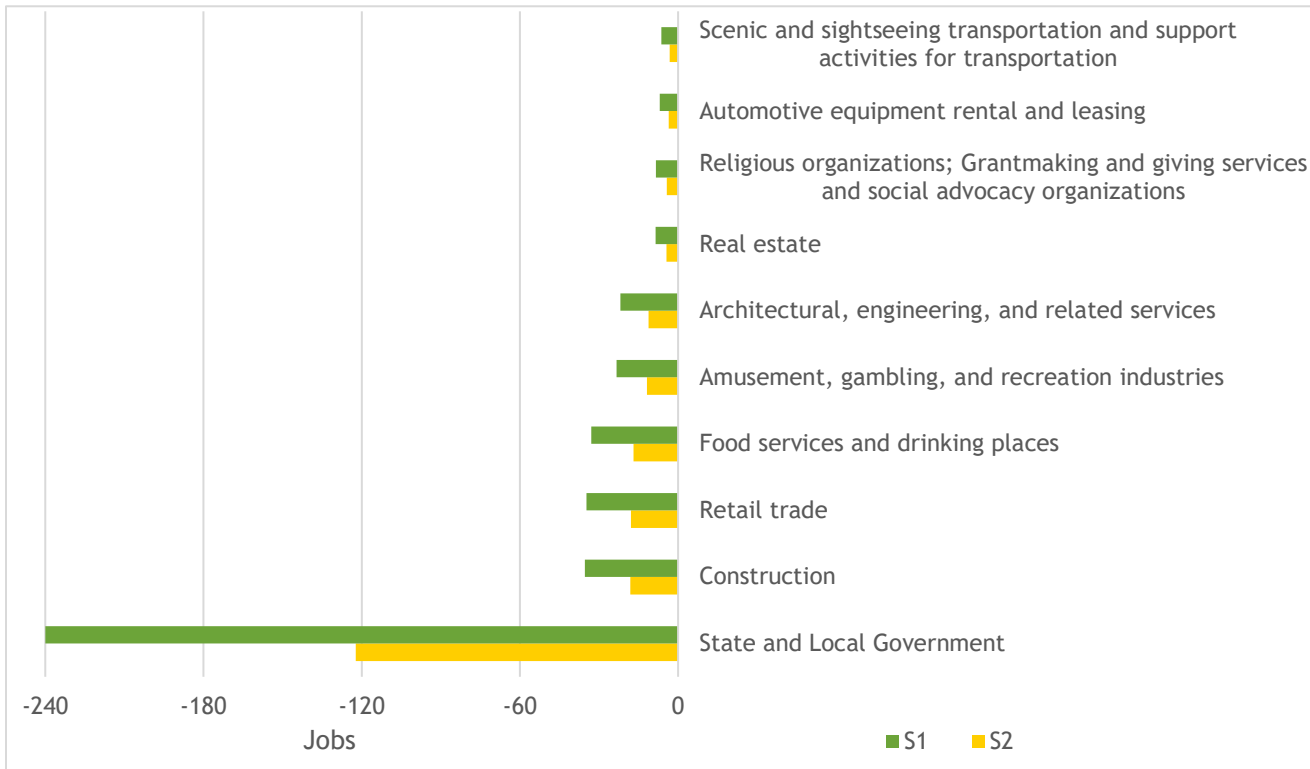
Notes: Numerical values are reported in Table A4; changes are relative to benchmark REMI forecasts in Table A3.

ment results also illustrate a clear trend over the time period: the job losses in Scenario 1 and 2 and the job gains in Scenario 3 increase over time. For year 2037, the projected employment changes grow in magnitude to -5.1%, -2.6%, and 6.8% in Scenarios 1, 2, and 3, respectively. Thus, similar to output, the employment impacts from changes in passenger air service at CMX become more pronounced over the time period.

Figure 5 shows the 10 sectors with the highest average annual losses in employment. Six of the industries in Figure 5 were directly shocked in the simulations: state and local government; food services and drinking places; amusement, gambling and recreation industries; architectural, engineering, and related services; automotive equipment rental and leasing; and scenic and support activities for transportation. Similar to the changes in output, state and local government has the largest change in employment: approximately 240 employees on average in Scenario 1 and 122 employees in Scenario 2.

Industries in Figure 5 that were not directly shocked include: construction; retail trade; real estate; and religious organizations, and grant making and giving services and social advocacy organizations. Of these sectors, construction loses the most employees (second overall) with an average annual loss of approximately 35 employees per year in Scenario 1 and 18 employees per year in Scenario 2. The list of most impacted industries in Figure 5 (employment) overlaps with many of the industries in Figure 3 (output). However, three

Figure 5. Average Annual Change in Employment by Sector



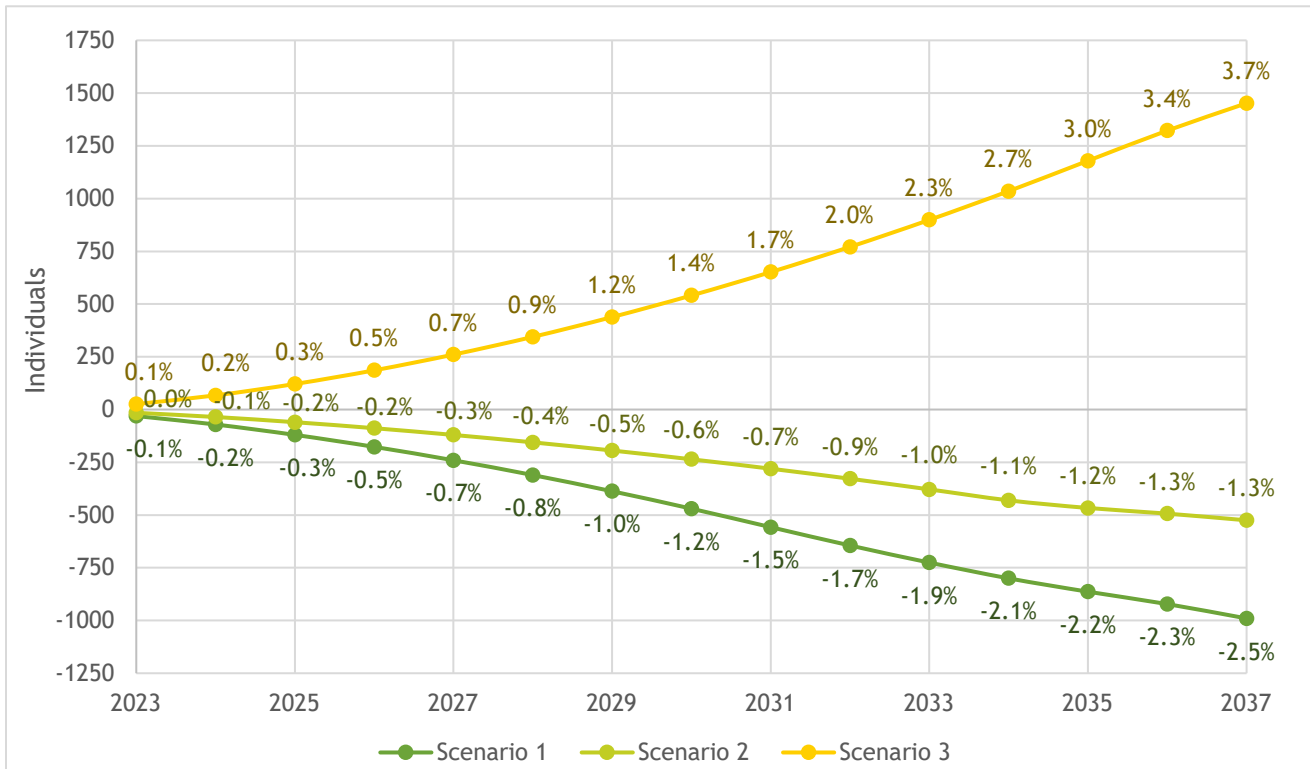
Notes: Average values calculated from 2023-2037 and shown for the top 10 sectors.

industries are different. Amusement, gambling, and recreation industries; religious organizations, grant making and giving services and social advocacy organizations; and scenic and support activities for transportation are among the industries with the greatest loss in employment instead of architectural, engineering, and related services; accommodation; and offices of health practitioners for output. This continues to support the concerns of local stakeholders that diminishing passenger air service at CMX will affect the community and local economic ecosystem in many ways.

Population

Another component of the economic health of the region is population. Figure 6 shows the expected annual change in Houghton County’s population across the three scenarios. Similar to the output and employment results, Scenarios 1 and 2 both induce decreases in population over the benchmark scenario while Scenario 3 induces an increase in population over the benchmark. In Scenario 1 the annual decrease in population from the benchmark forecast ranges from 31 to 990 people per year, while in Scenario 2 the decrease ranges from 15 to 525 people per year. In Scenario 3 the population increases over the benchmark range from approximately 26 to 1,452 people per year. For year 2023, the anticipated population changes relative to the REMI benchmark forecast translate to -0.1% in Scenario 1, -0.04% in Scenario 2, and 0.1% in Scenario 3. The population results continue to follow the same

Figure 6. Change in Population Across Scenarios



Notes: Numerical values are reported in Table A4; changes are relative to benchmark REMI forecasts in Table A3.

trend: declines become more severe over time in Scenarios 1 and 2 and growth becomes larger over time in Scenario 3. The percent difference between the forecasted population changes and the benchmark scenario for year 2037 is -2.5%, -1.3%, and 3.7% for Scenarios 1, 2, and 3, respectively.

As briefly discussed in Section 1, the region already faces population and work force challenges. Houghton was the only U.P. county with population gains from 2010 to 2020 (Broadway & Broadway, 2021). The results suggest that this trend will be reversed in the absence of high-quality passenger air service at CMX. Thus, reductions in air service lead to significant population declines, which will likely have many compounding, negative effects over time.

Rest of the Upper Peninsula

Our analysis thus far focuses on Houghton County, the county likely to experience the largest impacts from changes in service at CMX. However, surrounding counties are likely to be impacted as well. While our analysis does not allow us to analyze impacts at the county-level across the U.P., we are able to estimate impacts to the rest of the U.P. as a whole (excluding Houghton County). Similar to the results for Houghton County, the estimated economic changes for the rest of the U.P. are relatively small in size initially, but grow over time. For

year 2037, output is forecasted to change by approximately -7, -4, and 10 million dollars across Scenarios 1, 2, and 3, respectively; employment is expected to change by -48, -25, and 70 jobs in Scenarios 1, 2, and 3, respectively; and population is projected to change by -116, -60, and 155 across Scenarios 1, 2, and 3, respectively (annual impacts for the rest of the U.P. for years 2023-2037 are shown in Table A5 in the appendix).²

While these results indicate that changes in air service at CMX are likely to impact the rest of the U.P., it is important to note that the estimates only capture the effects of the shocks simulated in Houghton County. In other words, the results for the rest of the U.P. capture the indirect spillover effect of changes in Houghton County rather than direct changes to surrounding counties. While surrounding counties, such as Keweenaw, Baraga, and Ontonagon, are likely to be directly affected by changes in air service at CMX, direct shocks in those counties were not included in the simulations. For this reason, results for the rest of the U.P. may mask heterogeneous impacts across counties and likely underestimate the aggregate economic effects to the surrounding counties.

Conclusion

CMX, Michigan's northernmost airport, provides essential air service to the area, including Houghton, Keweenaw, Baraga, and Ontonagon Counties. Interviews with local stakeholders illustrated the reliance on CMX for business, university, tourism, and personal interests. In order to more comprehensively understand the implications of changes at CMX, we modeled three scenarios that ranged from worst-case, no passenger air service, to best-case, a 25% enhancement of passenger air service. We used REMI PI+ to estimate how changes in passenger air service at CMX will impact output, employment, and population in Houghton County for 2023-2037, the 15-year period following the end of SkyWest's current contract.

The elimination of passenger air service at CMX results in the most negative changes to output, employment, and population. The declines are projected to increase in magnitude over time, a strong indicator that changes in passenger air service today will impact the local economy for many years to come. While output and employment are projected to decline by approximately 0.6% each in 2023 relative to the benchmark forecast, the declines are almost ten times larger in 2037 at over 5% each. Similarly, population is projected to decline less than 0.1% in 2023 compared to the benchmark, and the decline increases to 2.5% in 2037, over 25 times larger. A 50% reduction in passenger air service follows similar negative trends, but the magnitudes are approximately half in comparison to those for no air service. In contrast, a 25% enhancement in passenger air service boosts projected economic growth

² The results for the U.P. as a whole, including Houghton County, are found by aggregating estimated impacts for a given year for Houghton County (Table A4) with those for the rest of the U.P. (Table A5).

“The Upper Peninsula of Michigan is among the most remote regions in the eastern United States with limited transportation options. Economic development depends, in no small measures, on the ability of its business, government entities, and non-profit enterprises to reasonably and conveniently access national and global markets through the nation’s transportation system.”

--- Kotler (2012)

relative to the benchmark forecast. While the projected changes continue to increase over time, the magnitudes are even larger than those estimated for no air service.

Of notable concern to local stakeholders and policymakers is the anticipated effects of no or reduced service at CMX on specific industries. Many of the industries we directly shocked are amongst those projected to experience the most significant declines, such as state and local government; architectural, engineering, and related services; and food services and drinking places. This highlights the negative, direct consequences to several of the most prominent industries and employers in the county: tourism, high-tech companies, and MTU. The predicted declines to MTU are particularly concerning as the university is the largest employer in the county, a consistent source of skilled labor, and their enrollment nearly doubles the population of Houghton, MI during the academic year.

However, several other industries are indirectly affected by the elimination or reduction in service at CMX. Real estate, construction, and retail trade see some of the largest declines in output and employment, which highlights the interconnectedness of the local economy. As reduced air service leads fewer tourists to visit the area, stalls business, university, and economic development, and hinders talent and student attraction and retention, these all spillover to affect other industries as less people are buying property, visiting retail stores, and fueling demand for construction.

Our results highlight the important role CMX plays in the local economy and the potential consequences of reducing or eliminating passenger air service. The simulation results reveal that many of Houghton County’s recent successes, such as population growth, business expansion, and talent attraction, are tied to high quality passenger air service at CMX. The elimination or reduction in service at CMX will harm the continuation of these successes.

References

- Broadway, M., & Broadway, J. (2021, October 13). *A Tale of Two Counties: Houghton Sees Younger Population, Stronger Economy Than Marquette*. Retrieved from Rural Insights: <https://ruralinsights.org/content/a-tale-of-two-counties-houghton-sees-younger-population-stronger-economy-compared-to-marquette/>
- Cassotis, C. (2019, July). *Air Service Development is Economic Development*. Retrieved from Airport Improvement: <https://airportimprovement.com/air-service-development-economic-development>
- Houghton County. (2022, June 29). *Houghton County Memorial Airport*. Retrieved from Houghton County: <https://houghtoncounty.org/>
- Kotler, F. B. (2012). *Passenger Air Service in Michigan's Upper Peninsula: Overview and Analysis*. Escabana, MI: UpWard Initiative.
- Michigan Technological University. (2022, June 29). *University Dashboard - Employee*. Retrieved from University Institutional Dashboards: https://www.banweb.mtu.edu/ibi_apps/portal/University/Institutional_Dashboards/Employee/university_dashboard_employee
- Regional Airline Association. (2019, First Quarter). Valuable Service. *Regional Horizons*, p. 8.
- REMI . (2022). REMI PI+ Version 2.5. Amherst, MA, USA.
- TV6 News Team. (2021, July 30). *MTEC SmartZone appoints David Rowe as CEO*. Retrieved from WLUC-TV6: <https://www.uppermichiganssource.com/2021/07/30/mtec-smartzone-appoints-david-rowe-ceo/>
- U.S. Census Bureau. (2022, June 29). *QuickFacts Houghton County, Michigan*. Retrieved from U.S. Census Bureau QuickFacts: <https://www.census.gov/quickfacts/fact/table/houghtoncountymichigan/PST045221>
- U.S. Department of Transportation. (2020, February 3). *Order Selecting Air Carrier and Approving Request to Wave Certain Essential Air Service Requirements at 49 U.S.C. 41732*. U.S. Department of Transportation.
- U.S. Department of Transportation. (2022, June 29). *Essential Air Service*. Retrieved from U.S. Department of Transportation Aviation Policy: 2022
- Wolfstellar, P. (2022, March 10). *SkyWest to end service to 29 cities due to pilot shortage*. Retrieved from FlightGlobal: <https://www.flightglobal.com/networks/skywest-to-end-service-to-29-cities-due-to-pilot-shortage/147887.article>

Appendix

Table A1. High-Tech Companies Alternative Forecast and Shocks

Year	REMI Forecast	Scenario 1			Scenario 2			Scenario 3		
		Growth Rate	Alternate Forecast	% Change	Growth Rate	Alternate Forecast	% Change	Growth Rate	Alternate Forecast	% Change
2019	346.27									
2020	322.47		363.59			363.59			363.59	
2021	360.37		381.76			381.76			381.76	
2022	377.33		400.85			400.85			400.85	
2023	375.91	0.0475	419.89	-0.24	0.04875	420.39	-0.12	0.0625	425.91	1.19
2024	375.58	0.045	438.79	-0.71	0.0475	440.36	-0.36	0.0625	452.53	2.40
2025	379.34	0.0425	457.44	-1.42	0.04625	460.73	-0.71	0.0625	480.81	3.61
2026	381.68	0.0425	476.88	-2.13	0.04625	482.04	-1.07	0.0625	510.86	4.85
2027	383.72	0.0425	497.15	-2.83	0.04625	504.33	-1.42	0.0625	542.79	6.10
2028	386.11	0.0425	518.27	-3.52	0.04625	527.66	-1.77	0.0625	576.71	7.36
2029	389.01	0.0425	540.30	-4.21	0.04625	552.06	-2.12	0.0625	612.76	8.64
2030	391.76	0.0425	563.26	-4.89	0.04625	577.60	-2.47	0.0625	651.05	9.93
2031	394.92	0.0425	587.20	-5.57	0.04625	604.31	-2.82	0.0625	691.74	11.24
2032	398.28	0.0425	612.16	-6.25	0.04625	632.26	-3.17	0.0625	734.98	12.56
2033	401.86	0.0425	638.18	-6.92	0.04625	661.50	-3.51	0.0625	780.91	13.90
2034	405.74	0.0425	665.30	-7.58	0.04625	692.10	-3.86	0.0625	829.72	15.26
2035	409.95	0.0425	693.57	-8.24	0.04625	724.10	-4.20	0.0625	881.58	16.63
2036	414.51	0.0425	723.05	-8.90	0.04625	757.59	-4.54	0.0625	936.68	18.02
2037	419.56	0.0425	753.78	-9.55	0.04625	792.63	-4.89	0.0625	995.22	19.42

Notes: REMI output levels listed here are calculated as the sum of output in the following sectors: Manufacturing; Software Publishers, Data Processing, Hosting, Related Services; Architectural, Engineering, and Related Services; Specialized Design Services; Computer Systems Design and Related Services; Management, Scientific, and Technical Consulting Services.

Table A2. State and Local Government Alternative Forecast and Shocks

Year	REMI Forecast	Scenario 1			Scenario 2			Scenario 3		
		Growth Rate	Alternate Forecast	% Change	Growth Rate	Alternate Forecast	% Change	Growth Rate	Alternate Forecast	% Change
2019	230.47									
2020	223.33		235.54			235.54			235.54	
2021	231.47		240.73			240.73			240.73	
2022	239.93		246.02			246.02			246.02	
2023	242.58	0.0165	250.08	-0.54	0.01925	250.76	-0.27	0.0275	252.79	0.54
2024	246.07	0.0165	254.21	-1.07	0.01925	255.58	-0.54	0.0275	259.74	1.08
2025	249.63	0.0165	258.40	-1.61	0.01925	260.50	-0.81	0.0275	266.88	1.62
2026	252.50	0.0165	262.67	-2.14	0.01925	265.52	-1.07	0.0275	274.22	2.17
2027	255.04	0.0165	267.00	-2.66	0.01925	270.63	-1.34	0.0275	281.76	2.72
2028	257.84	0.0165	271.41	-3.19	0.01925	275.84	-1.60	0.0275	289.51	3.27
2029	260.23	0.0165	275.88	-3.71	0.01925	281.15	-1.87	0.0275	297.47	3.83
2030	262.80	0.0165	280.44	-4.23	0.01925	286.56	-2.13	0.0275	305.65	4.39
2031	265.59	0.0165	285.06	-4.74	0.01925	292.08	-2.40	0.0275	314.06	4.95
2032	268.42	0.0165	289.77	-5.25	0.01925	297.70	-2.66	0.0275	322.69	5.51
2033	271.26	0.0165	294.55	-5.76	0.01925	303.43	-2.92	0.0275	331.57	6.08
2034	274.11	0.0165	299.41	-6.27	0.01925	309.27	-3.18	0.0275	340.69	6.65
2035	276.87	0.0165	304.35	-6.77	0.01925	315.23	-3.44	0.0275	350.06	7.23
2036	279.53	0.0165	309.37	-7.28	0.01925	321.29	-3.70	0.0275	359.68	7.80
2037	282.17	0.0165	314.47	-7.78	0.01925	327.48	-3.96	0.0275	369.57	8.38

Notes: REMI output levels listed here are half of output levels reported in the benchmark forecast to account for the fact that MTU represents approximately 50% of employment in this category.

Table A3. Benchmark Values

Year	Employment (Jobs)	Output (Millions of Dollars)	Population (Individuals)
2019	16,438	2,016	35,684
2020	16,865	2,102	36,103
2021	17,127	2,171	36,309
2022	15,907	1,959	35,830
2023	17,002	2,185	36,432
2024	16,930	2,207	36,519
2025	17,042	2,246	36,648
2026	17,091	2,277	36,809
2027	17,112	2,305	37,002
2028	17,169	2,338	37,240
2029	17,185	2,365	37,491
2030	17,235	2,396	37,757
2031	17,312	2,431	38,034
2032	17,403	2,466	38,322
2033	17,487	2,502	38,614
2034	17,571	2,539	38,907
2035	17,643	2,576	39,191
2036	17,694	2,612	39,471
2037	17,738	2,649	39,758

Notes: Data from 2019 are historical; values for all other years are projections from REMI.

Table A4. Forecasted Changes for Houghton County

Year	Employment (Jobs)			Output (Millions of Dollars)			Population (Individuals)		
	S1	S2	S3	S1	S2	S3	S1	S2	S3
2023	-93.81	-46.85	77.79	-12.75	-6.37	11.82	-30.89	-15.41	25.98
2024	-149.36	-74.67	146.55	-20.63	-10.32	22.50	-70.92	-35.40	67.21
2025	-209.44	-104.83	218.81	-29.76	-14.90	33.94	-120.13	-60.00	121.11
2026	-268.60	-134.61	292.15	-38.83	-19.47	45.68	-176.89	-88.43	185.85
2027	-327.27	-164.23	366.42	-47.95	-24.06	57.75	-240.55	-120.38	260.53
2028	-385.71	-193.82	441.56	-57.21	-28.76	70.20	-310.57	-155.58	344.44
2029	-445.27	-224.06	519.88	-66.72	-33.58	83.26	-387.40	-194.29	438.38
2030	-504.26	-254.09	598.05	-76.26	-38.43	96.51	-469.85	-235.91	540.72
2031	-564.24	-284.75	678.43	-86.08	-43.45	110.32	-557.62	-280.48	651.57
2032	-624.94	-316.50	762.06	-96.06	-48.65	124.73	-644.37	-328.06	771.05
2033	-684.22	-348.80	847.78	-106.00	-54.01	139.71	-725.45	-378.53	898.93
2034	-741.77	-381.36	935.60	-115.88	-59.50	155.30	-800.15	-430.45	1035.16
2035	-796.23	-410.75	1025.05	-125.52	-64.65	171.48	-863.52	-466.58	1179.15
2036	-848.49	-437.56	1114.39	-135.09	-69.57	188.06	-922.11	-493.37	1322.20
2037	-901.57	-464.62	1201.34	-145.01	-74.65	204.76	-990.08	-525.07	1452.00

Table A5. Forecasted Changes for the Rest of U.P.

Year	Employment (Jobs)			Output (Millions of Dollars)			Population (Individuals)		
	S1	S2	S3	S1	S2	S3	S1	S2	S3
2023	0.67	0.33	2.24	-0.22	-0.11	0.38	-2.22	-1.11	2.69
2024	-2.93	-1.47	6.45	-0.69	-0.35	0.93	-6.31	-3.16	7.65
2025	-6.91	-3.47	11.16	-1.22	-0.61	1.55	-11.80	-5.91	14.32
2026	-10.86	-5.45	15.96	-1.75	-0.88	2.19	-18.28	-9.16	22.28
2027	-14.69	-7.39	20.70	-2.27	-1.14	2.84	-25.49	-12.79	31.26
2028	-18.31	-9.23	25.30	-2.77	-1.39	3.47	-33.20	-16.67	41.00
2029	-22.12	-11.16	30.19	-3.30	-1.66	4.16	-41.45	-20.84	51.57
2030	-25.59	-12.93	34.75	-3.80	-1.92	4.81	-50.03	-25.19	62.71
2031	-29.03	-14.70	39.36	-4.30	-2.17	5.48	-58.91	-29.70	74.37
2032	-32.55	-16.56	44.22	-4.81	-2.45	6.19	-68.09	-34.41	86.63
2033	-35.96	-18.45	49.21	-5.32	-2.73	6.93	-77.50	-39.32	99.49
2034	-39.25	-20.36	54.33	-5.83	-3.02	7.71	-87.06	-44.40	112.93
2035	-42.33	-22.03	59.54	-6.31	-3.28	8.52	-96.66	-49.46	126.89
2036	-45.29	-23.51	64.70	-6.79	-3.52	9.34	-106.30	-54.46	141.26
2037	-48.36	-25.03	69.64	-7.30	-3.77	10.15	-116.12	-59.49	155.86

Notes: The rest of the U.P. excludes Houghton County.