Analysis of the Colorado High Technology Industry

Analysis by cber.co
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Analysis of Colorado High-Technology Industry
Definition

Overview

The purpose of this document is to provide an analysis of the Colorado High-Tech (HT) industry using a definition of HT published by the U.S. Census Bureau at https://www.census.gov/data/experimental-data-products/bds-high-tech.html.

The Census Bureau defines High-Tech (HT) industries based on NAICS codes chosen by the percentage of STEM occupations in a NAICS sector. It compares employment and establishment data for HT and non-High-Tech (non-HT). Both groups add value to the economy in different ways.

The data looks at changes in the number of employees, establishments, and business dynamics at the state and MSA levels. This information is particularly relevant for economic and workforce development.

HT establishments account for about 7.8% of all private sector employees. In Colorado, 92% of the HT establishments are in the following MSAs: Denver, Boulder, Colorado Springs, and Fort Collins. Additional research or anecdotal evidence is necessary to evaluate the performance of specific HT clusters or industries such as aerospace, defense, cybersecurity, bioscience, and quantum.

This analysis evaluates the performance of the Colorado HT industry and provides information that will strengthen Colorado HT and the overall economy in the future.

Contents

This chartbook addresses the following topics.

Defining the High Technology Industry
Business Dynamic Statistics

There are many definitions of High Tech (HT) Industries.

- The Census Bureau states that, "The Business Dynamics Statistics of U.S. High Tech Industries (BDS-HT) is an experimental data product extending the set of statistics published by the Business Dynamics Statistics (BDS) program. BDS-HT is a component of a broader set of approaches aimed at better measuring the business dynamics of innovative firms (BDS-IF), described in greater detail in Goldschlag & Perlman (2017)."
- BDS-HT provides annual measures of business dynamics for High-Tech and non-high-tech (non-HT) industries, defined by the occupation intensity of Science, Technology, Engineering, and Math (STEM) categories.
- For details, go to https://www.census.gov/data/experimental-data-products/bds-high-tech.html#accordion-bd794b571f-item-50d27511b6.

This data provides trends and in-depth information for 45 years from 1978 to 2022.

The various employment reports can be confusing.

- The Census Bureau prepares the data for the *County Business Patterns* (CBP). The Bureau of Labor Statistics prepares the CES and QCEW data series.
- The CBP data focuses on business flows. It primarily includes private sector employees, and the BLS includes civilian government employees. CBP does a better job of including employees in nonprofit and membership organizations.

For additional information, please refer to https://www.bea.gov/help/faq/104.

List of High-Tech Industries	
NAICS	Description
3341	Computer and Peripheral Equipment Manufacturing
3342	Communications Equipment Manufacturing
3344	Semiconductor and Other Electronic Component Manufacturing
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing
3364	Aerospace Product and Parts Manufacturing
5112	Software Publishers
5182	Data Processing, Hosting, and Related Services
5191	Other Information Services
5413	Architectural, Engineering, and Related Services
5415	Computer Systems Design and Related Services
5417	Scientific Research and Development Services

Concentration of High-Tech (HT) Employees and non-High Technology (non-HT) Establishments

Key Points

The Census Bureau provided data for the state and the largest coarse MSAs. The smallest MSAs (Pueblo and Grand Junction) and micropolitan areas are part of the non-metro total. The non-metro total is the state total less the sum of the coarse MSAs.

In 2022, about 92% of tech employment and 84% of tech establishments were in the Denver, Boulder, Colorado Springs, and Fort Collins MSAs. The breakdown by MSA follows:

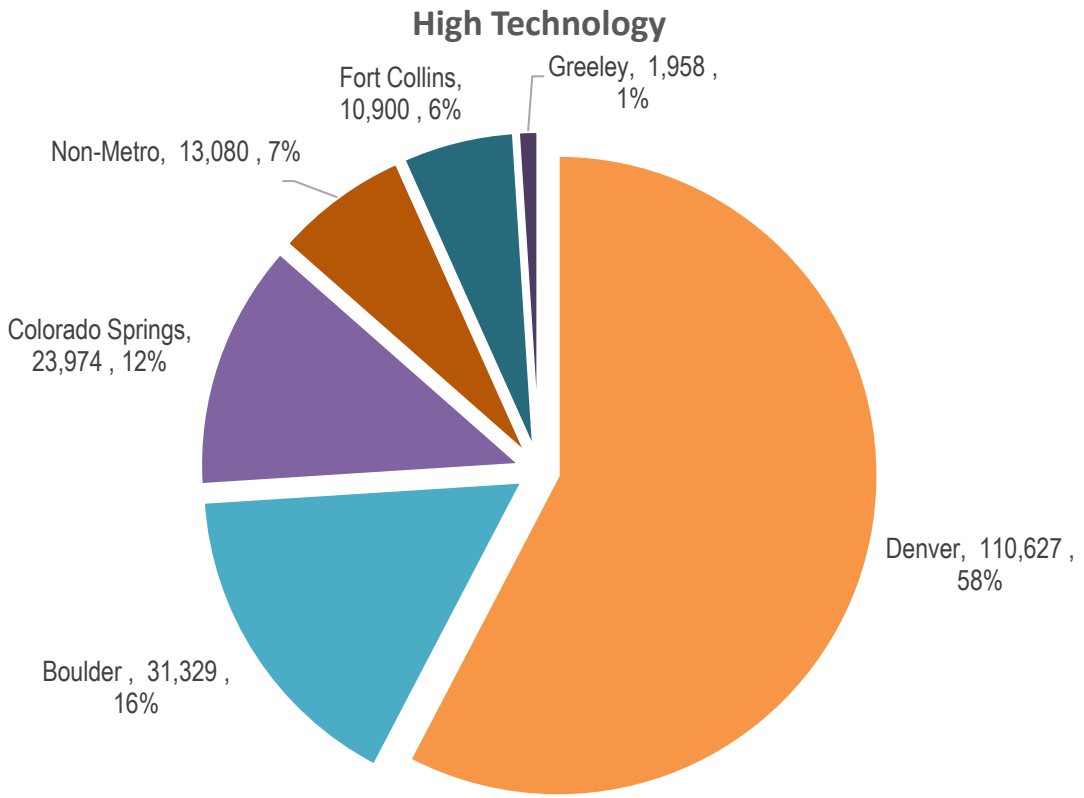
- Denver has 58% of the HT employees but 53% of the HT establishments.
- Boulder has 16% of the HT employees and 13% of the HT establishments.
- Colorado Springs has 12% of the HT employees and 11% of the HT establishments.
- Fort Collins has 6% of the HT employees and 7% of the HT establishments.

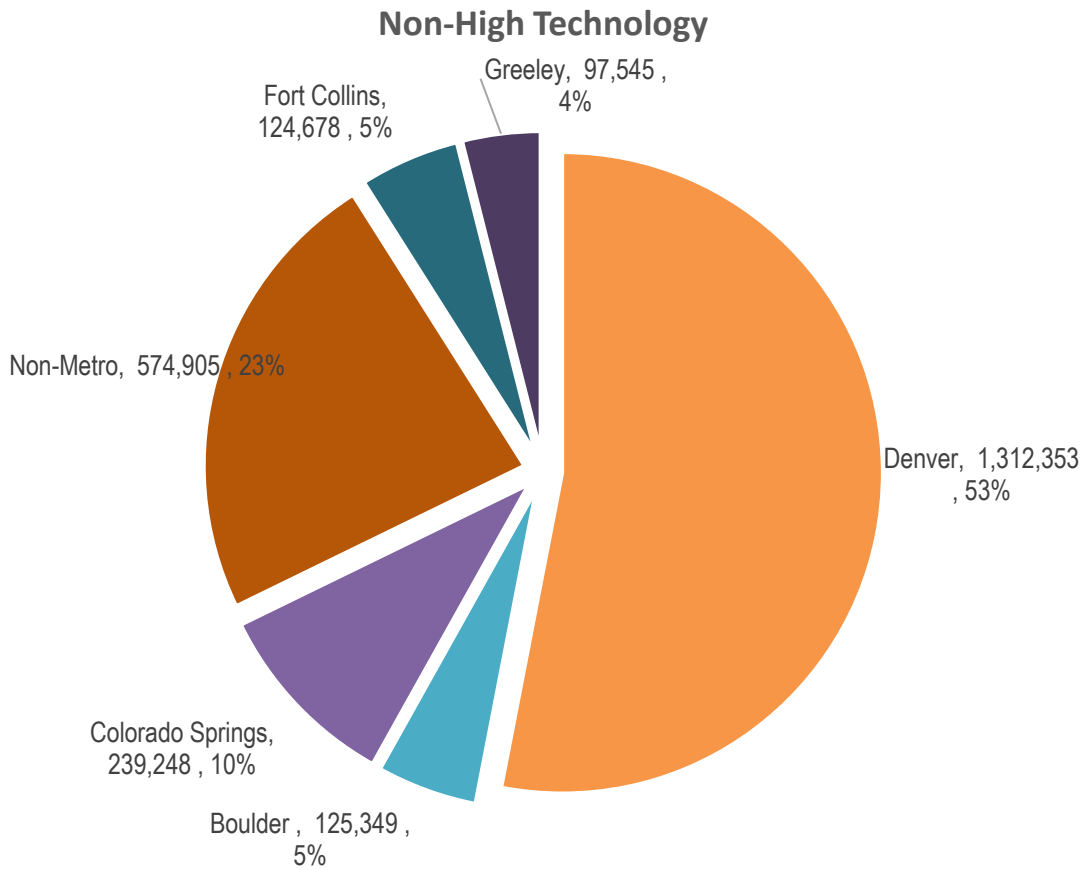
The breakdown of Colorado employees follows:

- 191,868 HT employees at 9,264 establishments.
- 2,2,282,210 non-HT employees at 148,777 establishments.
- 2,474,078 total HT+ non-HT employees at 158,041 establishments.

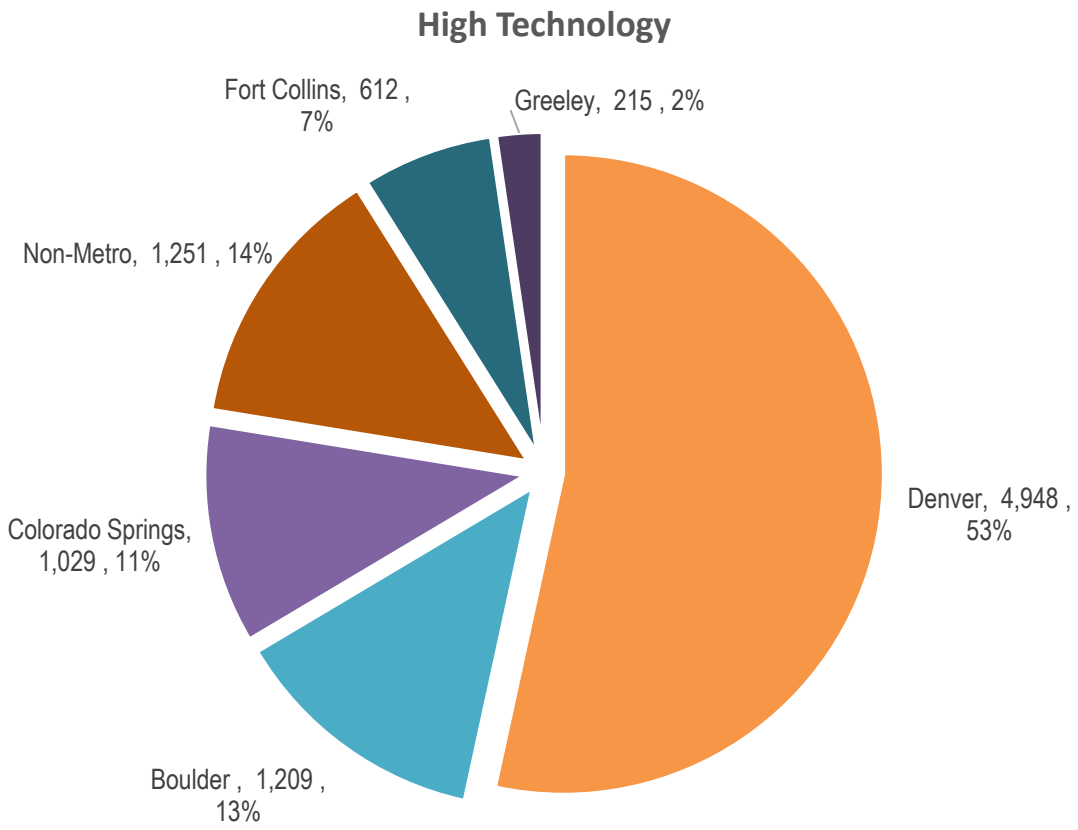
Note that this data series is different from the CES and QCEW employment data produced by the Bureau of Labor Statistics.

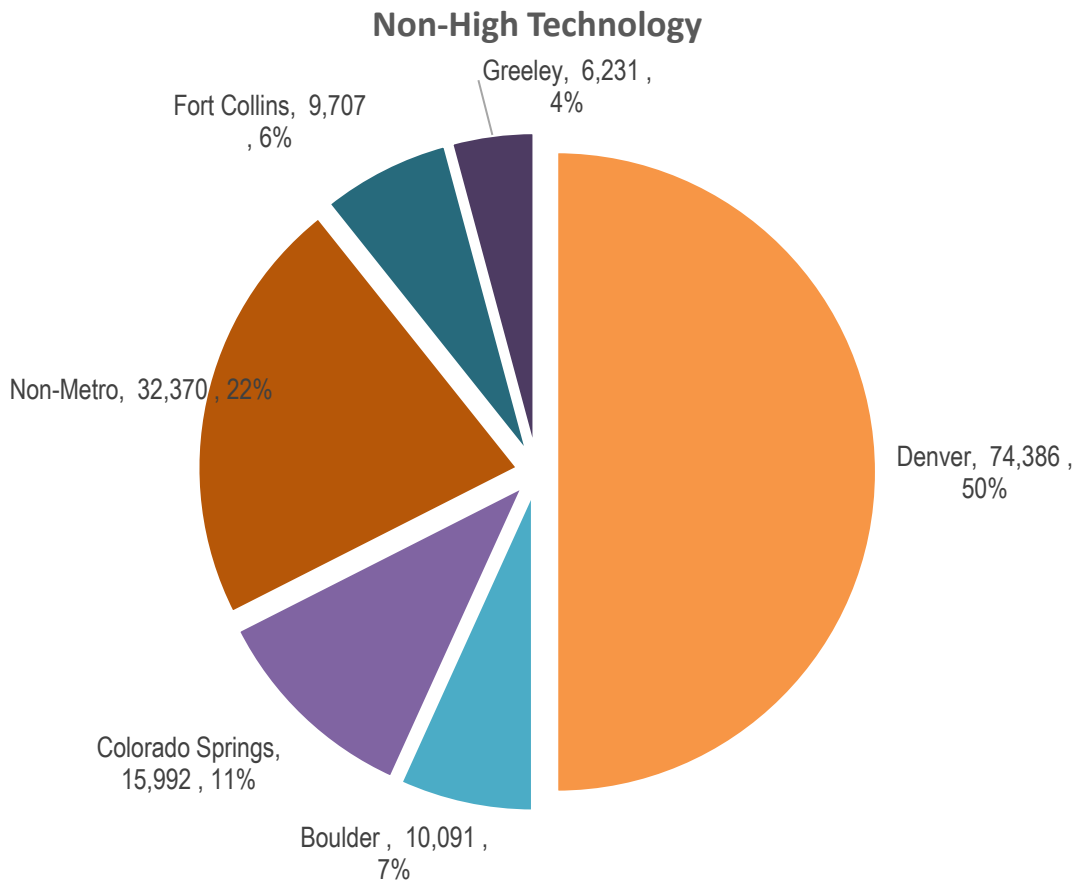
2022 Geographic Share of State Employment
High Technology vs. Non-Technology



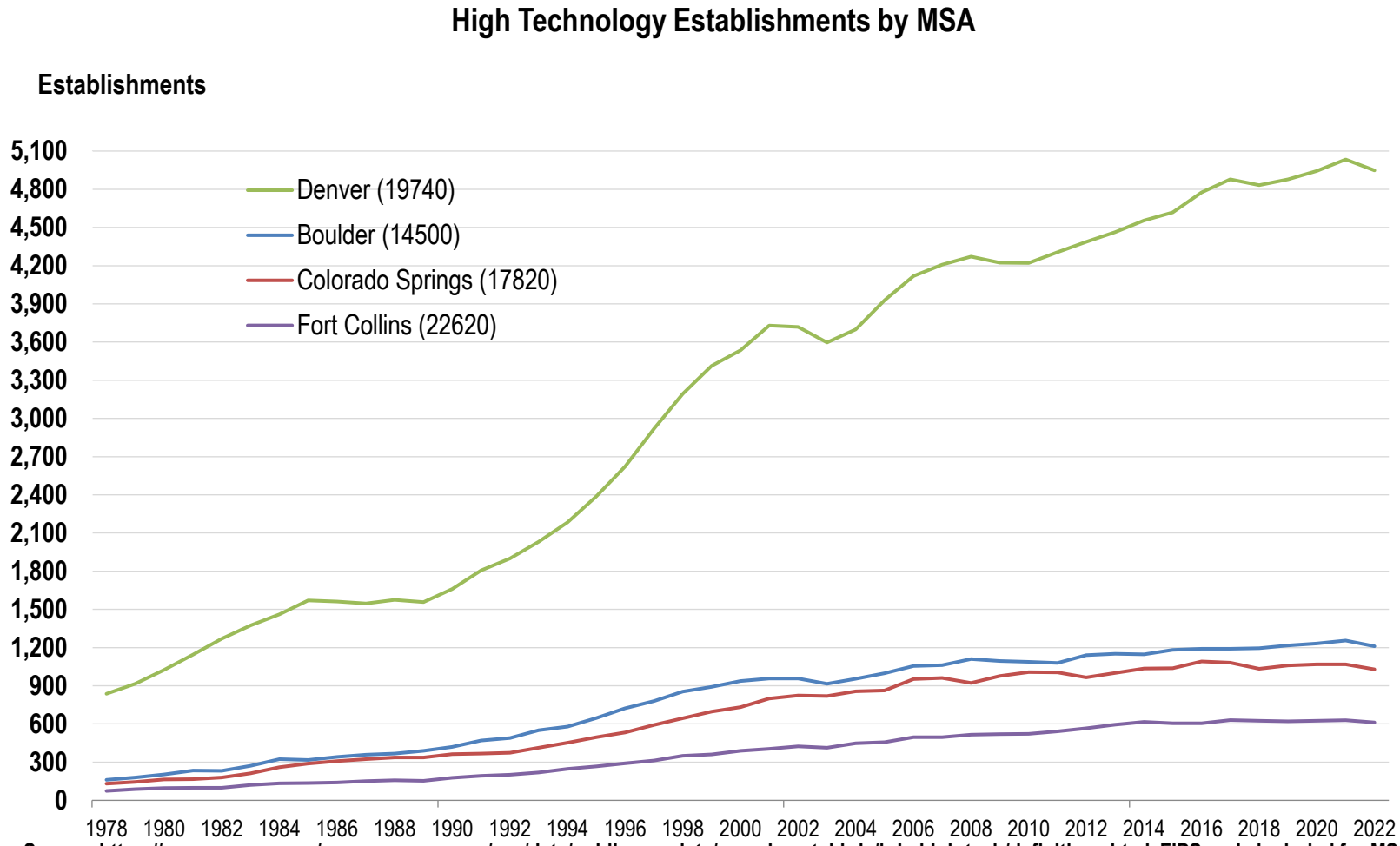


2022 Geographic Share of State Establishments
Technology vs. Non-Technology





High Technology Colorado
1978-2022 Number of Establishments



Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, FIPS code included for MSA, cber.co.

Number of Establishments

The number of Denver establishments was flat in the late 1980s. There were national and local recessions. There was a decline in the number of establishments after the 2001 recession, the Great Financial Crisis, and before and after the COVID-19 recession.

Employment for the Boulder, Colorado Springs, and Fort Collins MSAs spiked around 2000 (the end of the tech boom).

Colorado HT changed at that time, and the mix of companies by primary NAICS codes shifted away from Manufacturing to the Professional, Scientific, and Technical sector.

- HT employment for Boulder peaked at 33,056 in 2000. At that time, there were 936 establishments. There were 1,209 in 2022.
- Colorado Springs HT employment topped out at 28,253 in 2001. There were 800 establishments. In 2022, there were 1,029.
- Fort Collins HT peaked at 11,860 in 1997. There were 312 establishments. In 2022, there were 612.

Entries and Exits for HT and non-HT Establishments and U.S. and Colorado Survival Rates

Key Points

Establishment entries measure the number of new establishments started during a year. Likewise, establishment exits measure the number of establishments that closed during a year.

The establishment entry rate measures the formation of new businesses, and the establishment exit rate measures their closure. These rates express entries and exits as a percentage of the total number of establishments.

From 1978 through 2006, the HT and non-HT entries and exits increased at a steady pace, then growth tapered off. From 2007 to 2022, the entry rates typically exceeded the exit rate for HT and non-HT employment. There were exceptions around the Great Financial Crisis and the 2020 recession.

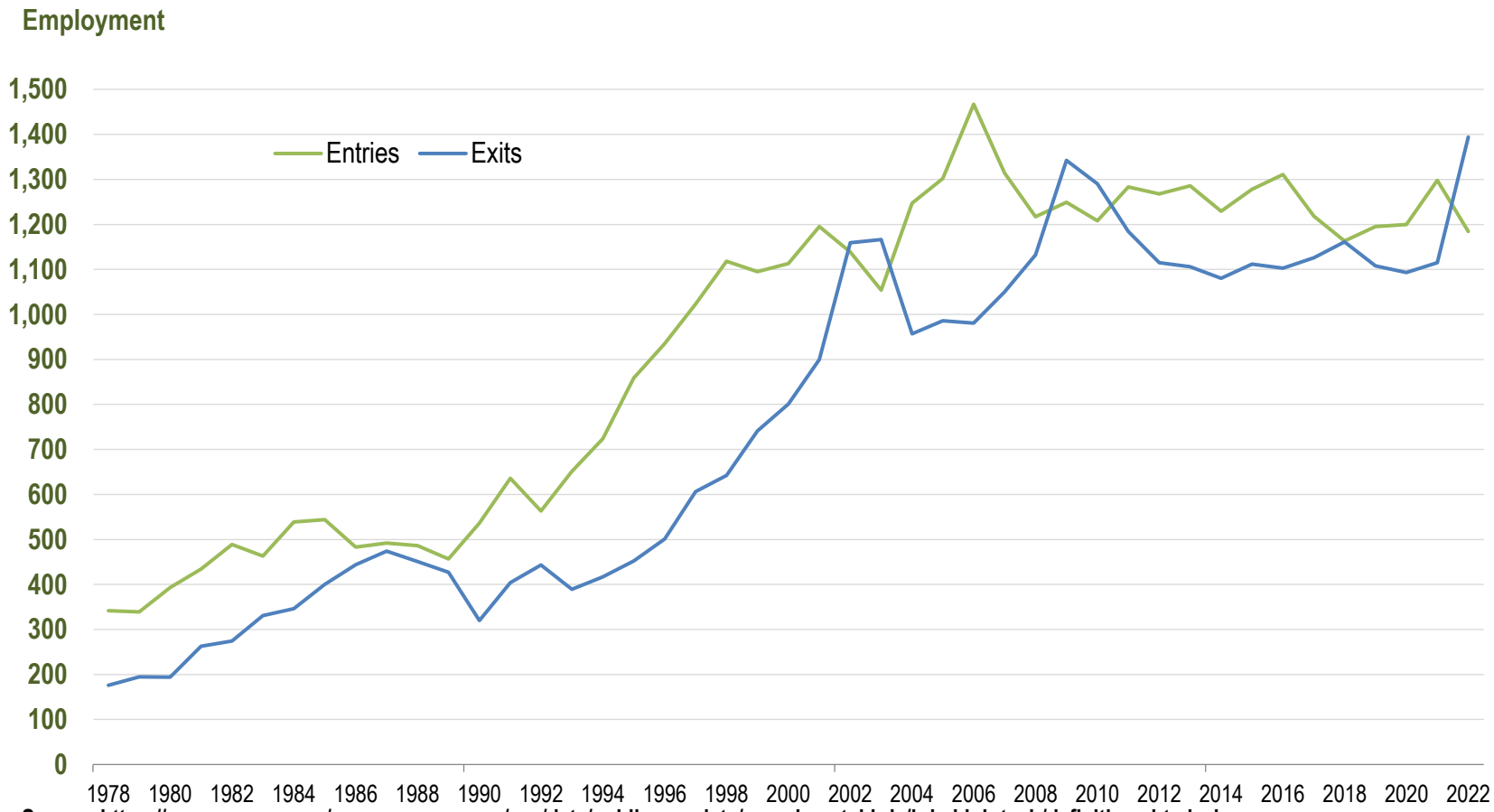
Between 1978 and 2022, the HT entry rate and non-HT rates declined. The non-HT exit rates declined. The HT exit rates were volatile, but they trended flat. The entry rates typically exceeded the exit rates for HT and non-HT.

The survival rates for the defined HT industries (U.S. manufacturing, information, and PST industries) were risky. Innovation was strong from 1995 to 2001 and weaker from 2002 to 2022.

Colorado establishments (HT and non-HT) have been resilient over the past 45 years.

High Technology Colorado
1978-2022 Establishment Entries vs. Establishment Exits

High Technology Establishment Entries vs. Exits



Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

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Establishment Entries vs. Exits

1978-1993 – There was modest growth in the number of entries and exits. A significant recession occurred during the 1980s.

1994 - 2001 – Strong growth occurred in entries and exits during the 1990s tech boom. Between 1978 and 2001, the number of entries (green) exceeded the exits (blue).

2002 - 2022 – There was limited job growth during the 2000s (the Lost Decade). In 2002, 2003, 2009, and 2010, the number of exits exceeded the entries.

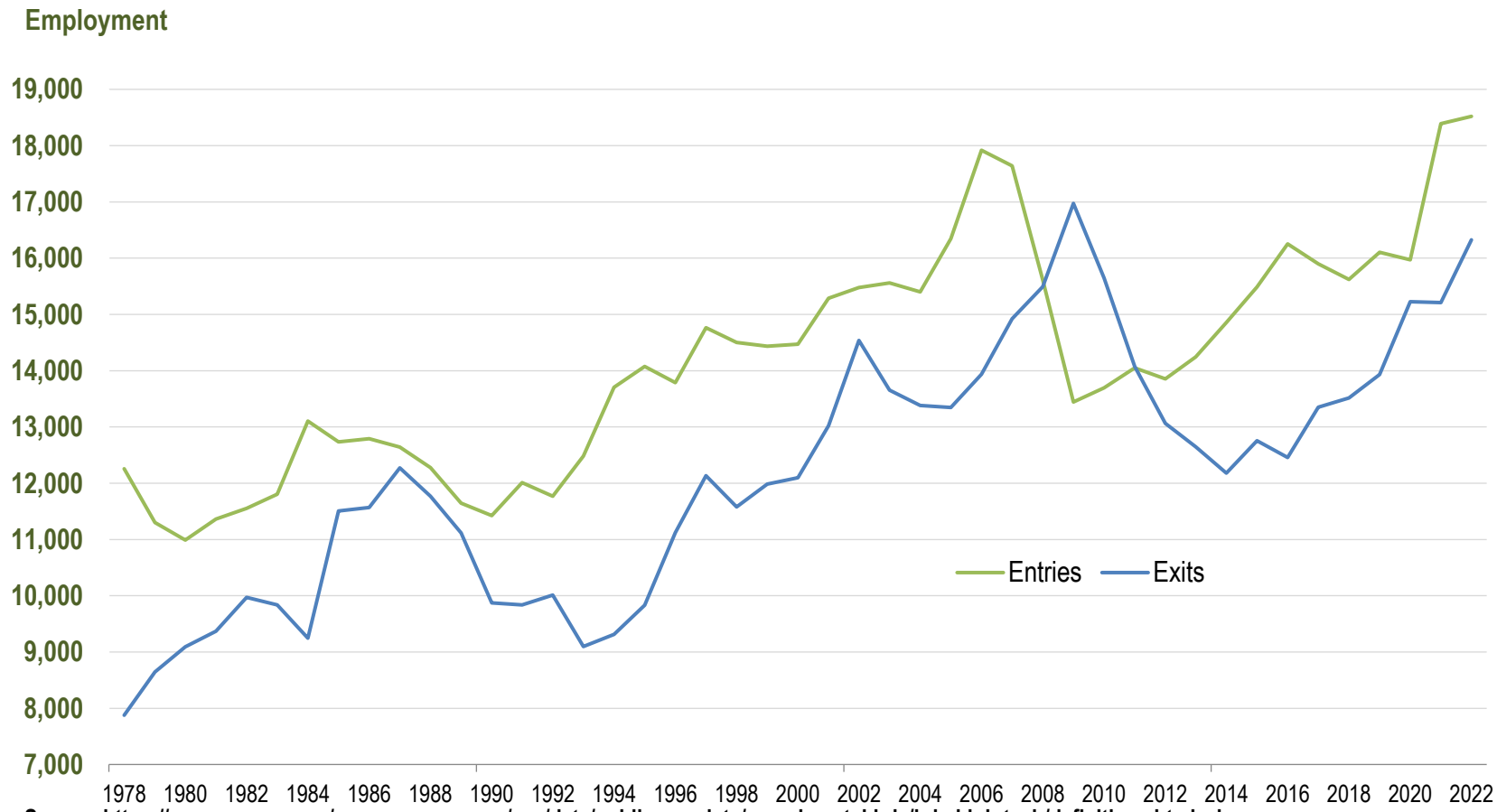
There was strong overall employment growth between 2012 and 2019. During that period, entries exceeded exits.

There was an uptick in the number of entries in 2021 that seemed to be temporary. The number of exits reached new levels in 2022.

The number of exits exceeded the number of entries in five years: 2002, 2003, 2009, 2010, and 2022.

Non-High Technology Colorado
1978-2022 Establishment Entries vs. Establishment Exits

Non-High Technology Establishment Entries vs. Exits



Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

Establishment Entries vs. Exits

The change in the number of non-HT establishment entries and exits was volatile but trended upwards. Changes in the exits (blue) lagged changes in the entries (green).

1978-1993 – There was no growth in the number of entries during this period. The number of exits increased through 1987, presumably in line with the state recessions.

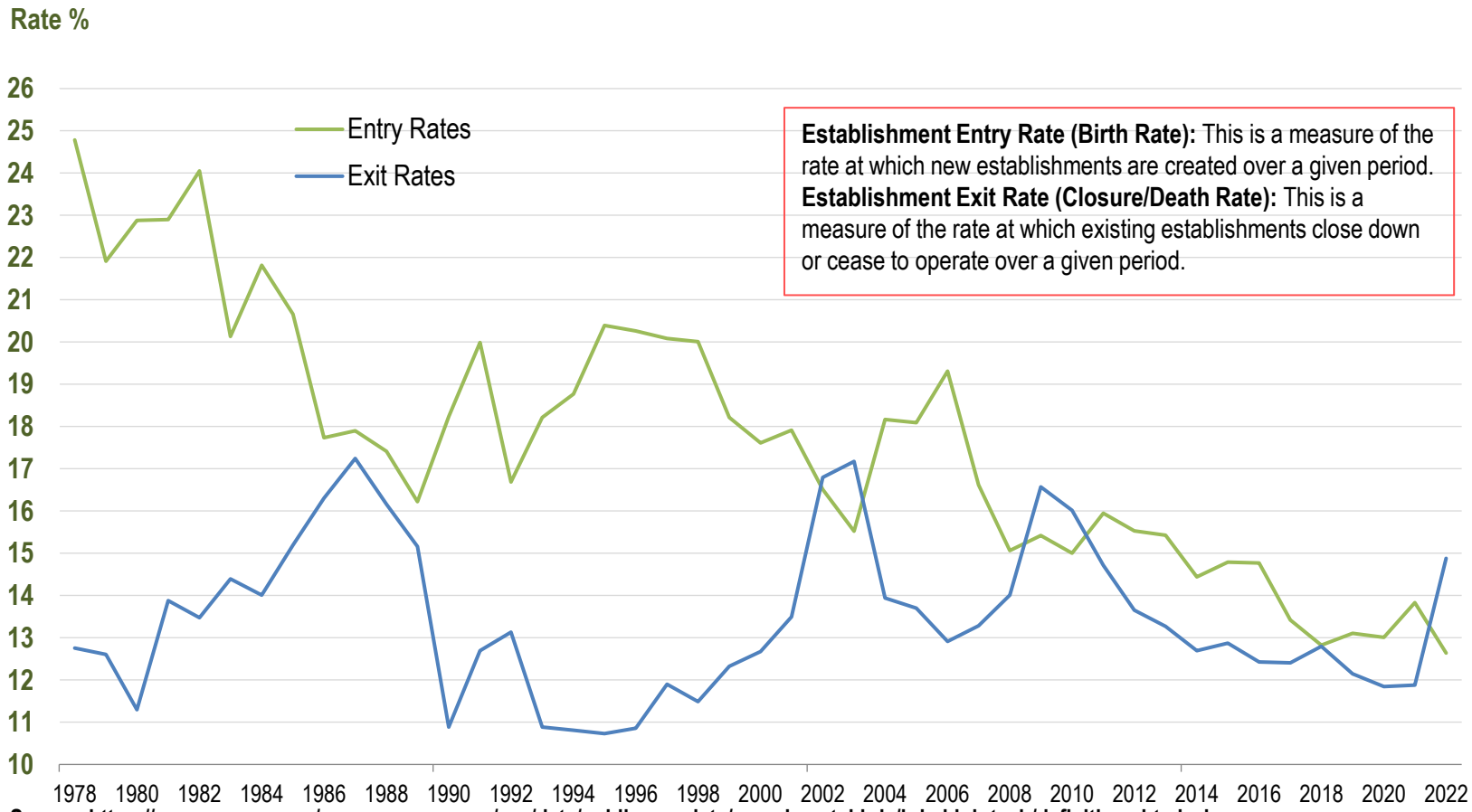
1994 - 2001 – Strong extended growth occurred during the tech boom. Entries exceeded exits.

2002 – 2011 – The entries and exits increased during the first part of the Lost Decade. There was a decrease in the number of entries from 2006 to 2011. There was an increase in the number of exits from 2007 to 2011 (Great Financial Crisis). The number of exits exceeded the number of entries in 2009, 2010, and 2011.

2012 – 2022 The number of entries and exits trended upward. Entries exceeded exits.

High Technology Colorado
1978-2022 Establishment Entry Rates vs. Establishment Exit Rates

High Technology Establishment Entry Rates vs. Exit Rates



Establishment Entry Rate (Birth Rate): This is a measure of the rate at which new establishments are created over a given period.
Establishment Exit Rate (Closure/Death Rate): This is a measure of the rate at which existing establishments close down or cease to operate over a given period.

Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

Establishment Entries vs. Exits

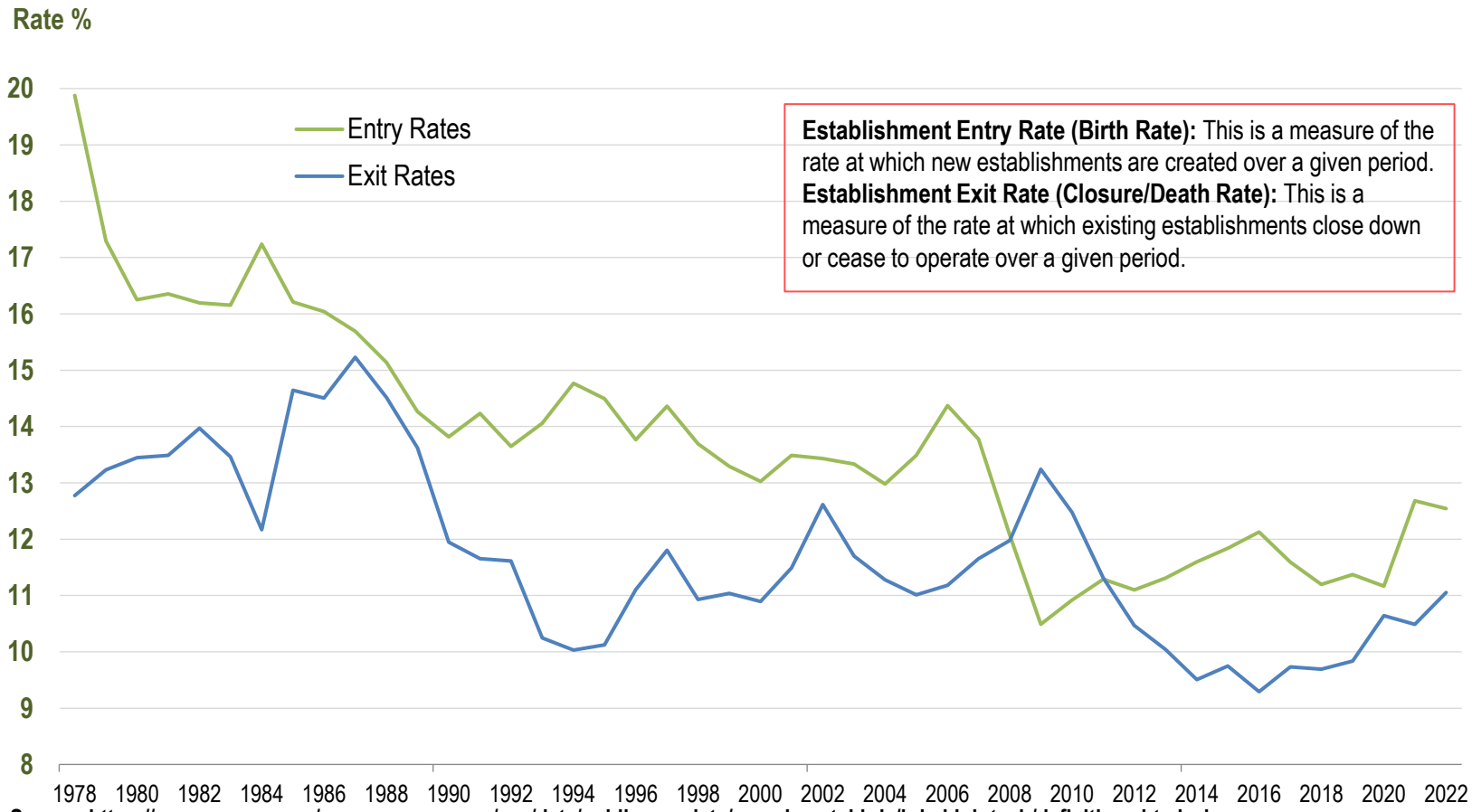
The entry rate (green) for HT establishments declined from 24.8% in 1978 to 12.6% in 2022. More recently, the rates dropped from 15.9% in 2011 to 12.6% in 2022.

Slower growth during the "Lost Decade" (2000s) and the impact of the Great Financial Crisis were a result of the downward trend in the entry rate and the increase in the exit rates (blue). Similarly, the strong job growth between 2012 and 2021 in HT establishments was a result of entry rates exceeding exit rates.

The periods of high exit rates for HT establishments follow the 1980s recession (1987), the 2001 recession (2002-2003), the Great Financial Crisis (2009-2010), and the pandemic (2022).

Non-High Technology Colorado
1978-2022 Establishment Entry Rates vs. Establishment Exit Rates

Non-High Technology Establishment Entry Rates vs. Exit Rates



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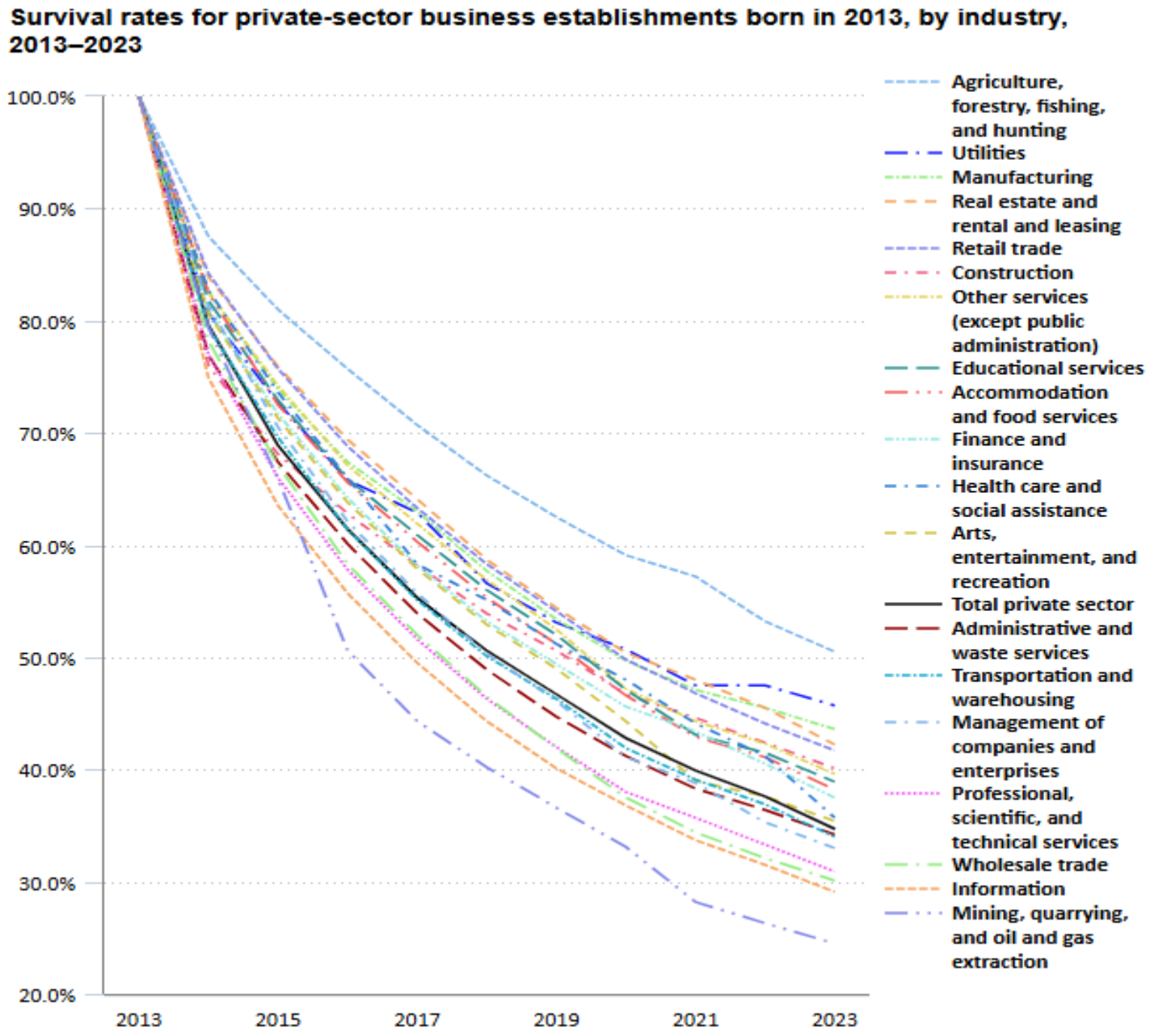
Establishment Entries vs. Exits

The non-HT entry rate (green) declined significantly from 19.9% in 1978 to 13.8% in 1990. It was relatively flat from 1990 to 2007, then declined between 2008 and 2022. It was 12.5% in 2022.

The non-HT exit rates (blue) increased from 12.8% in 1978 to 15.2% in 1987, then trended downward to 11.1% in 2022.

The exits parallel the entry rates with a lag, except for 2008, 2009, and 2010. In those years, the exit rates exceeded the entry rates.

Non-HT establishments tended to react more favorably to changing economic conditions than HT establishments.



U.S. Survival Rates All Industries

The chart shows the negative impact of establishment exits over time. It illustrates the survival rates for U.S. establishments by NAICS industry.

The chart shows the survival rate of establishments opened in 2013. They are in descending order based on the percentage that has survived in 2023. The scale is on the left.

- About 50.5% of the agriculture, forestry, fishing, and hunting establishments were opened in 2013 and were still in existence in 2023 (top).
- Only 24.5% of mining, quarrying, and oil and gas extraction establishments opened in 2013 were in existence in 2023 (bottom).

The sectors that are relevant to Colorado HT follow:

- Manufacturing 43.6%.
- Professional, scientific, and technical services 30.9%
- Information 29.1%.

The survival rates for PST and Information are comparatively weak.

Source: https://www.bls.gov/opub/ted/2024/34-7-percent-of-business-establishments-born-in-2013-were-still-operating-in-2023.htm#:~:text=The%20agriculture%2C%20forestry%2C%20fishing%2C,Establishment%20Age%20and%20Survival%20Data.

Colorado Survival Rates All Industries

- In 2013, there were 13,850 establishments opened in Colorado, and 4,211 were still open in 2024.
- The establishment survival rate is 30.4% in 2024.
- The number of employees increased from 52,519 in 2013 to 58,419 in 2019 (pre-COVID). The number of employees has since decreased to 51,379 in 2024.
- The average number of employees per establishment increased from 3.8 in 2013 to 12.2 in 2024.
- The survival rates were above 90.0% for all establishments (prior year) since 2017 (8 years).
- Between 1995 and 2001, the starting annual total employment from surviving companies was greater than 90,000. The total was below 73,000 from 2002 to 2022. The totals for 2023 and 2024 exceeded 80,000 (not shown). Innovation in all industries may be returning to Colorado.

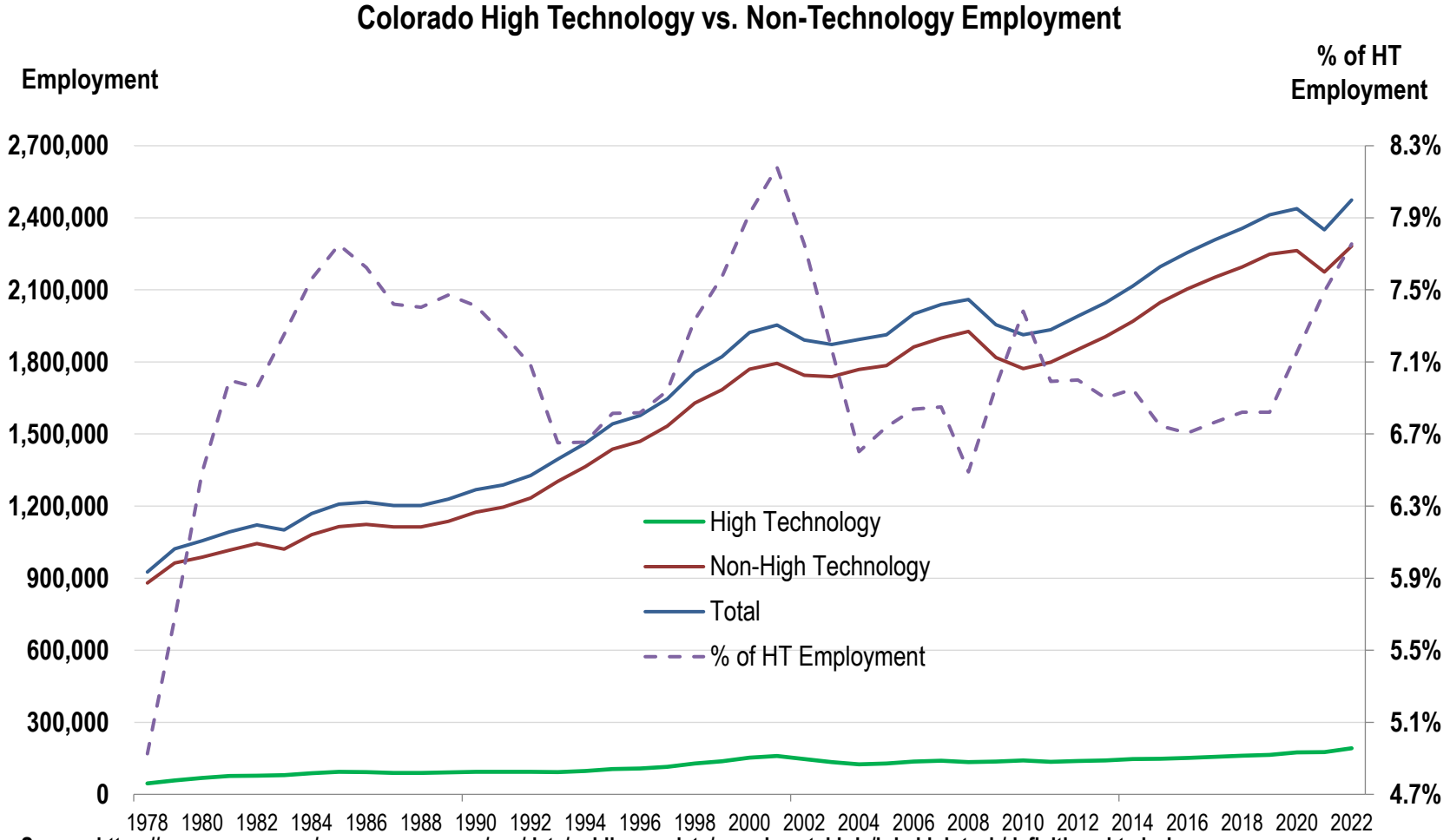
Survival of private sector establishments by opening year - Colorado					
Year	Annual Openings	Total Employees	Survival Rates	Survival Rates Prior Year	Average Employees
March 2013	13,850	52,519	100.0%	-	3.8
March 2014	10,996	54,977	79.4%	79.4%	5.0
March 2015	9,548	56,480	68.9%	86.8%	5.9
March 2016	8,404	56,678	60.7%	88.0%	6.7
March 2017	7,609	57,197	54.9%	90.5%	7.6
March 2018	6,891	58,005	49.8%	90.6%	8.4
March 2019	6,346	58,419	45.8%	92.1%	9.2
March 2020	5,711	56,483	41.2%	90.0%	9.9
March 2021	5,425	54,809	39.2%	95.0%	10.1
March 2022	5,068	56,550	36.6%	93.4%	11.2
March 2023	4,635	54,641	33.5%	91.5%	11.8
March 2024	4,211	51,379	30.4%	90.9%	12.2
Source: https://www.bls.gov/bdm/co_age_total_table7.txt					

Colorado HT Employment

Key Points

- Colorado HT employment initially peaked in 2001 at 159,810 employees.
- In 2001, HT employment was 8.2% of total employment (HT + non-HT employment).
- Colorado HT employment increased to 191,868 in 2022, an increase of 32,058 from the previous peak in 2001.
- In 2022, HT employment was 7.8% of the total.
- Half of the US HT employees work in seven states (CA, TX, NY, VA, FL, MA, and WA)
- In 2022, Colorado was ranked 13th among all states with 191,868 HT employees.

High Technology vs. Non-High Technology Employment
1978-2022 Colorado



High Tech vs. Non-High Tech

Colorado high-tech (HT) employment (green) was 45,594 in 1978. It was 139,378 in 2012, an increase of 93,784.

In 2022, there were 191,868 HT employees. The increase was 52,490 from 2012. There was an increase of 146,724 from 1978.

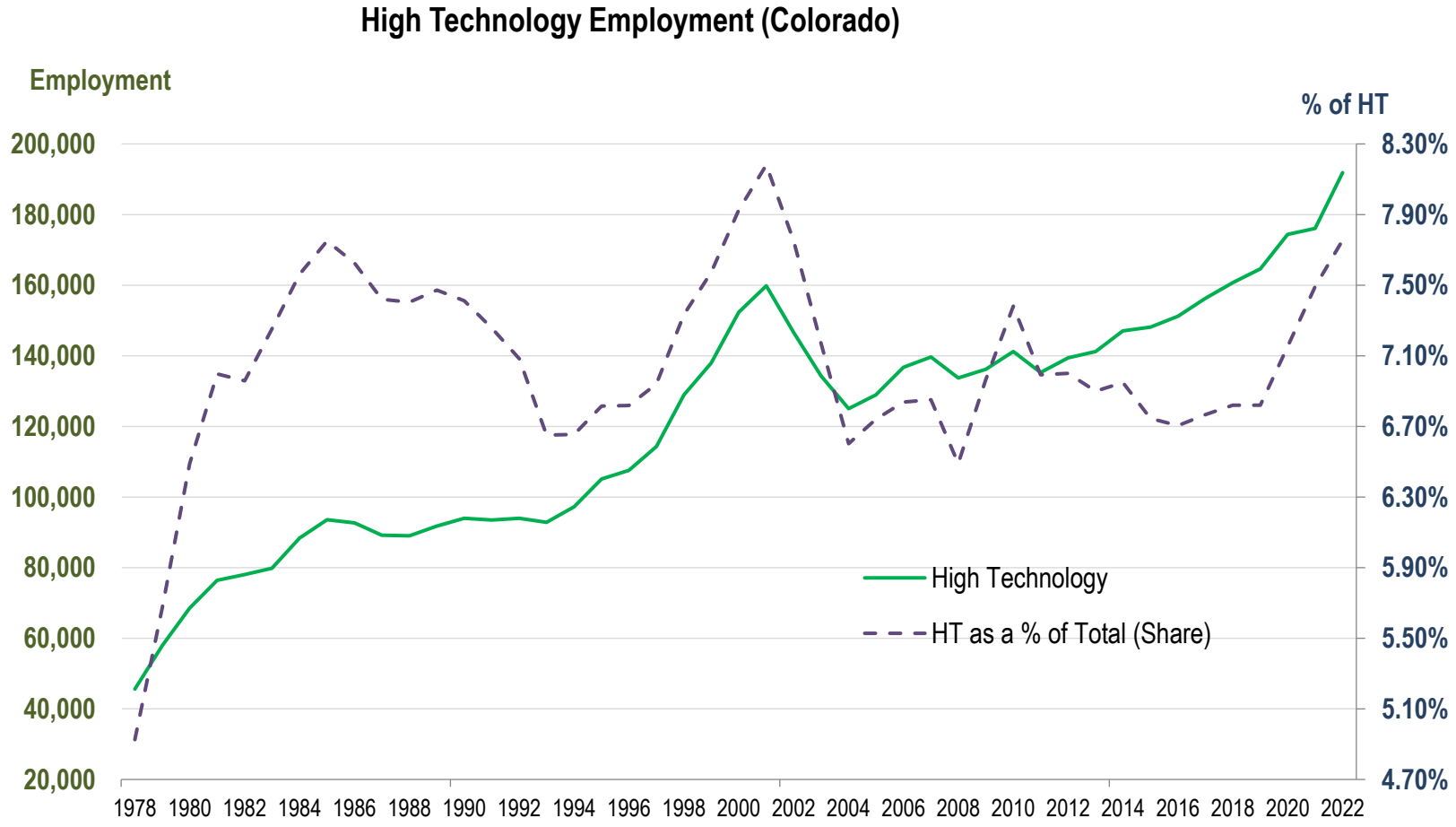
In 2022, HT employment was 7.8% (dotted purple line) of total employment (HT and non-HT). The range of the HT employment share was between 4.9% in 1978 and a peak of 8.2% in 2001.

Non-HT employment (red) increased by 1,402,141 from 880,069 in 1978 to 2,282,210 in 2022.

Total HT and non-HT employment (blue) increased from 925,663 in 1978 to 2,474,078 in 2022.

Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

High Technology
1978-2022 Colorado



High Tech Employment

HT employment (green) has had periods of strong growth, stagnation, and decline.

There were four periods of growth

- 1978 to 1985
- 1993 to 2001 – Colorado tech boom.
- 2005 to 2007 – A growth spurt occurred after the downturn following the 2001 recession.
- 2011 to 2022 – Employment growth occurred after the Great Financial Crisis. There was growth during and after the pandemic

HT employment share increased significantly between 1978 and 2001, from 4.9% to 8.2%.

There were periods of stagnation and decline:

- 1986 to 1992 – lost market share
- 2002 to 2004 – lost market share
- 2010 to 2019 – lost market share.

Each downturn or period of limited growth followed a recession. Note that during a period of strong growth after the Great Financial Crisis, HT employment increased, but it lost market share.

Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

Top States by Number of HT Employees 2022

Top States by Number of HT Employees					
Rank	FIPS	State	Establishments	HT Employees	Avg. Employees/Establishments
1	6	CA	45,615	1,412,055	31.0
2	48	TX	25,154	633,803	25.2
3	36	NY	16,745	398,371	23.8
4	51	VA	13,353	381,624	28.6
5	12	FL	21,621	349,690	16.2
6	25	MA	9,085	343,438	37.8
7	53	WA	8,307	264,710	31.9
8	17	IL	10,555	252,079	23.9
9	42	PA	10,426	239,802	23.0
10	34	NJ	10,084	228,969	22.7
11	24	MD	8,404	228,303	27.2
12	13	GA	9,133	223,980	24.5
13	8	CO	9,264	191,868	20.7
14	37	NC	8,282	191,447	23.1
15	39	OH	7,585	188,998	24.9
16	26	MI	6,983	179,106	25.6
17	4	AZ	5,665	144,679	25.5
18	27	MN	5,116	134,051	26.2
19	29	MO	3,775	121,192	32.1
20	9	CT	3,157	111,266	35.1

Top States by Number of HT Employees

In 2022, the top two states in HT employment were California and Texas. They had 2,045,858 HT employees. The following five states had 1,737,833 HT employees. The top seven states had 3,783,691 HT employees. About half of all HT employees worked in these states.

The remaining states and the District of Columbia employed a total of 3,780,607 HT employees.

Colorado was ranked 13th for the number of HT employees. It was ranked 21st for the number of non-HT employees (not shown).

Colorado has a competitive advantage in the number of HT employees. That advantage is in smaller, specific clusters, such as aerospace, defense, bioscience, quantum, and cybersecurity.

The Colorado HT industry is a small but critical part of the Colorado and U.S. economies.

Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

Average Number of HT and non-HT Employees per Establishment

Key Points

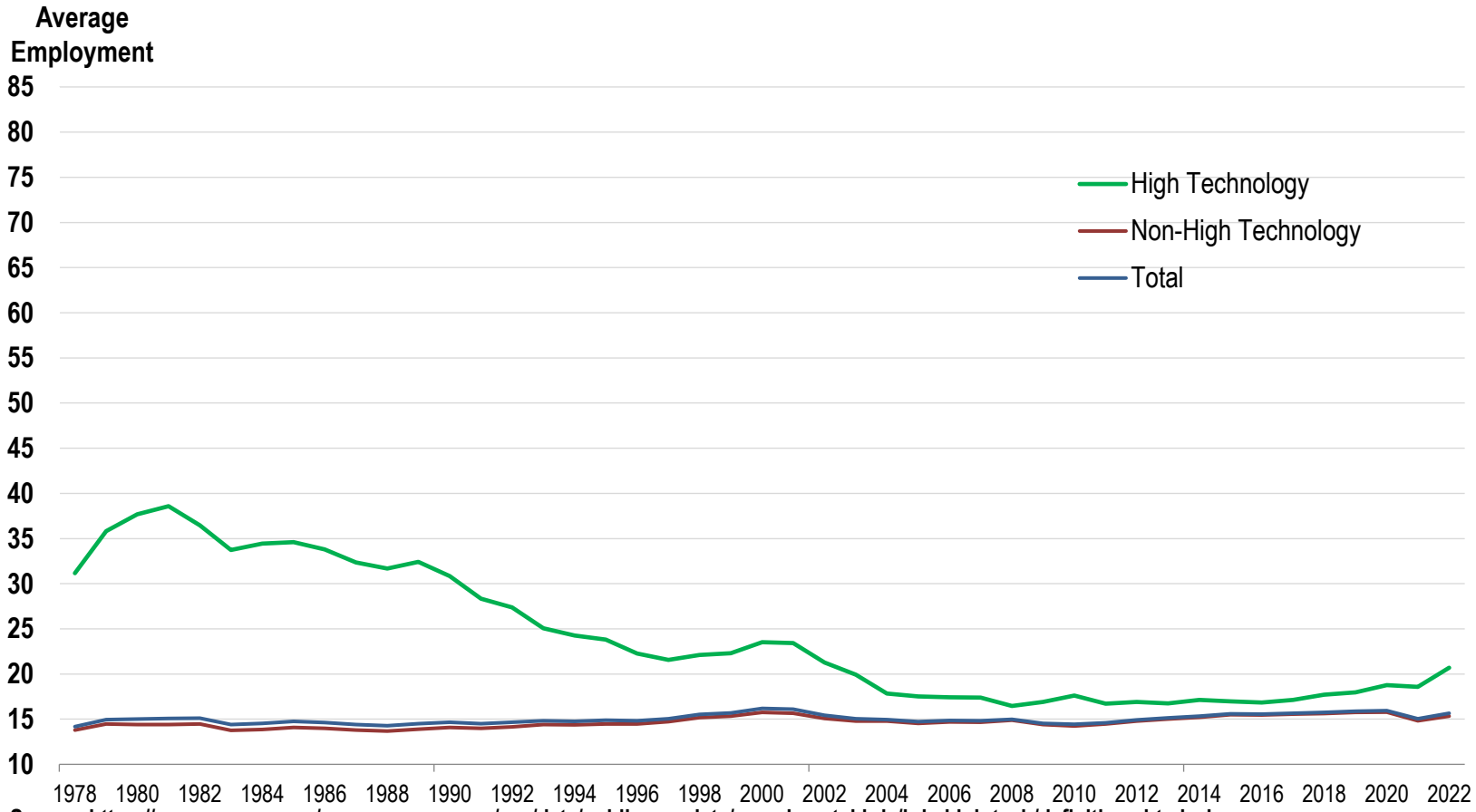
The average number of employees at Colorado HT establishments is greater than for non-HT establishments.

On average, there were 21 employees at Colorado HT establishments in 2022. The range was 18 to 26 HT employees for establishments in the four MSAs.

On average, there were 15 employees at Colorado non-HT establishments in 2022.
The range was 12 to 18 non-HT employees for the four MSAs.

High Technology vs. Non-High Technology
1978-2022 Colorado (Average Number of Employees)

High Technology vs. Non-Technology Average Employees Per Establishment (Colorado)



Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

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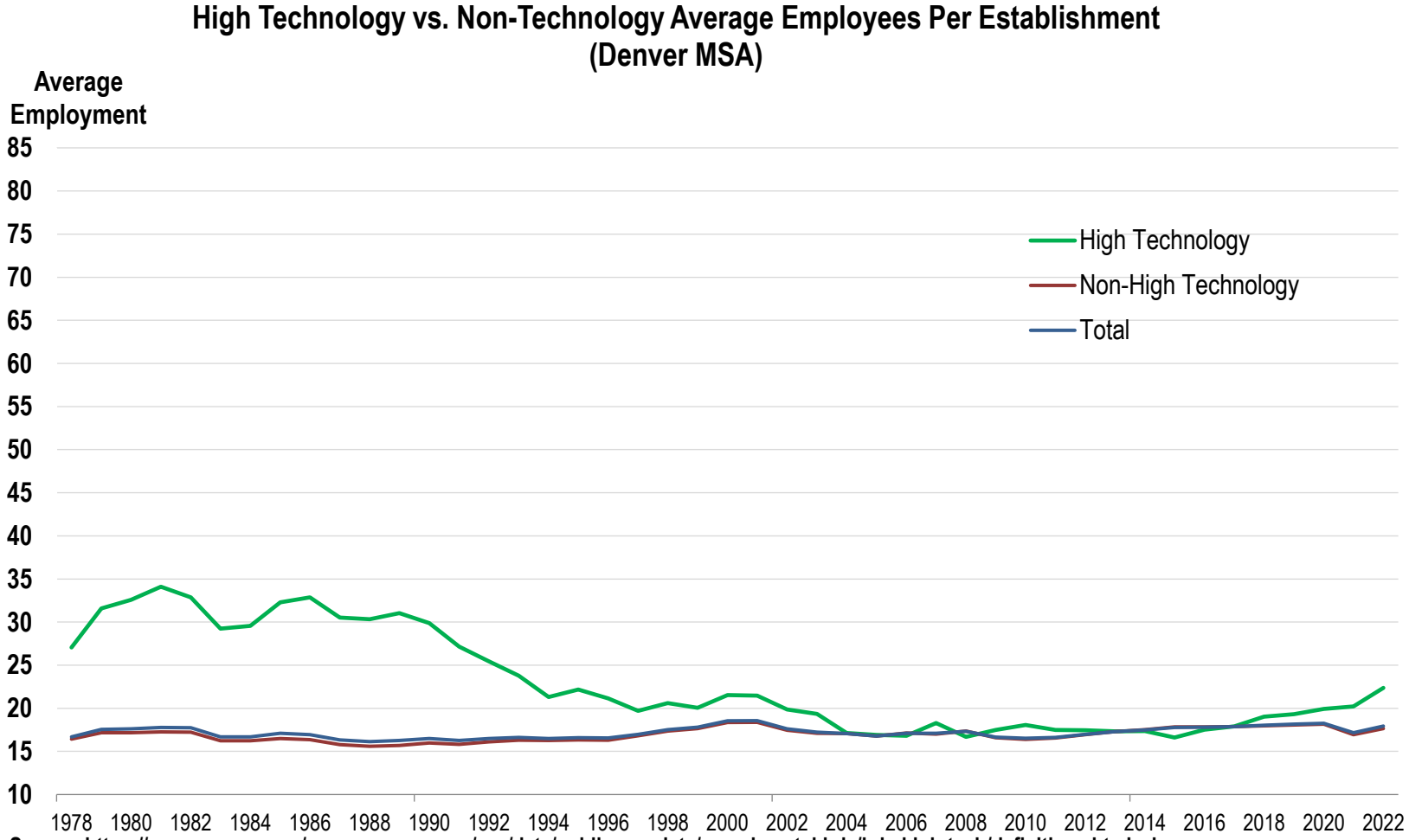
High Tech vs. Non-High Tech Average Employees

In 1978, the average number of employees at Colorado HT companies was 31, much higher than the average for non-HT and total employment. Proportionately, there were a higher number of large HT companies, which contributed to the higher average. The average declined with the formation of new establishments and the loss of larger establishments. In 2022, the average number of HT employees per establishment was 21. The average number per non-HT establishment was 15.

Year	HT Avg.	Non-HT Avg.	Total Avg.
1978	31	14	14
2012	17	15	15
2022	21	15	16

High Technology vs. Non-High Technology
1978-2022 Denver (Average Number of Employees)



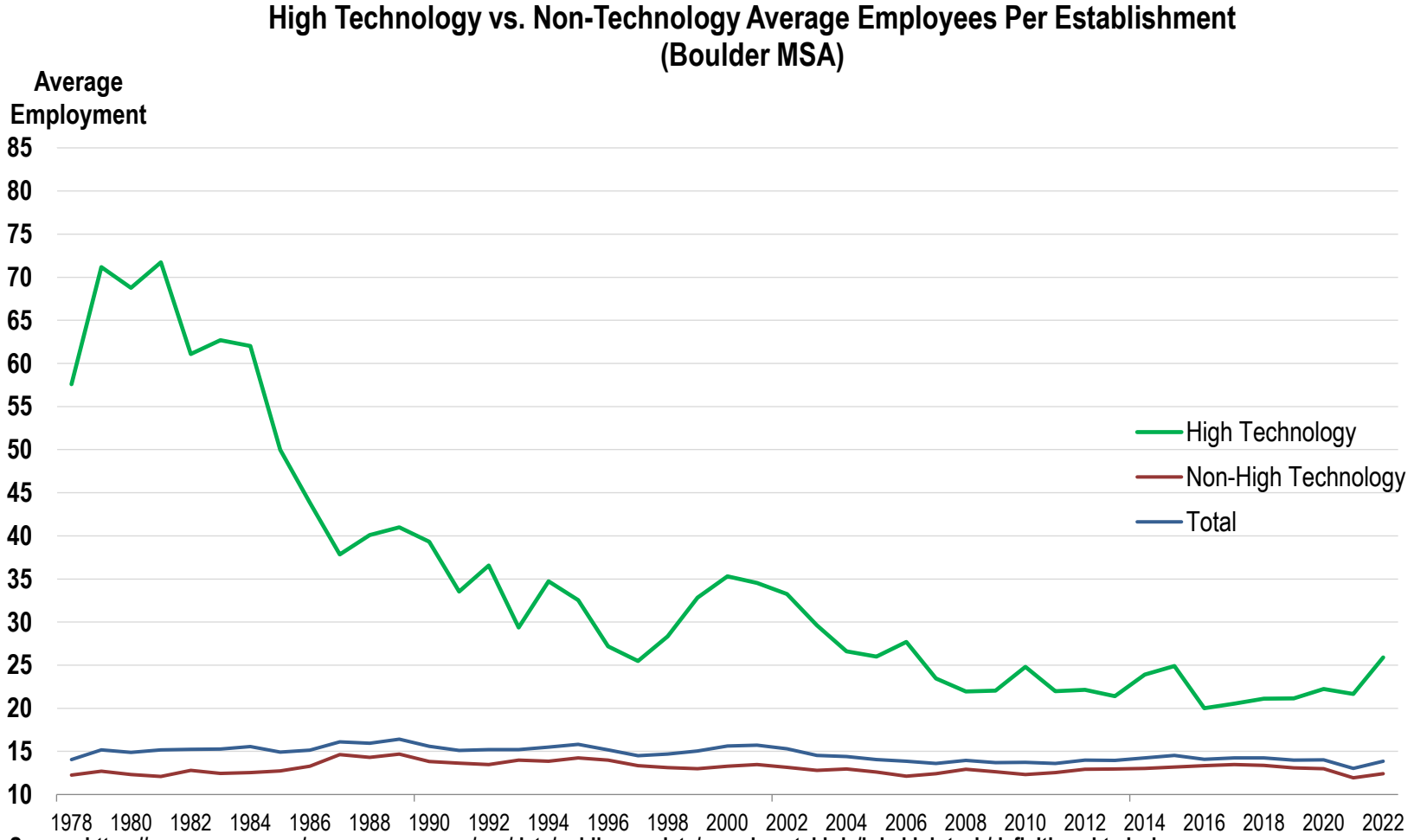
High Tech vs. Non-High Tech

In 2022, Denver had 110,627 HT employees, or 58% of the state's HT employment. On average, there were 22 employees per HT establishment. By comparison, non-HT businesses had an average of 18 employees.

Year	HT Avg.	Non-HT Avg.	Total Avg.
1978	27	16	17
2012	17	17	17
2022	22	18	18

Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

High Technology vs. Non-High Technology
1978-2022 Boulder (Average Number of Employees)



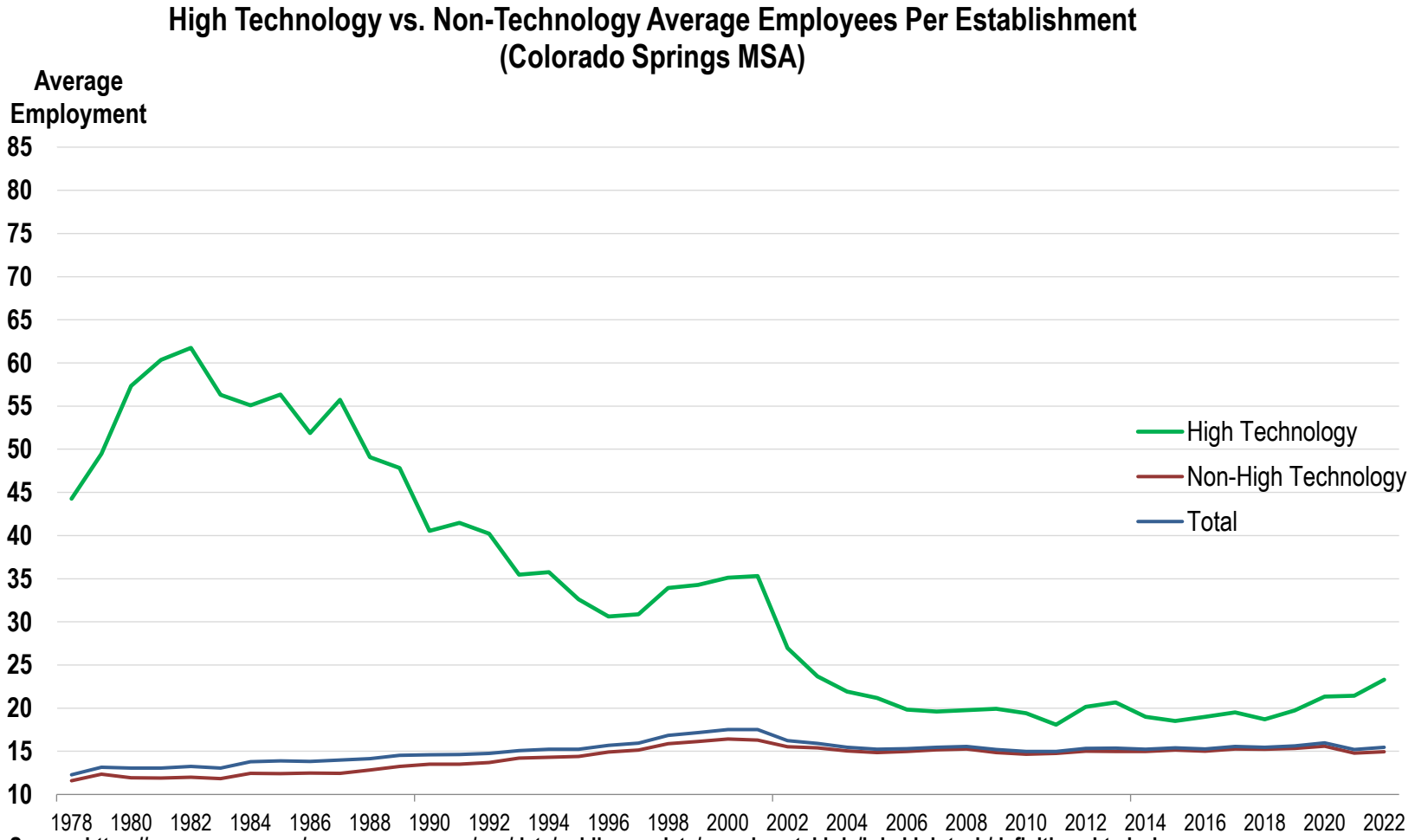
High Tech vs. Non-High Tech

In 2022, Boulder had 31,329 HT employees, 16% of the Colorado HT total. On average, there were 26 employees per HT company. By comparison, non-HT Boulder establishments had an average of 12 employees.

Year	HT Avg.	Non-HT Avg.	Total Avg.
1978	58	12	14
2012	22	13	14
2022	26	12	14

Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

High Technology vs. Non-High Technology
1978-2022 Colorado Springs (Average Number of Employees)



High Tech vs. Non-High Tech

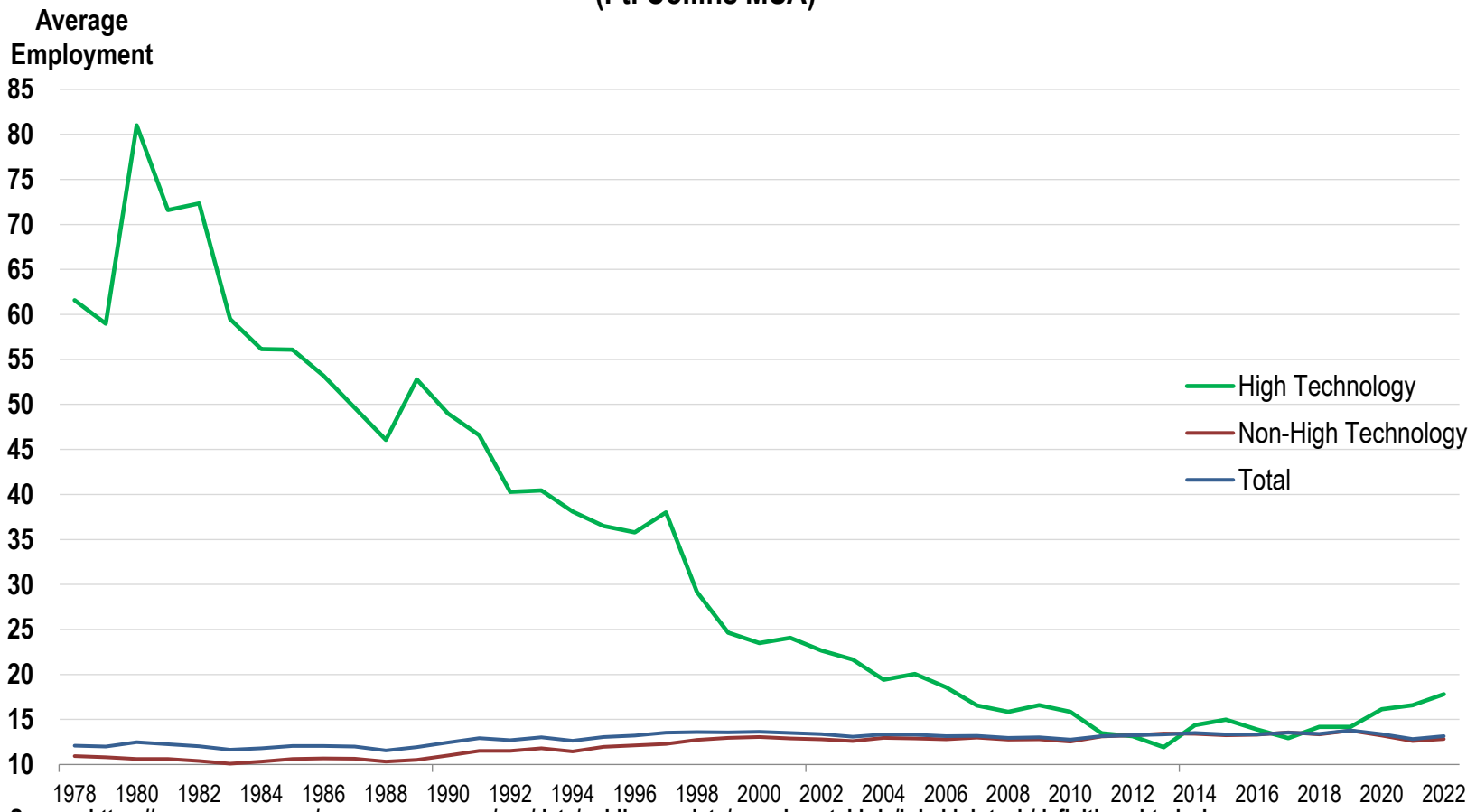
In 2022, Colorado Springs had 23,974 HT employees, 12% of the Colorado HT total. On average, there were 23 employees per HT company. By comparison, non-HT businesses had an average of 15 employees.

Year	HT Avg.	Non-HT Avg.	Total Avg.
1978	44	12	12
2012	20	15	15
2022	23	15	15

Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

High Technology vs. Non-High Technology
1978-2022 Ft. Collins (Average Number of Employees)

High Technology vs. Non-Technology Average Employees Per Establishment (Ft. Collins MSA)



Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

Colorado-based Business and Economic Research https:cber.co

High Tech vs. Non-High Tech Employment

In 2022, Fort Collins had 10,900 HT employees, or 6% of Colorado's HT employment. On average, there were 18 employees per HT company. By comparison, non-HT businesses had an average of 13 employees.

Year	HT Avg.	Non-HT Avg.	Total Avg.
1978	62	11	12
2012	13	13	13
2022	18	13	13

HT, Non-HT, and Total (HT + non-HT) Major Coarse MSAs Employment

Key Points

In 2022, there were 191,868 Colorado HT employees and 2,282,210 Colorado non-HT employees. The total was 2,474,078. HT employment was 7.8% of total HT and non-HT employment.

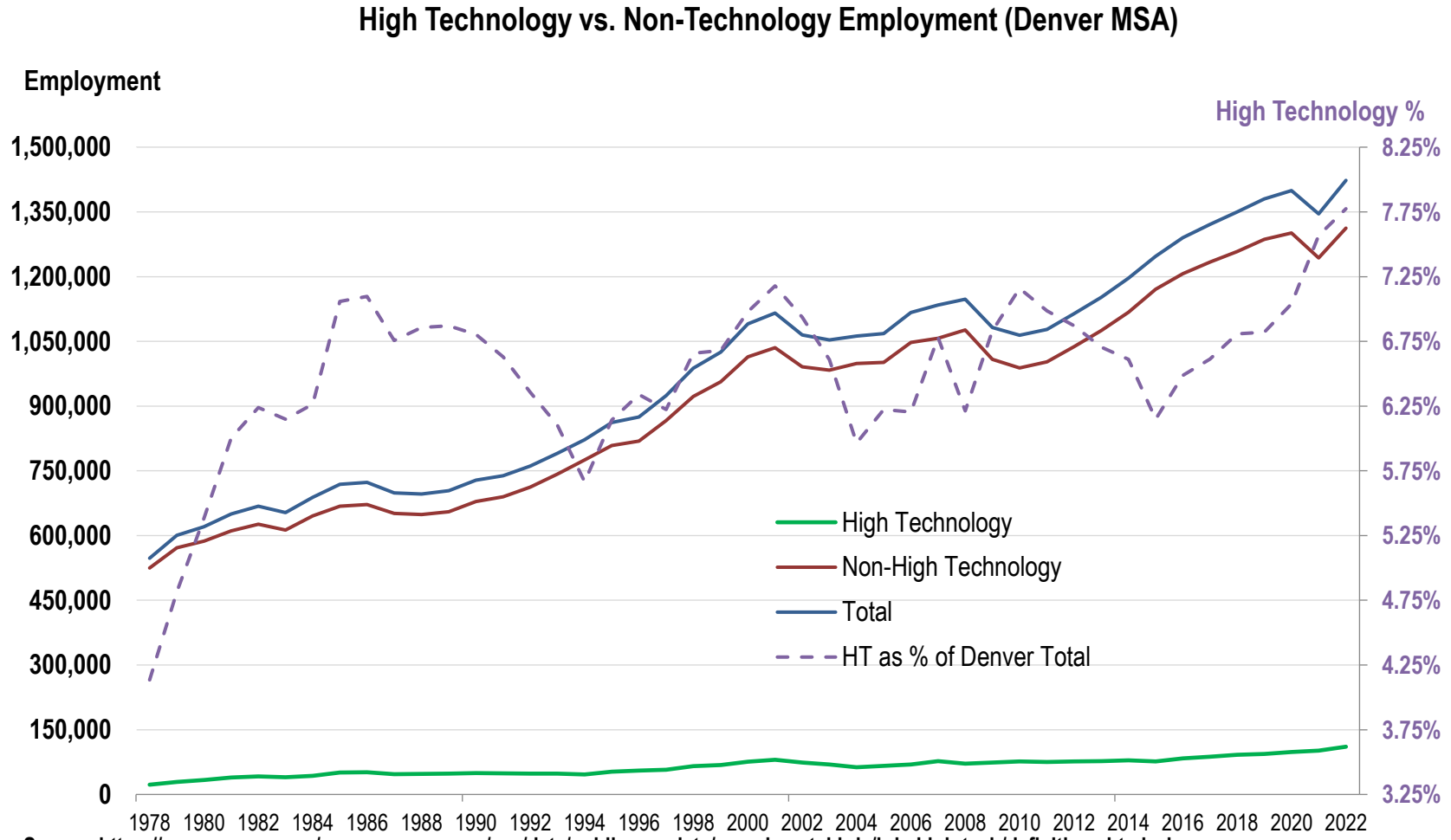
The change in HT employment was different by MSA:

- Denver HT employment increased from 22,636 in 1978 to a peak of 110,627 in 2022.
- Boulder HT employment was 9,272 in 1978. It peaked at 33,056 in 2000 and declined to 31,329 in 2022.
- Colorado Springs HT employment was 5,800 in 1978. It peaked at 28,253 in 2001. HT employment was 23,974 in 2022.
- Fort Collins HT employment was 4,557 in 1978. It peaked at 11,860 in 1997 and declined to 10,900 in 2022.

In the Denver MSA, the importance of HT employment increased as an economic driver. HT employment decreased in the other three MSAs.

The definition of HT employment includes 11 NAICS sectors. The data does not identify changes by NAICS sector. Nor does it identify market segments where Colorado and its MSAs had competitive advantages. The employment changes are likely a result of reduced employment growth in the durable goods manufacturing and information sectors. In addition, there has been increased employment growth in the professional, scientific, and technical sectors.

High Technology vs. Non-High Technology/HT % of Employment 1978-2022 Denver MSA



High Tech vs. Non-High Tech

About 58% of the state's HT employment was in Denver in 2022.

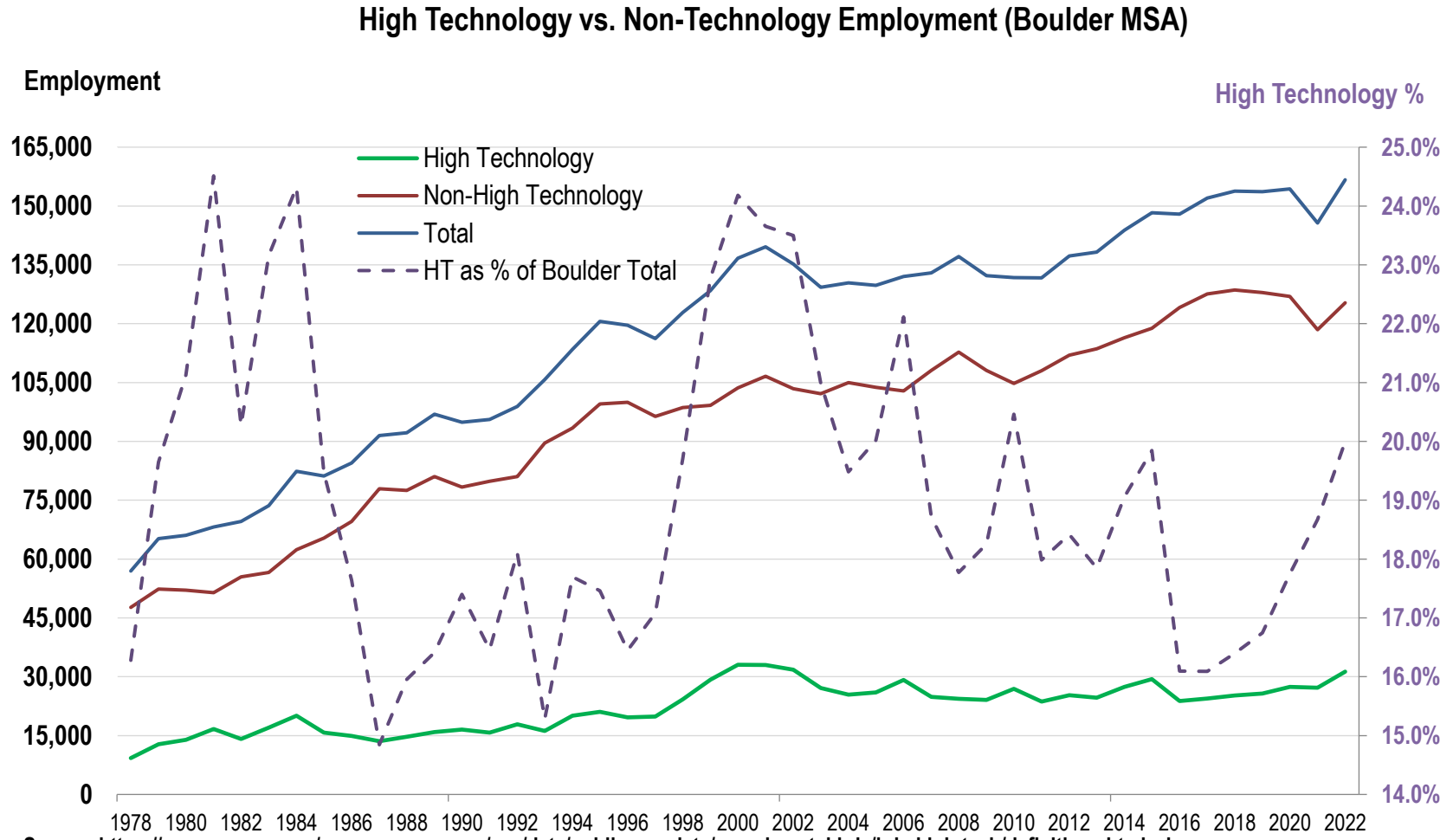
There was steady employment growth from 1978 to 2022 (blue). The path of non-HT employment (red) is similar to the path of total employment.

Denver HT (green) employment increased from 22,636 employees in 1978 to 110,627 in 2022. Denver non-HT grew from 524,809 in 1978 to 1,312,353 employees in 2022.

HT employment (dotted purple line) was 4.1% of total Denver employment in 1978. It increased to 7.8% in 2022. The Denver MSA economy is more diversified than other MSAs.

Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

High Technology vs. Non-High Technology/HT % of Employment 1978-2022 Boulder MSA



Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

High Tech vs. Non-High Tech

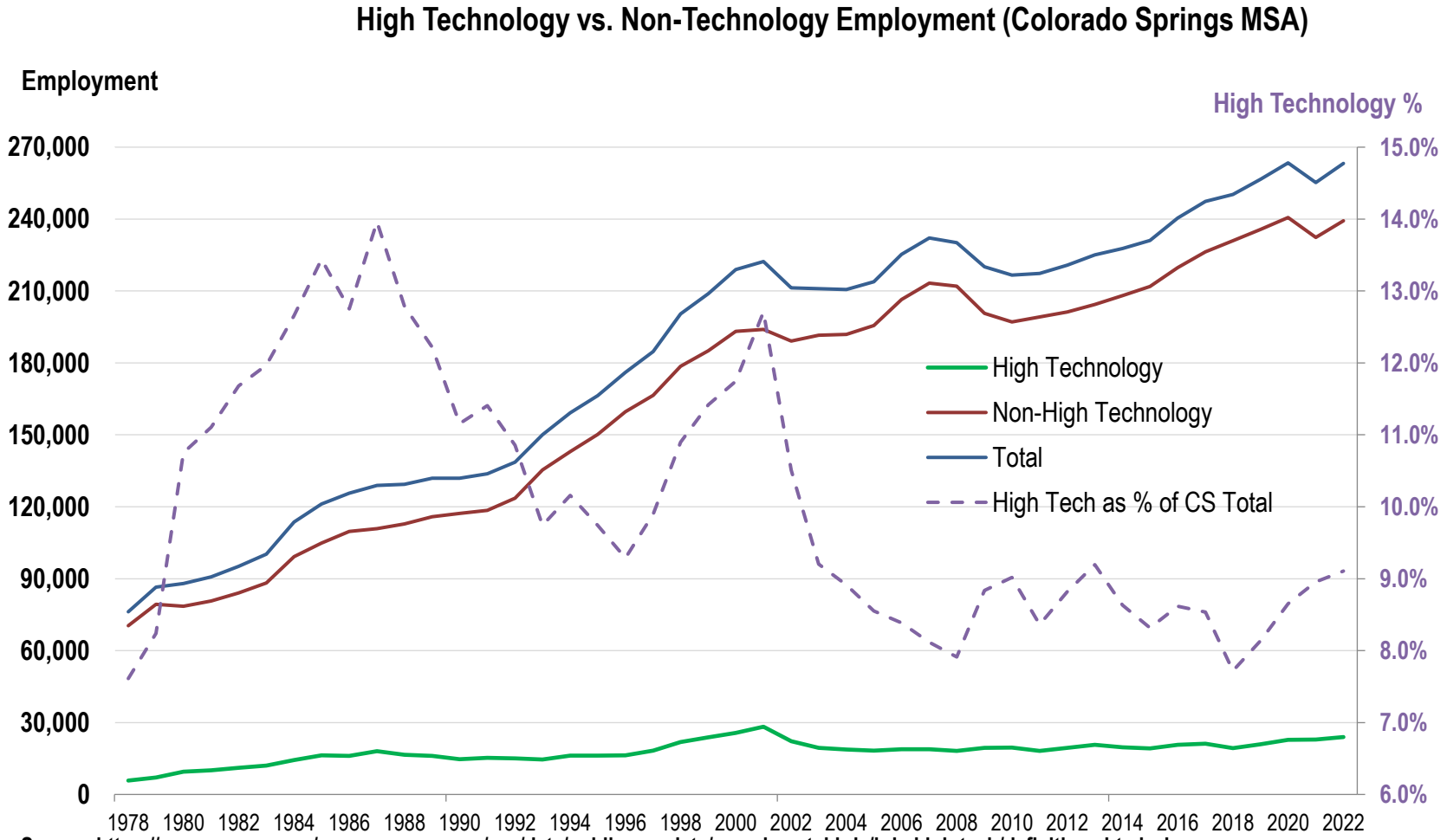
Approximately 16% of the state's HT employment was in the Boulder MSA as of 2022.

There was steady total growth (blue) from 1978 to 2001. Boulder HT employment (green) increased during this period; however, it was stagnant from 2002 to 2022. On the other hand, total growth (blue) plateaued between 2001 and 2013, and there was modest growth between 2014 and 2022.

Non-HT employment recorded steady growth through 2001 (red). It was flat from 2002 to 2007. There was modest non-HT employment growth from 2008 through 2018. It tapered off from 2019 to 2022.

HT employment accounted for 20% of Boulder employment in 2022. It ranged from 14.8% to 24.5% between 1978 and 2022. Boulder has a competitive advantage, but a disproportionately high level of HT employment for a small MSA.

High Technology vs. Non-High Technology/HT % of Employment 1978-2022 Colorado Springs MSA



Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

High Tech vs. Non-High Tech

Approximately 12% of the state's HT employment was in the Colorado Springs MSA in 2022.

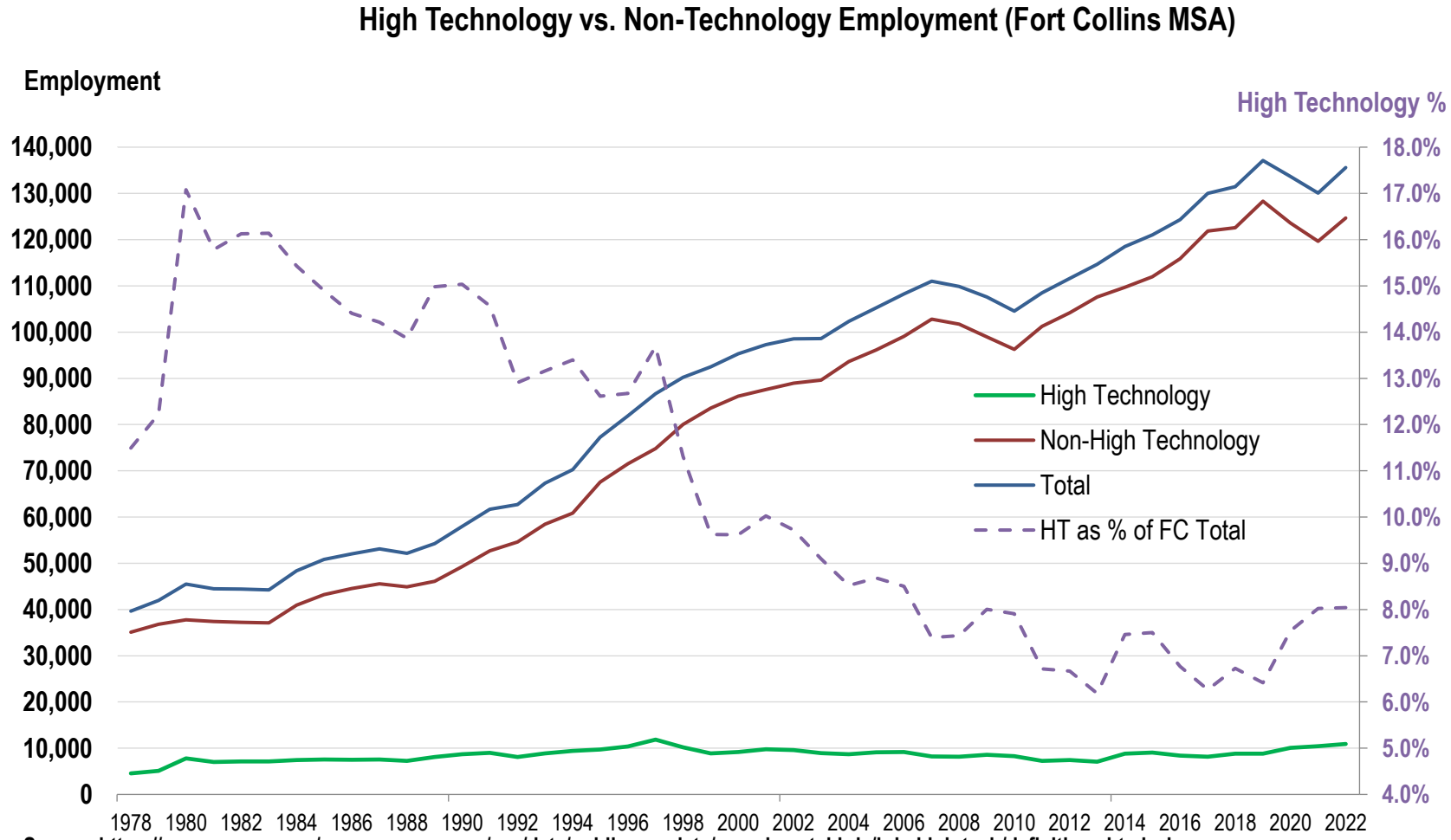
Total employment for Colorado Springs increased at a steady rate between 1978 and 2022 (blue line). The exception was in the years following recessions.

Non-HT employment paralleled total employment (red line).

HT employment increased from 5,800 (green line) in 1978 to 28,253 in 2001. Employment slipped to 23,974 in 2022.

HT employment was 8.0% of the Colorado Springs total in 1978 (purple dotted line). It spiked to 14.0% in 1987 and 12.1% in 2001. HT employment was 9.1% of the Colorado Springs employment in 2022. HT employment has been a competitive advantage for Colorado Springs.

High Technology vs. Non-High Technology/HT % of Employment 1978-2022 Fort Collins MSA



Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

Colorado-based Business and Economic Research https:cber.co

High Tech vs. Non-High Tech

Approximately 6% of the state's HT employment was in the Fort Collins MSA in 2022.

There was steady growth in total Fort Collins employment (blue) between 1978 and 2022. Slowdowns were associated with the Great Financial Crisis and the pandemic.

Non-HT employment (red) followed a path similar to total employment.

HT employment (green) increased from 4,557 in 1978 to 11,860 in 1997. It flattened out and was 10,900 in 2022.

HT employment (purple dotted line) was 11.5% of total Fort Collins employment in 1978. It gradually fell to 8.0% in 2022. HT employment has been a competitive advantage for Fort Collins.

Job Creation and Job Destruction – Colorado HT and non-HT Employment

Key Points

Job creation and destruction measure the number of employees added and eliminated. The job creation and destruction rates measure the changes, expressed as a percentage of employment.

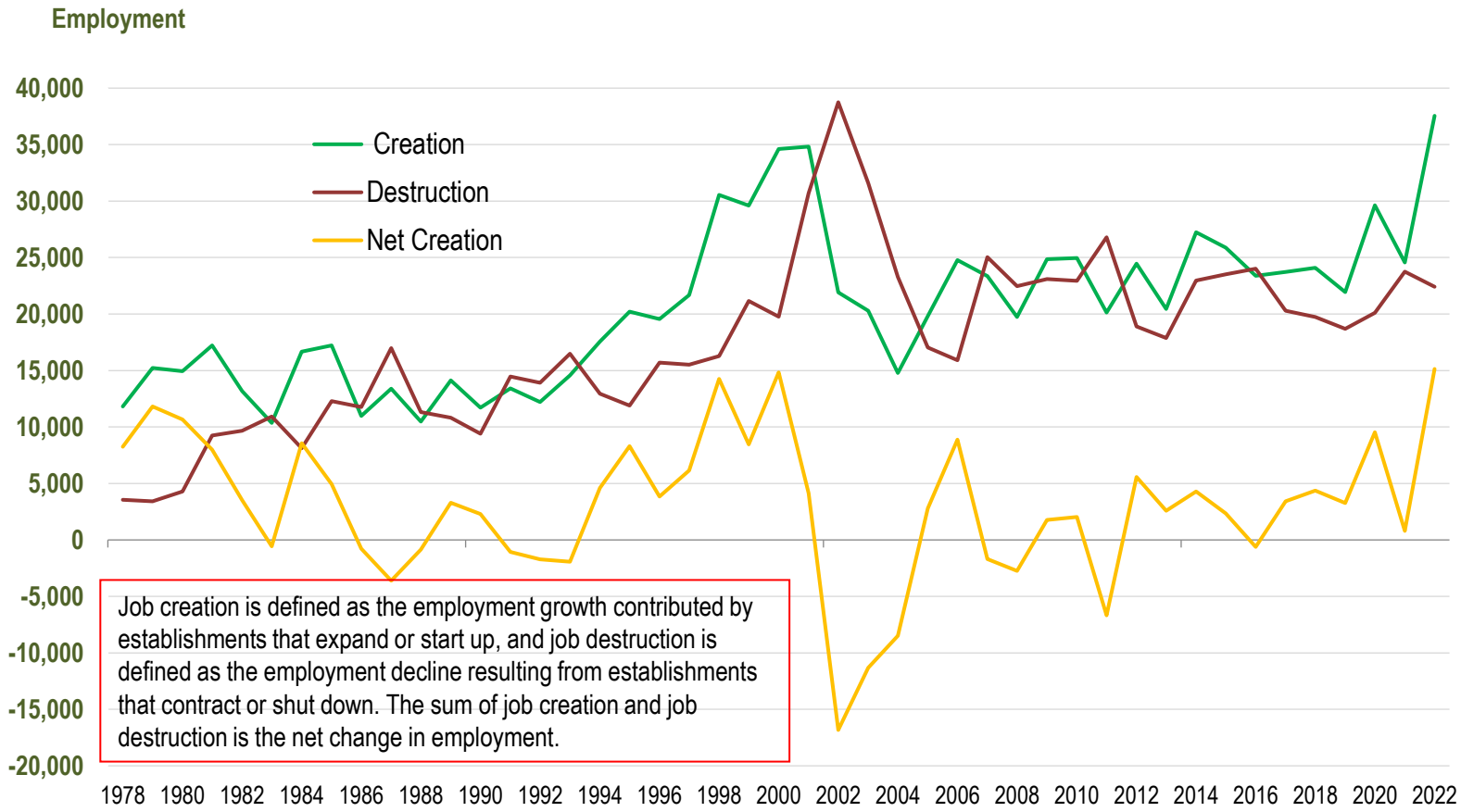
Net creation is the difference between job creation and job destruction.

The net downward trend in the creation and destruction rates for non-HT establishments may be an indicator of lower productivity or fewer jobs added.

Net creation for HT employment occurs less frequently than for non-HT employment.

High Technology Colorado
1978-2022 Job Creation vs Destruction

High Technology Employment Creation vs. Destruction



Job creation is defined as the employment growth contributed by establishments that expand or start up, and job destruction is defined as the employment decline resulting from establishments that contract or shut down. The sum of job creation and job destruction is the net change in employment.

HT Job Creation vs. Job Destruction

Colorado HT creation (green) exceeded destruction (burgundy) from 1978 through 1985. Creation and destruction were similar from 1986 to 1994. Creation increased at a faster rate from 1995 to 2001 (the Colorado tech boom).

Between 2002 and 2011, destruction frequently exceeded creation (The Lost Decade).

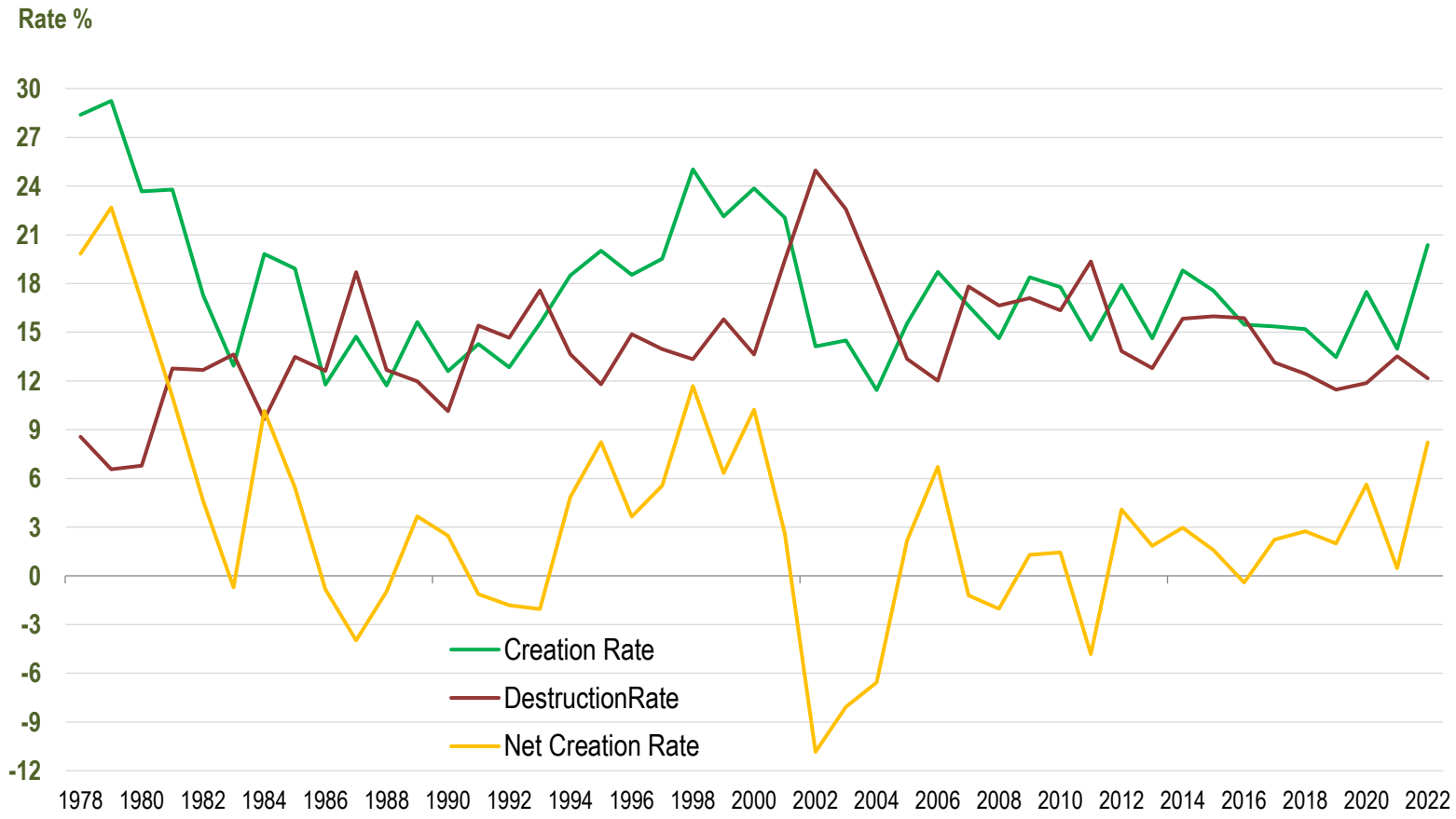
From 2012 to 2022, creation was stronger than destruction, including a spike in 2022. There was strong job growth between 2012 and 2019.

HT creation exceeded destruction for 31 of 45 years between 1978 and 2022.

Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

High Technology Colorado
1978-2022 Job Creation Rate vs Destruction Rate

High Technology Employment Creation Rate vs. Destruction Rate



Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

Colorado-based Business and Economic Research https:cber.co

HT Job Creation Rate vs. Job Destruction Rate

During this period, the job creation rate (green) ranged from 11.4% in 2004 to 29.2% in 1978. The job destruction rate (burgundy) ranged from 6.5% to 25.0%. The creation rate exceeded the destruction rate for 31 of 45 years.

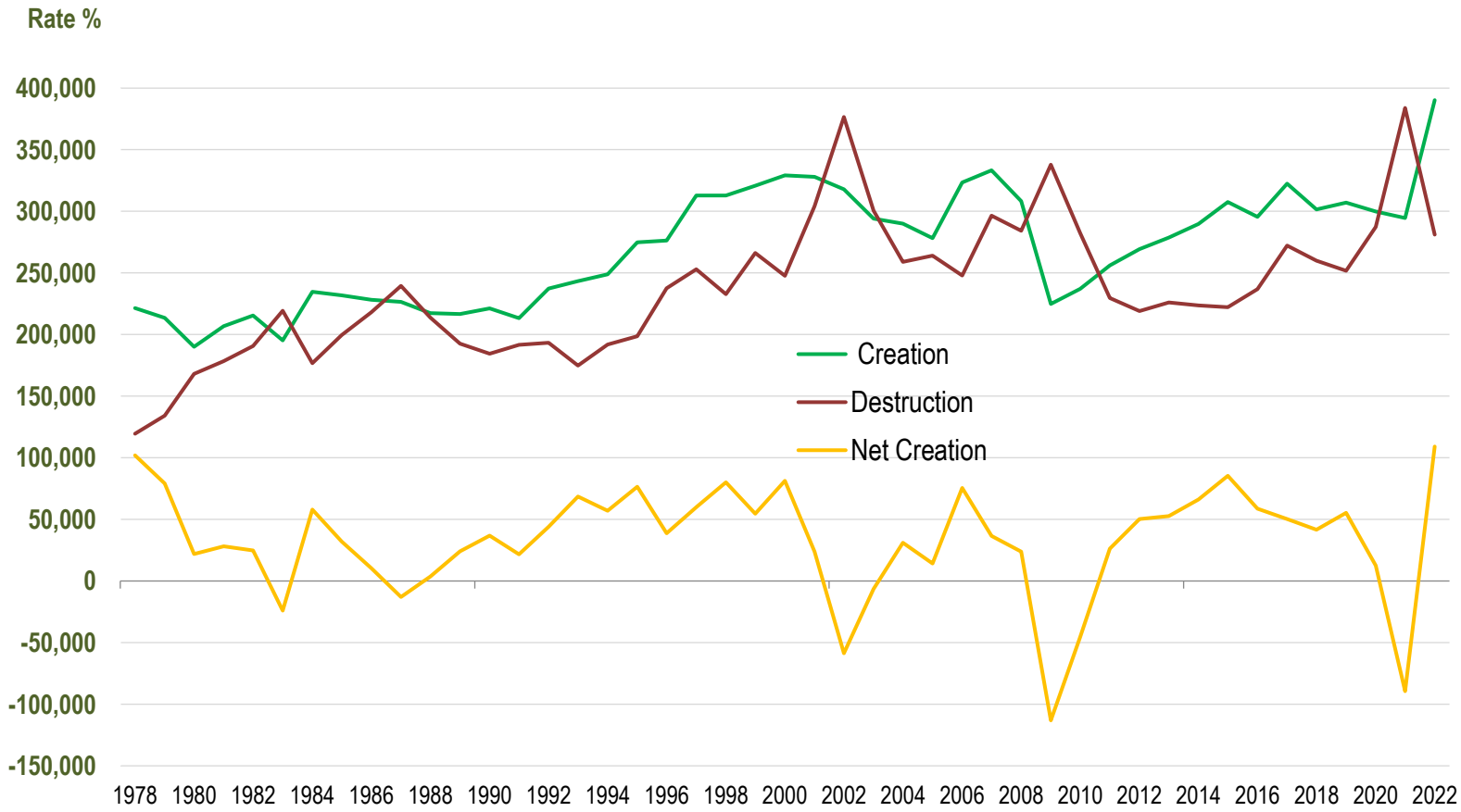
The HT creation and destruction rates reflect the effects of the recessions, for example, the second half of the 1980s, early 1990s, and after the 2001 and 2007 recessions.

There was also growth in the early 1980s, the 1990s tech boom, and in the recovery after the Great Financial Crisis.

Job creation and **destruction rates** measure the dynamic underlying forces of the labor market, reflecting continuous shifts as some establishments expand or open (creation) while others contract or shut down (destruction).

Non-High Technology Colorado
1978-2022 Job Creation vs Destruction

Non-High Technology Employment Creation vs. Destruction



Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

Colorado-based Business and Economic Research https:cber.co

Non-HT Job Creation vs. Job Destruction

During this period, job creation (green) and destruction (burgundy) were similar for non-HT employment. Most notably, creation exceeded destruction in 38 of 45 years. Non-HT employment was less volatile compared to HT employment.

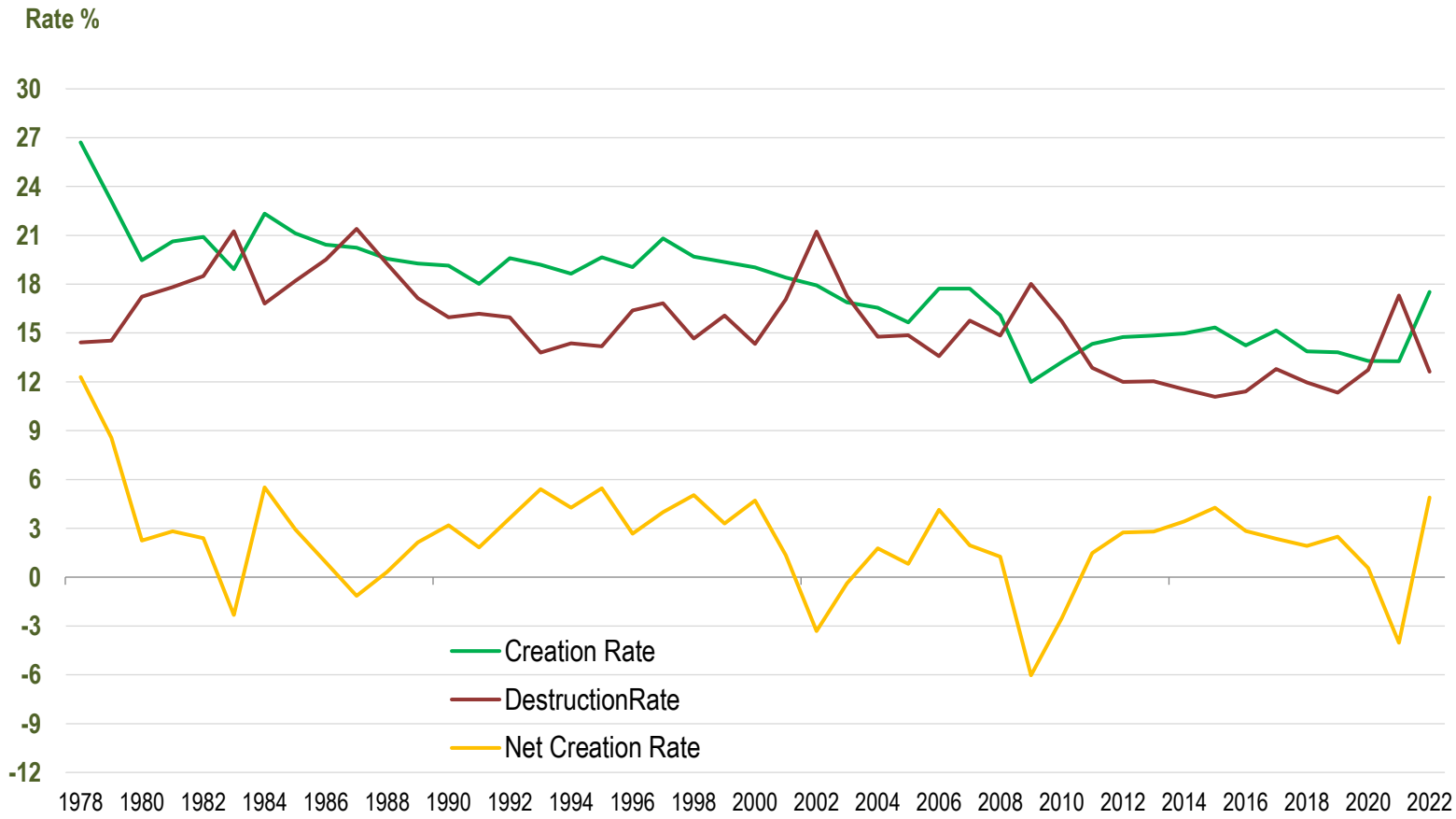
There were periods of strong job creation related to the tech boom: (1989 to 2001), after the 2001 recession (2004 to 2008), and the 2007 recession (2011 to 2020). There was a spike in creation in 2022.

There were spikes in destruction in 1987, 2002, 2009, and 2021.

Job creation is defined as the employment growth contributed by establishments that expand or start up, and job destruction is defined as the employment decline resulting from establishments that contract or shut down. The sum of job creation and job destruction is the net change in employment.

Non-High Technology Colorado
1978-2022 Job Creation Rate vs Destruction Rate

Non-High Technology Employment Creation Rate vs. Destruction Rate



Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.
Colorado-based Business and Economic Research https:cber.co

Non-HT Job Creation Rate vs. Job Destruction Rate

During this period, the job creation rate (green line) and destruction rate (burgundy line) were similar. They trended downward, and creation usually exceeded destruction.

There were periods of net job creation in the late 1970s-early 1980s, related to the tech boom (1990s) and after the 2001, 2007, and 2020 recessions. There were small spikes in the destruction rate during the 1980s, 2002, 2009, and 2021.

In 38 of 45 years, the creation rate exceeded the destruction rate. The downward trend of the creation and destruction rates may indicate that the economy was not as robust after the tech boom of the 1990s.

Job creation and **destruction rates** measure the dynamic underlying forces of the labor market, reflecting continuous shifts as some establishments expand or open (creation) while others contract or shut down (destruction).

Job Creation and Job Destruction – Denver, Boulder, Colorado Springs, and Fort Collins HT employment

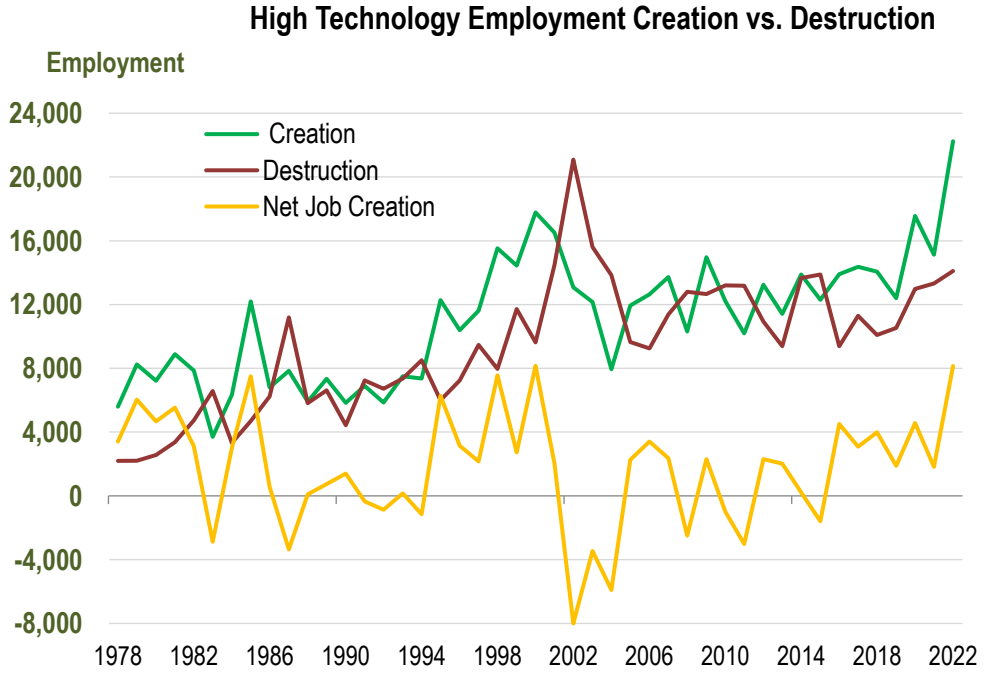
Key Points

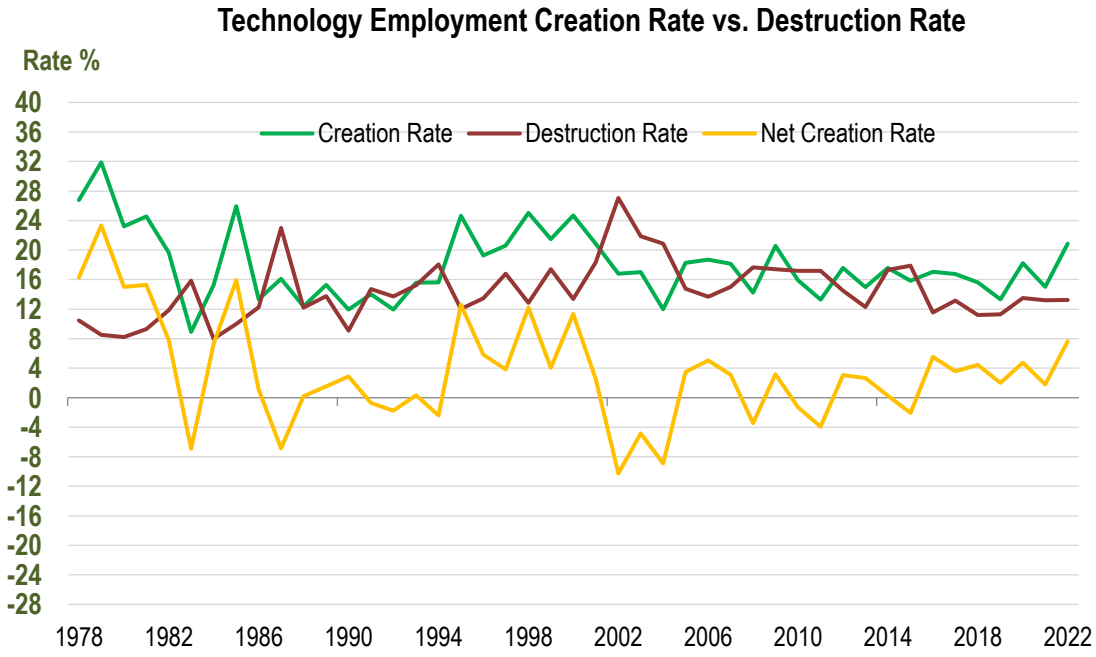
This section looks at the levels of job creation, destruction, and the net job creation for the Denver, Boulder, Colorado Springs, and Fort Collins MSAs. It also includes the creation rates, destruction rates, and net creation rates.

The takeaways from this analysis include the following:

- There is more likely to be volatility and negative net job creation when the MSAs have fewer employees and a higher concentration of HT employees.
- There appears to be less risk with non-HT employment, because there are more employees and the industries may be more risk-averse.
- Periods of notable creation and destruction are the early 1980s, during the tech boom of the 1990s, the 2001 recession, and after the Great Financial Crisis.
- The Denver MSA had the most years of positive net creation, and Colorado Springs had the least.

High Technology Denver
1978-2022 Job Creation vs Destruction



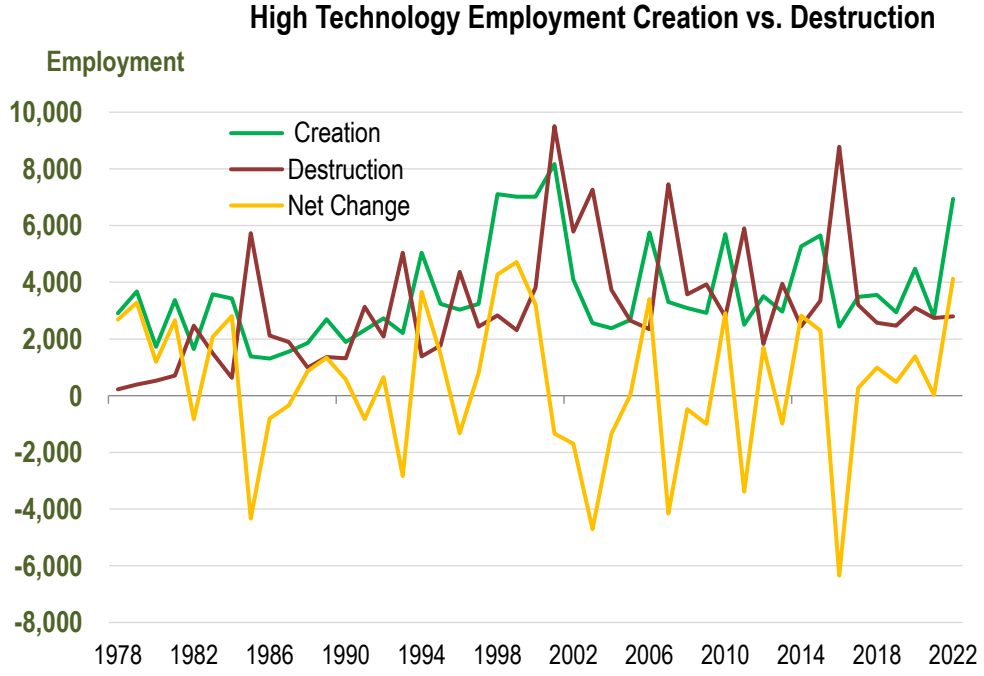


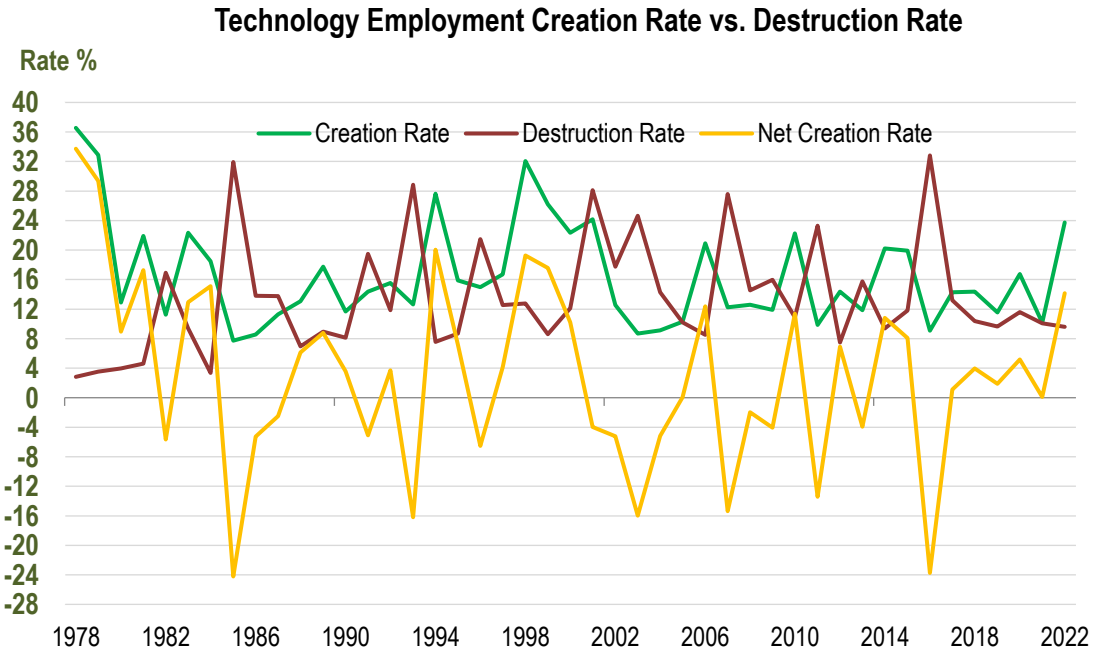
For Denver, HT job creation (green) had an upward trend from 1978 to 2001. HT job destruction (burgundy) followed a similar path; however, it had a significant spike in 2002. From 2005 to 2021, net job creation (yellow) was flat.

The creation rate for Denver (green) was similar to the rate for Colorado. The net creation rate (yellow) was positive in 33 of 45 years. It was positive for an extended period on three occasions: during the 1980s, the tech boom, and from 2012 to 2022.

Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

High Technology Boulder
1978-2022 Job Creation vs Destruction



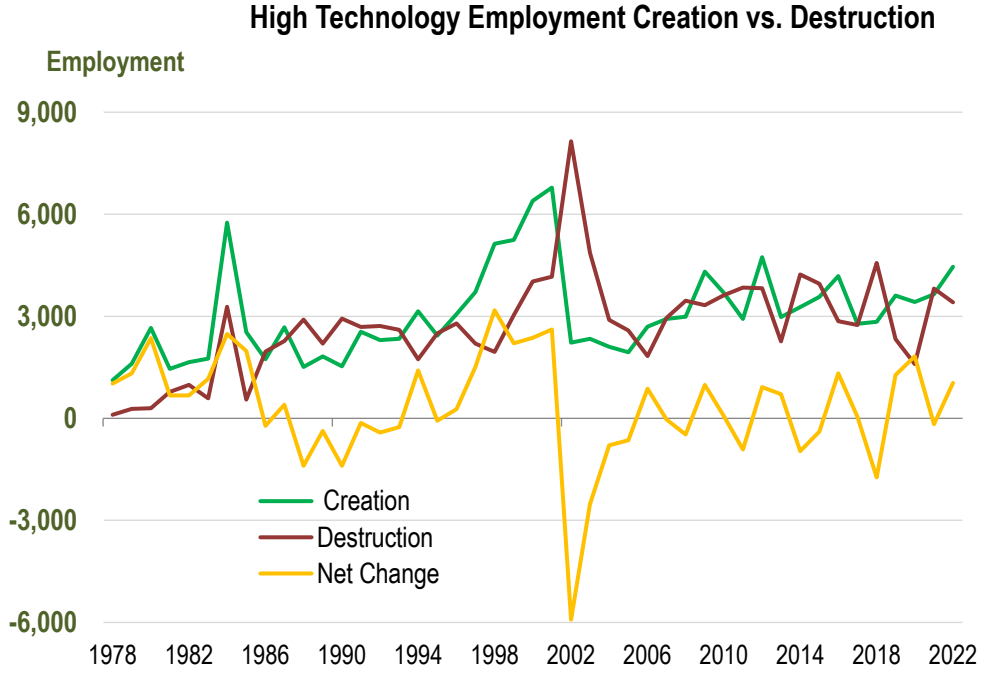


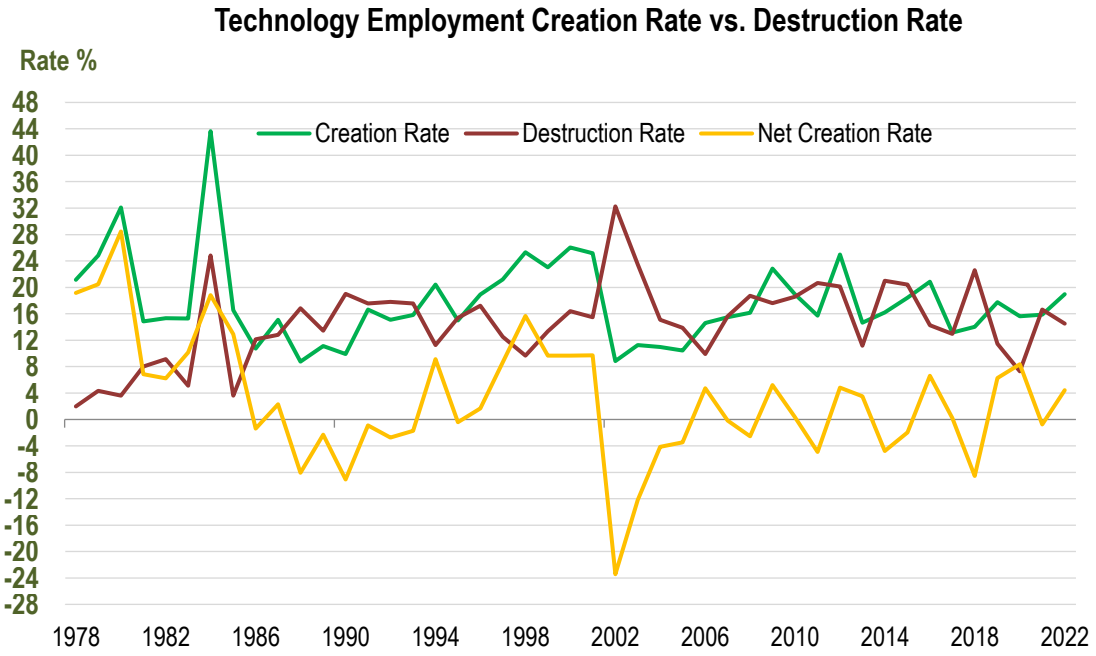
Boulder HT job creation (green) had an upward trend from 1978 to 2002. It was volatile, but flat from 2003 to 2022. HT job destruction (burgundy) followed a similar path; however, it had significant spikes in 1986, 1993, 2001, 2003, 2007, 2011, and 2016.

The creation rate for Boulder was more volatile than the creation rate for Colorado. The net creation rate was positive in 28 of 45 years for Boulder. Between 2007 and 2022, net creation was positive in 10 of the 16 years. There were modest job creation rates, but frequent and significant destruction rates.

Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

High Technology Colorado Springs
1978-2022 Job Creation vs Destruction



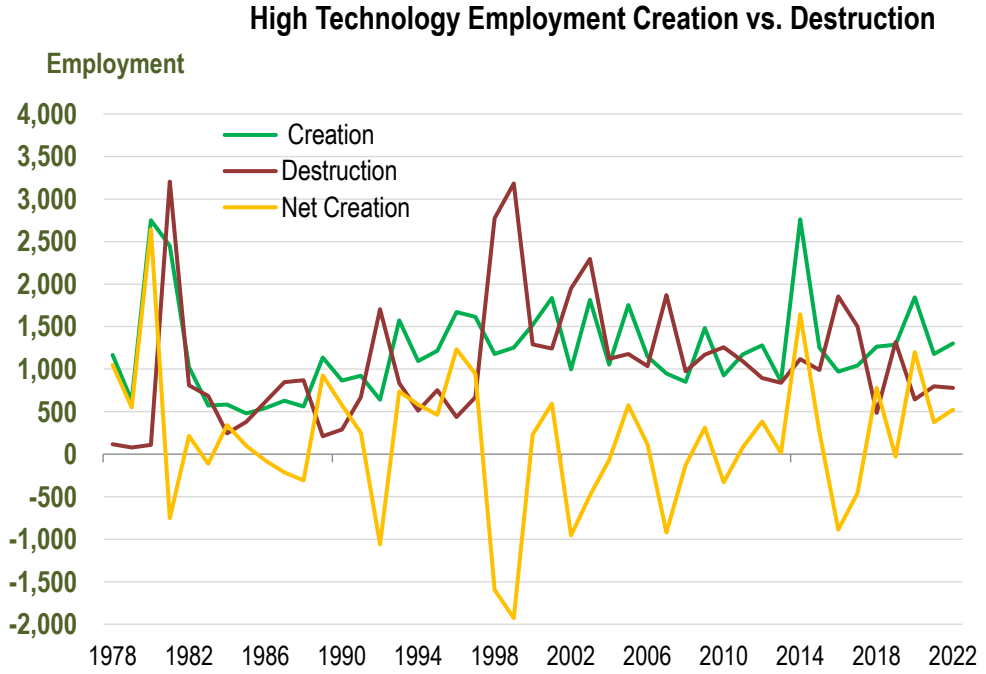


Colorado Springs HT job creation (green) had a slight upward trend from 1978 to 2002. HT job destruction (burgundy) followed a similar path; however, it had significant spikes in 1984, 2002, and 2018. The spike in 2002 happened at the same time as a downturn in job creation. Net creation was dismal.

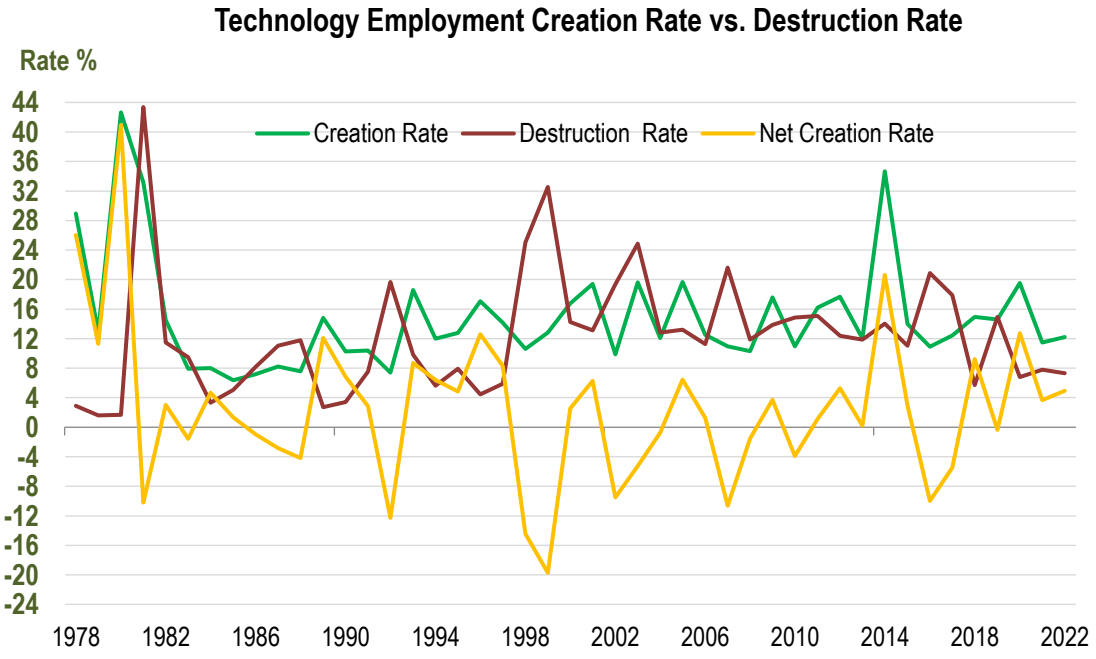
The creation rate (green) for Colorado Springs was more volatile than the Colorado creation rate. The net creation rate was positive in 26 of 45 years. Colorado Springs had fewer periods of extended positive net creation than the other MSAs. There were extended periods of destruction rates from 1988 to 1993, 2002 to 2006, and 2014 to 2018.

Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

High Technology Fort Collins
1978-2022 Job Creation vs Destruction



Fort Collins HT creation (green) had a slight upward trend from 1978 to 2002. HT destruction (burgundy) moved in the same general direction but was more erratic. B There were creation spikes in 2014 and 2020, and multiple destruction spikes.



The creation rate for Fort Collins was more volatile than the creation rate for Colorado. The net creation rate was positive in 28 of 45 years. There were multiple years with significant changes in the creation and destruction rates.

Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

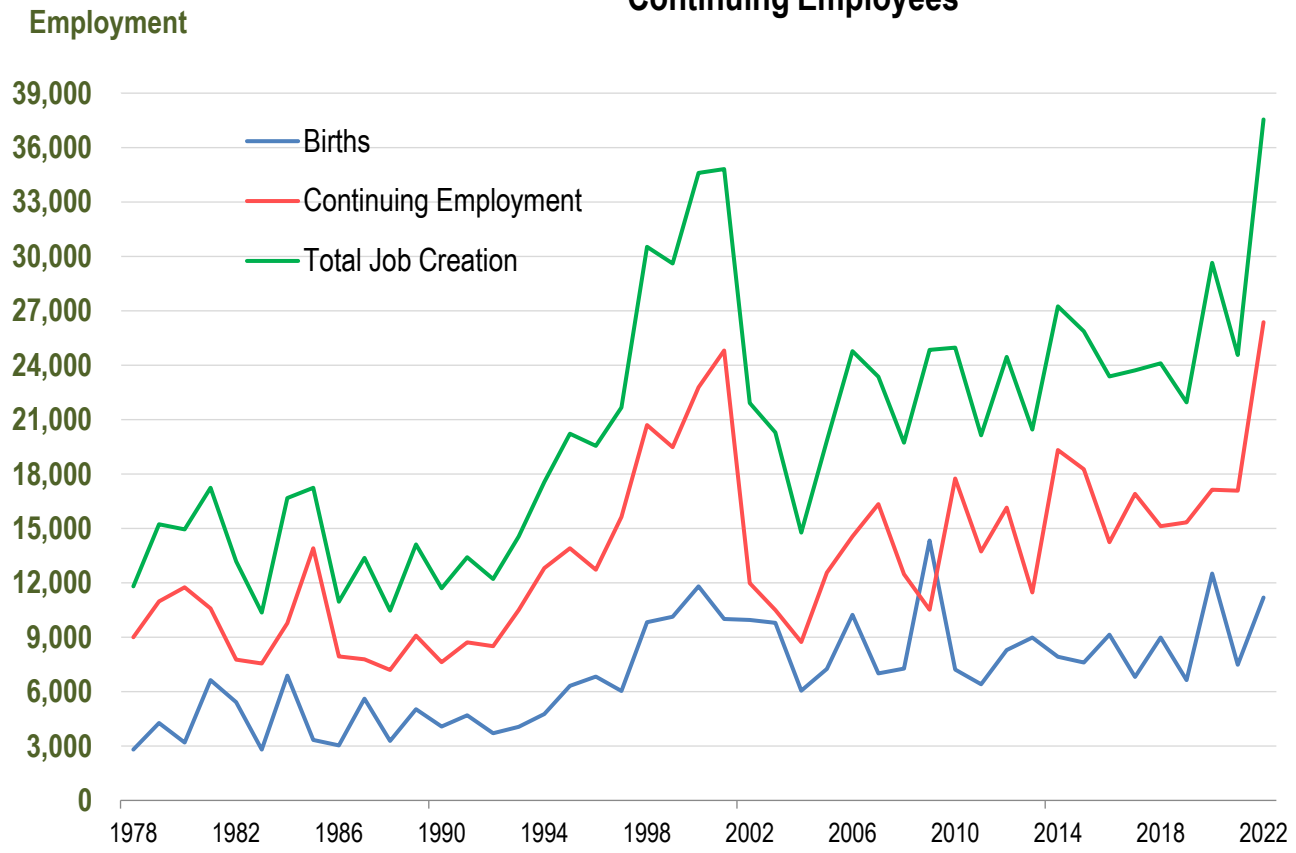
Births, Deaths, and Continuing Expansion and Contraction of Employment

Key Points
Changes in Births, Deaths, Expansion, and Contraction

- Births for HT employment account for about 34% of the total job expansion.
- Deaths for HT employment account for about 37% of total job destruction.
- Births for non-HT employment account for about 37% of the total job expansion.
- Deaths for non-HT employment account for about 36% of the total job destruction.
- The levels of annual employment expansion and contraction vary greatly. On average, slightly less than two-thirds of employment expansion and contraction comes from continuing HT and non-HT establishments.

High Technology Colorado
1978-2022 Job Creation – Births and Continuing Employees

High Technology Employment Creation From Births and Additions to Continuing Employees

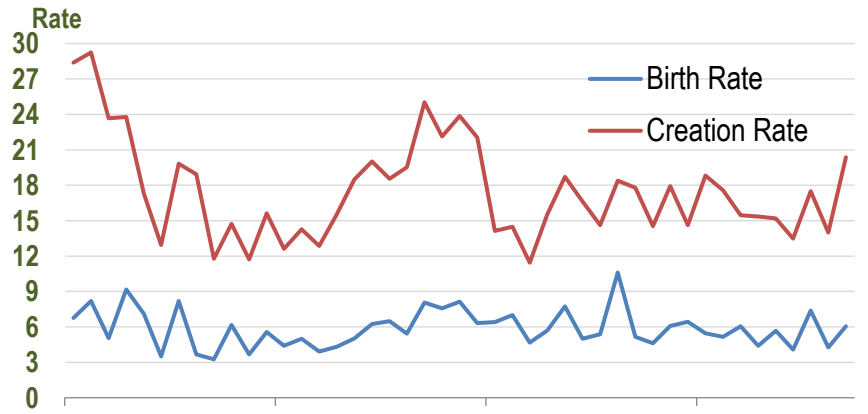


Creation from Births and Continuing Employees

Left: The number of HT birth employees (blue) trended upward from 1978 to 2000. Since then, the number of births has been stagnant and volatile. In 2009, the number of HT birth employees exceeded the number added at continuing establishments. HT births accounted for about 34% of the change in employment. Continuing employment (red) was flat from 1978 to 1993, followed by strong growth from 1994 to 2001. It decreased from 2001 through 2004, then trended upward from 2005 to 2022.

Below: The birth rate (blue) was generally stable. It ranged from 3.2% to 10.6% from 1978 to 2022. Changes in total creation were a result of changes in continuing employment, especially during the 1980s, the 1990s tech boom, and from 2006 to 2022. Most of the change comes from continuing employment.

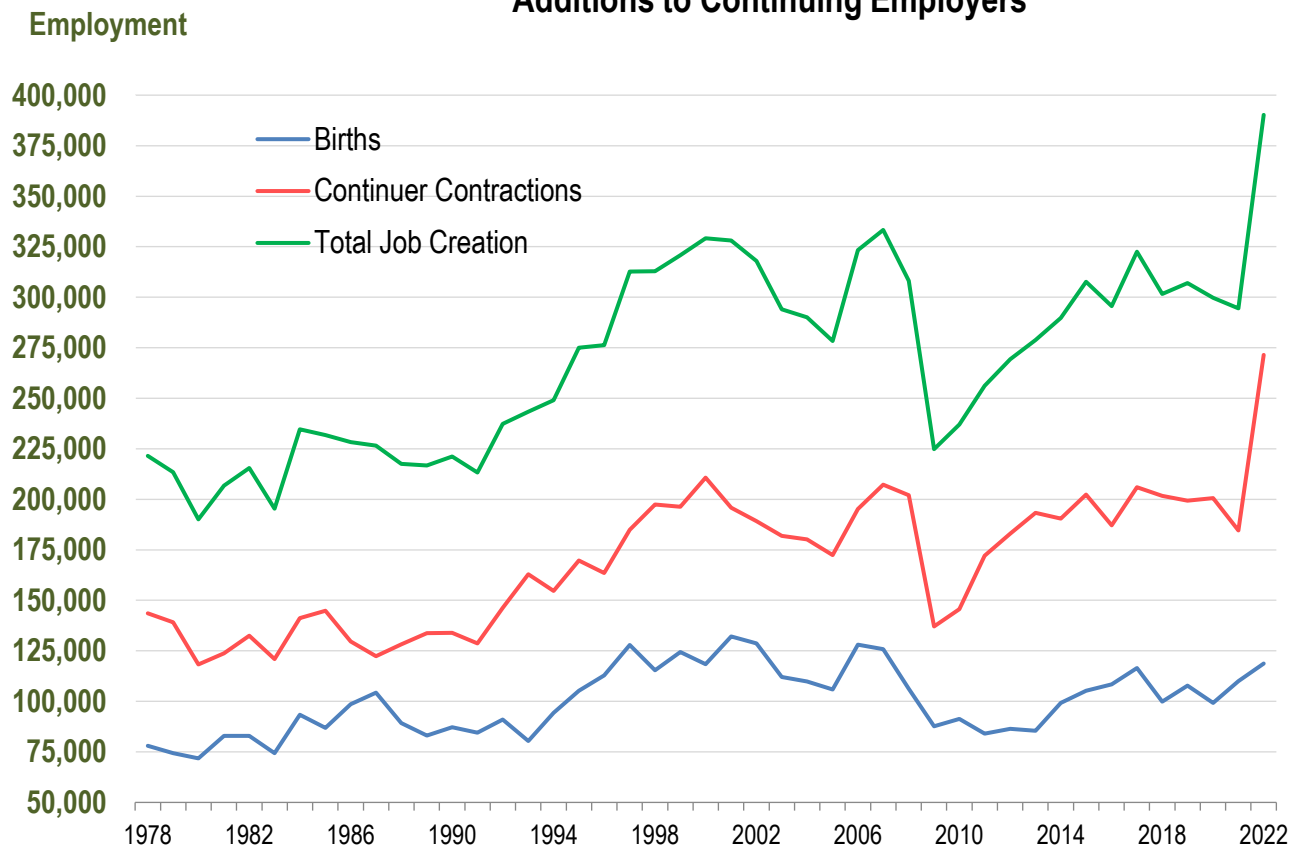
Birth Rate and Job Creation Rate



Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

Non-High Technology Colorado
1978-2022 Job Creation – Births and Continuing Employees

Non-High Technology Employment Creation From Births and Additions to Continuing Employers

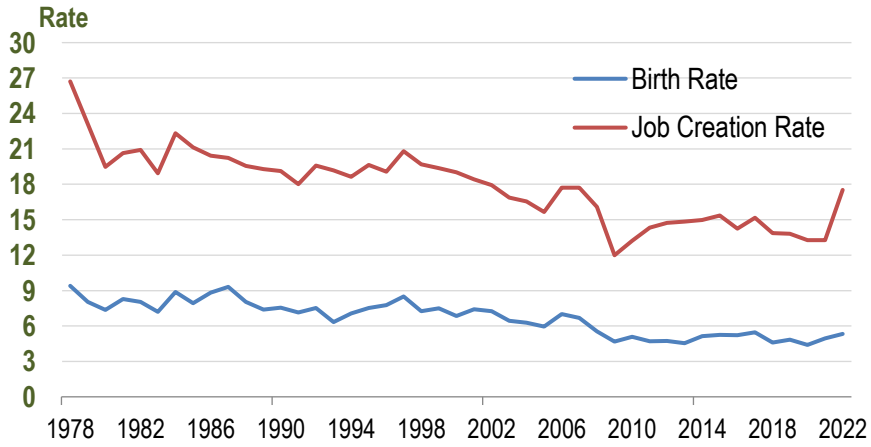


Creation from Births and Continuing Employees

Left: The number of non-HT birth employees (blue) remained flat from 1978 to 1993, then increased from 1994 to 2006. Since then, it has been volatile with a slight downward trend. The number of continuing non-HT employees (red) was flat from 1978 to 1992, then increased through 2000. It was volatile with a downward trend from 2001 through 2009. There was an upward trend from 2010 through 2021, with a spike in 2022. On average, births accounted for about 37% of the job creation.

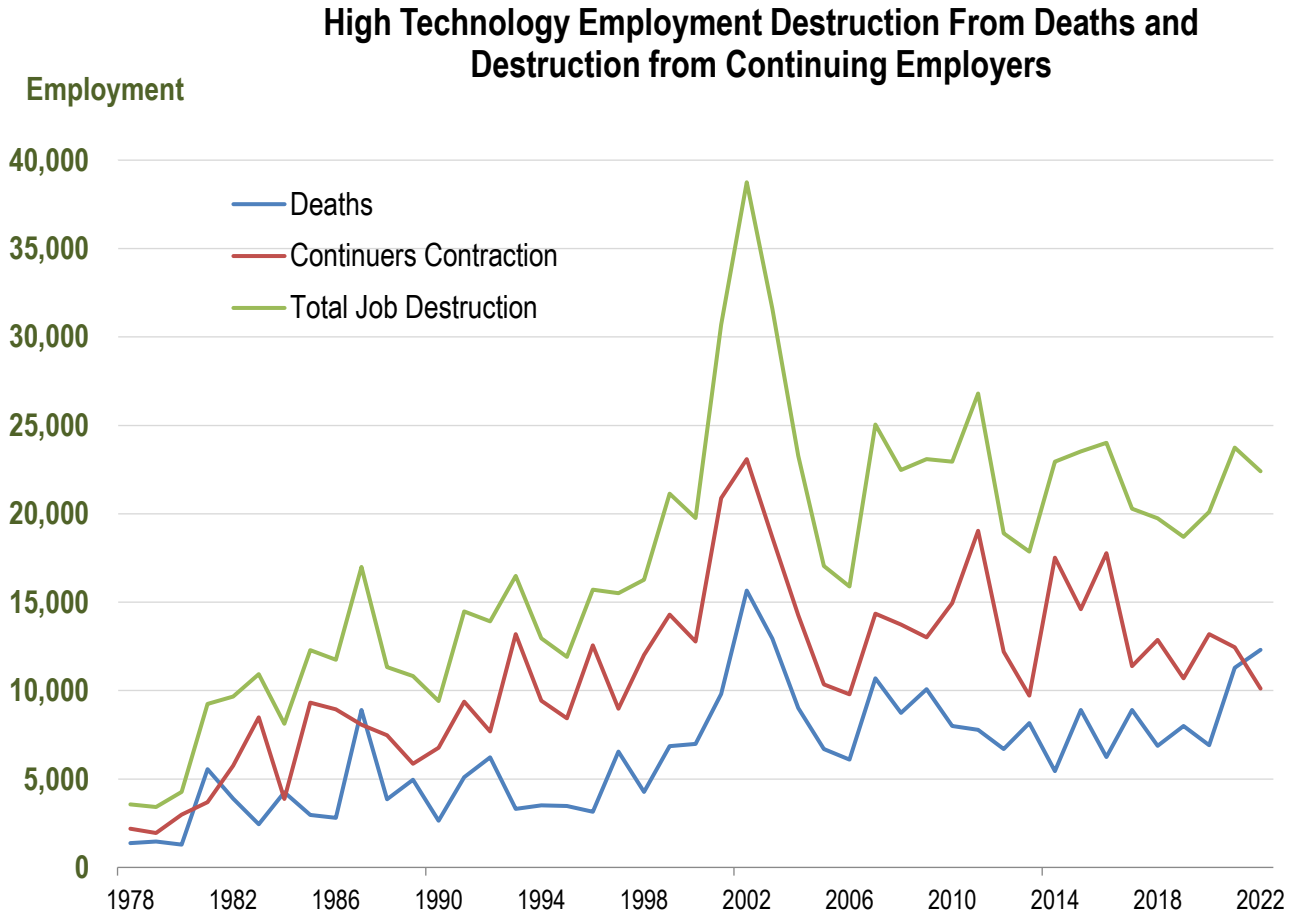
Below: The birth rate (blue) declined from 1978 to 2009. Between 2010 and 2022, the birth rate was stagnant. The job creation rate (red) trended downward.

Birth Rate and Job Creation Rate



Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

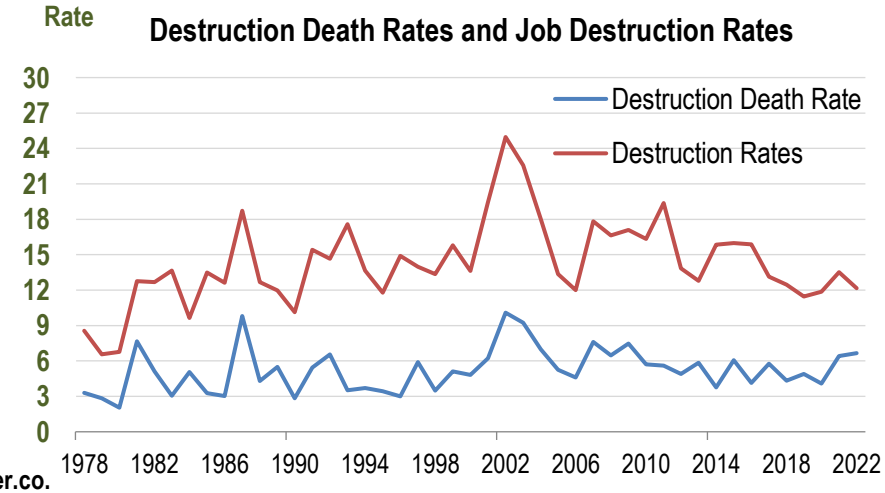
High Technology Colorado
1978-2022 Job Destruction – Deaths and Continuing Employees



Destruction from Deaths and Continuing Employees

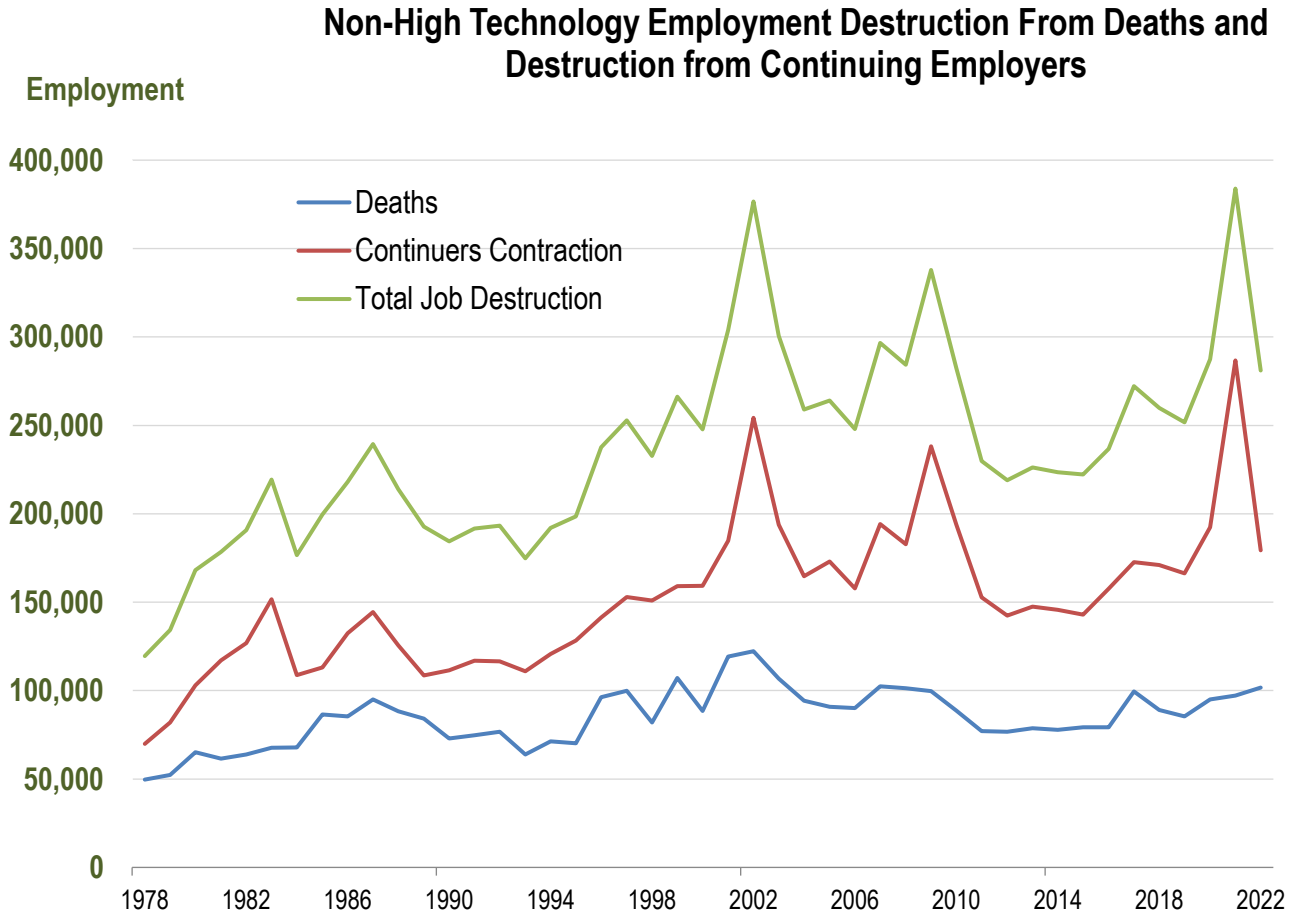
Between 1978 and 1997, the number of deaths (blue) was flat. They increased and spiked in 2002, then trended downward through 2020. In 2021 and 2022, the number of deaths rose. The pattern for continuing employees was similar. On four occasions, the deaths exceeded contraction from continuing employers (1981, 1984, 1987, and 2022). The number of deaths accounted for about 37% of the employment destruction.

Below: Between 1978 and 2002, the death rate was generally flat with some volatility. It spiked in 2003, then trended downward. The destruction rate followed a similar pattern. The range of the death rate was 2.4% to 10.8% and the range of the destruction rate was from 6.6% to 25.0%.



Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

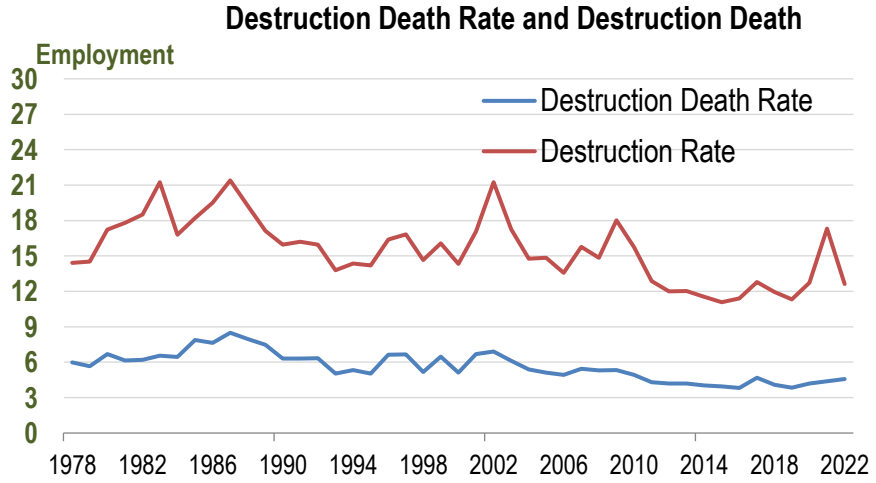
Non-High Technology Colorado
1978-2022 Job Destruction – Deaths and Continuing Employees



Destruction from Deaths and Continuing Employees

Left: The number of non-HT deaths (blue) trended upward from 1978 to 1988. Since then, deaths have trended downward through 1993. From 1994 through 2002, they trended upward. Non-HT deaths trended downward from 2003 to 2022. From 1978 to 2022, the continuing non-HT deaths (red) increased. There were spikes near the recessions (1980s, 2002, 2009, and 2021). The deaths accounted for about 36% of job destruction.

Below: The death rate and destruction rate trended downward. The death rate ranged from 3.8% to 8.5%. After peaking at 8.5% in 1987, the rate slowed to 4.6% in 2022. The overall destruction rate declined from a peak of 21.4% in 1987. There were peaks of 21.2% in 2002, 18.0% in 2009, and 17.3% in 2021.



Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

Summary of Analysis of Colorado HT and Non-HT Establishments and Employment

Fundamentals

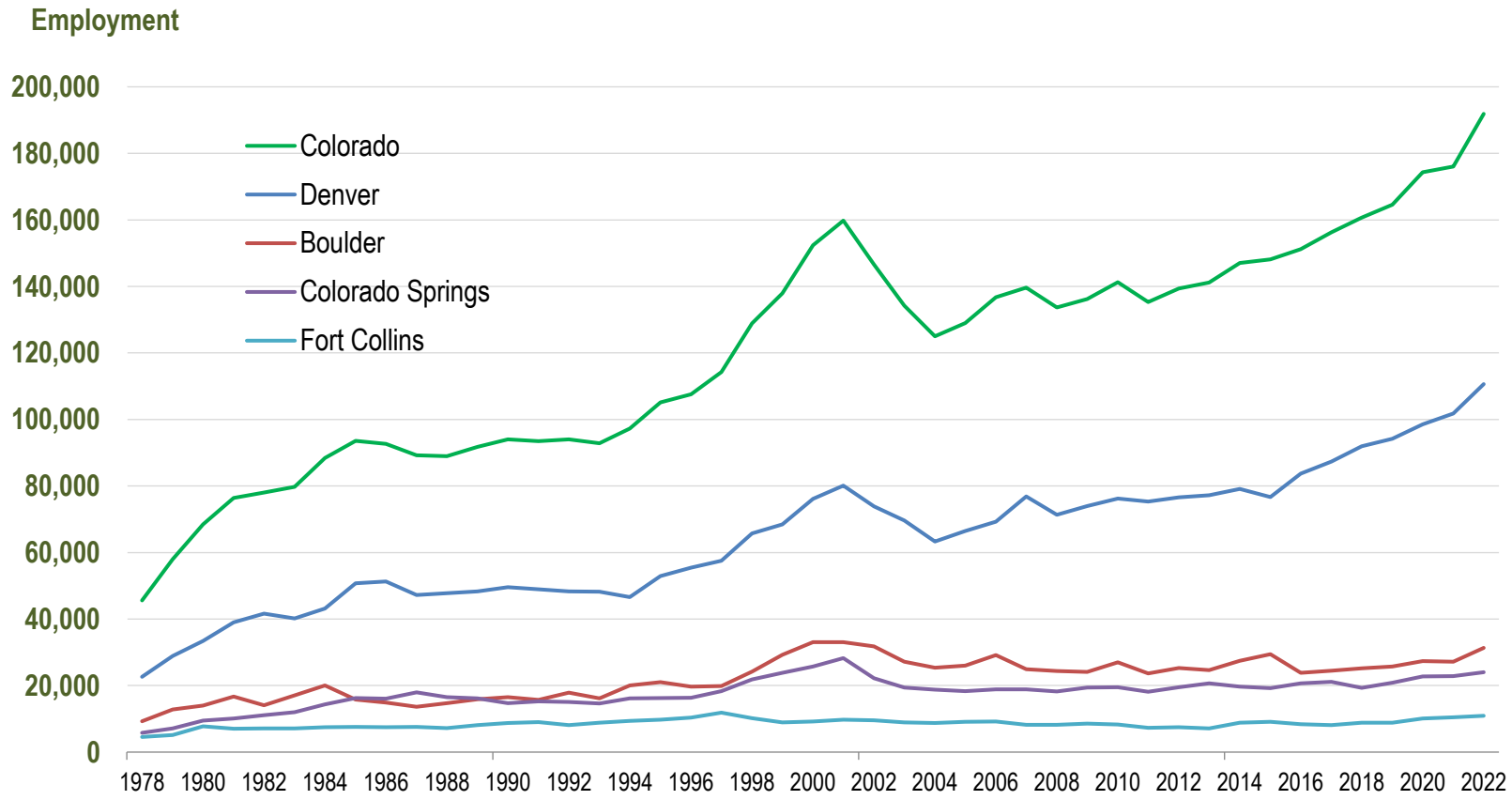
- There are many definitions for the HT industry. The definition used in this analysis is 11 NAICS sectors selected by their percentage of STEM occupations.
- The analysis evaluated the HT industry based on employment, establishments, location, and business dynamics provided in a Census Bureau database.
- The database has two industry groups for establishments: HT and non-HT. It does not segment companies into NAICS codes or clusters such as aerospace, bioscience, cybersecurity, or quantum.
- The 11 four-digit NAICS codes are from three sectors. The database does not include changes in establishments and employment based on the 11 NAICS codes.
- Additional research could include wages, GDP, or potential growth. For example, other data show that HT establishments have higher AAW (wages) and a higher multiplier effect than many non-HT establishments.

Findings

- In 2022, there were 191,868 HT employees. They worked at 9,264 establishments and accounted for approximately 7.8% of the total employment.
- Over half the establishments and employees are in the Denver MSA, followed by the Boulder, Colorado Springs, and Fort Collins MSAs. About 92% of HT employment is in these four MSAs.
- Between 1978 and 2022, HT employment trended upward in the Denver MSA. Over time, Denver has increased its market share of HT employment.
- HT employment in the other three MSAs peaked between 1997 and 2002. It has trended downward (slightly) in the other three MSAs.
- Positive net job creation occurs more frequently for non-HT establishments than for HT establishments.
- Most employment gains (and losses) are from existing companies, not from new companies.
- Other research shows that the mix of Colorado HT employees by NAICS has changed dramatically over the past 25 to 30 years. The concentration of manufacturing employees has decreased. There has been an increase in the number of employees from the professional, scientific, and technical services sector.

High Technology Colorado and MSAs
1978-2022 Colorado

High Technology Employment (Colorado and MSAs) 1978 - 2022



High Tech Employment

HT employment increased from 45,594 in 1978 to 159,810 in 2001 and 191,868 in 2022 (green).

- The increase was driven by Denver MSA (blue) employment of 22,636 in 1978 to 80,067 in 2001 and 110,627 in 2022.
- The job creation and destruction rates for Denver were similar to the state, i.e., Denver dictates state HT growth.

HT employment has been flat in Boulder, Colorado Springs, and Fort Collins for the past 25 to 30 years.

- Boulder peaked at 33,056 in 2000.
- Colorado Springs topped out at 28,253 in 2001.
- Fort Collins peaked at 11,860 in 1997.

Companies such as Amgen, Novartis, Intel, Hewlett-Packard, StorageTek, Sun Microsystems, Level 3, and Exabyte are examples of job destruction that has occurred in the Boulder, Colorado Springs, and Fort Collins MSAs. Both sides of the equation have been impacted as major companies have also moved to these areas.

Source: https://www.census.gov/programs-surveys/ces/data/public-use-data/experimental-bds/bds-high-tech/definitions.html, cber.co.

Summary of Analysis of Colorado HT and Non-HT Establishments and Employment – Looking Ahead

High Tech Employment – The Future?

This analysis provides a succinct overview of the Colorado HT industry. In doing so, it raises more questions than it provides answers about the role of HT in the state economy.

- Is there an appropriate level of HT employment for the HT hub in Denver and other MSAs? If so, what is it? What technologies should the state focus on that will complement the assets in Denver and Colorado? Does Colorado have the supply chain to support existing and future technologies? If not, can it develop the supply chain? Colorado has an educated workforce. Is it sufficient to support future growth in HT employment? If not, can Colorado create a sufficient workforce training program?

- Denver, Boulder, Colorado Springs, and Fort Collins have higher education and federal facilities that are distinctive competencies. Is it appropriate and possible to increase the impact of the HT industry on these MSAs (establishments and employees)? If so, how will that be accomplished, i.e., what technologies can be introduced for further development in these areas? Is it possible to create a critical mass of HT employment in other areas of Colorado, such as Weld and Adams County, Pueblo, and the Western Slope? What does Colorado need to have an efficient HT infrastructure? Is it possible to have too much HT infrastructure in a region?

- Is Michael Porter's theory of clusters (Harvard) still an appropriate strategy for Colorado? If so, what clusters are appropriate for Colorado? How does Paul Romer's theory of endogenous growth, or enabling technologies, apply to Colorado?

- Should the state have a science-based technology economic development effort to support the growth of HT employment? What technology-based economic development practices have been most effective in the past? Would it be appropriate to replicate a derivative of them in the current economy?

Colorado is fortunate to have 191,868 HT employees. What is the next step for the state's HT industry?

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Analysis of the Colorado Advanced Technology Industry
1978 to 2022

This analysis is for informational purposes only. Any opinions or interpretations of data are those of the presenter. As such, they do not represent the viewpoints of any group or particular organization.
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Gary Horvath has produced annual employment forecasts of the state economy for over 30 years. They have been supplemented by monthly economic updates and indices that track economic performance over the short term. In addition, he has directed three statewide analyses that included reviews of all 64 county economies.

Horvath was the principal investigator for a state and federally funded project to prepare a nanotechnology roadmap for Colorado. As well, he was a co-founder of the Colorado Photonics Industry Association, a trade group for Colorado's Photonics cluster. Horvath has been an active board member of the group since its inception.

Horvath has also served on the Board of Directors for the Economic Development Council of Colorado, Northwest Denver Business Partnership, Adams County Regional Economic Partnership, and Broomfield Economic Development Corporation. Horvath has also been the chair of the electronics committee in the Governor's Office of Economic Development and International Trade early stage and proof of concept Advanced Industries grant program, and he served on the 2021 Colorado Legislative Redistricting Commission.