The Perryman Group

The Economic Effects of Sustained Higher Temperatures June 2024

A June heat wave affected millions of people from Texas and New Mexico to Florida to the northeastern United States. An area of high pressure over the Midwest pushed warm air to the surface and trapped it there, forming a heat dome. The result was a long period of record high temperatures and little precipitation. Records were tied or broken across the country, from Boston and New York to Fort Lauderdale.

In addition to the negative quality of life and health effects, excessive heat involves substantial economic costs. The Perryman Group estimated the net losses associated with recent heat conditions, as well as the potential long-term effects of hotter temperatures. A NASA analysis of global surface temperatures found that May 2024 was the warmest on record, capping an unprecedented streak of record highs for each respective month for an entire year.

As with any extreme weather event, excessive heat affects the economy in dynamic and complex ways. Substantial losses occur as a result of lower agricultural yields and an overall decline in productivity across multiple industries. Even morbidity and mortality increase in the face of record heat. However, these losses are partially offset by gains in other sectors, such as increases in utility consumption.

To estimate the effects, baseline forecasts from The Perryman Group's US Multi-Regional Econometric Model were merged with an extensive analysis of economic responses to average temperature changes over several decades in all 50 states. This process allowed for detailed modeling of a comprehensive set of several hundred industries.

During the past 12 months, the United States has been about 2.39 degrees above the twentieth-century global standard. If that pattern continues through the summer and the remainder of the year, the US economy will lose an estimated $110.2 billion in real gross product (measured in 2017 dollars) and 663,000 jobs compared to projections under normal weather conditions. These losses represent a 0.48% reduction in real gross product and a 0.40% decline in employment compared to baseline expectations.

Large relative losses could be expected in agriculture (farms and forestry, in particular), insurance, and a number of other industries as indicated in the accompanying table. Though dwarfed by the losses, some industries see gains during extreme heat. For example, utilities providing power for cooling experience higher revenues. The demand for some types of manufactured goods also rises.

Over time, the negative economic effects of hotter sustained temperatures would escalate notably. The Perryman Group projected long-term effects through 2050 assuming annual temperatures one degree above historical norms. As effects

compound, losses could be expected to rise to $1.1 trillion in real gross product and more than five million jobs by 2050; effects by industry are included in the accompanying table. Such a scenario would lead to US real gross product about 2.65% below the baseline scenario, with employment 2.10% lower.

For the entire 26-year period between this year and 2050, the cumulative effects are estimated to include more than $12.0 trillion in real gross product and almost 58.5 million job-years. (A job-year is one person working for one year, though it could be multiple individuals working partial years.)

Extreme weather can involve a high human cost. In addition, heat waves and other events cause economic disruptions and inhibit growth. Although the effects vary greatly across industries, gains are far outweighed by losses. Over time, negative effects compound, leading to even more damage to the economy.

The Estimated Cost of Excessive Heat to the US Economy

	The Economic Cost of the 2024 Heat Wave		The Economic Cost by 2050 of Temperatures One Degree Above Historical Norms	
INDUSTRY	**OUTPUT**	**JOBS**	**OUTPUT**	**JOBS**
Agriculture	-$9.5 b	-71,798	-$107.2 b	-718,441
Mining	-$1.1 b	-2,165	-$8.1 b	-11,022
Utilities	$5.1 b	+8,208	$84.2 b	+123,562
Construction	-$7.6 b	-73,397	-$98.7 b	-903,136
Manufacturing	$3.7 b	+20,641	$230.1 b	+845,449
Wholesale Trade	-$7.6 b	-41,976	-$96.4 b	-561,028
Retail Trade	-$7.5 b	-89,517	-$95.2 b	-922,121
Logistics	$3.3 b	+30,851	$66.2 b	+634,073
Information	-$11.2 b	-21,566	-$166.6 b	-143,174
Finance and Insurance	-$24.3 b	-116,434	-$393.2 b	-1,631,729
Real Estate	-$28.5 b	-20,290	-$470.7 b	-239,653
Professional Services	-$17.4 b	-121,744	-$196.3 b	-1,020,345
Educational Services	-$0.0 b	-377	$11.2 b	+156,062
Health and Social Services	-$0.2 b	-2,036	$88.3 b	+878,863
Amusement and Recreation Services	$2.6 b	+23,828	$105.0 b	+643,766
Accommodation and Food Services	-$4.3 b	-111,752	-$55.1 b	-1,537,288
Other Services	-$2.6 b	-43,837	-$32.8 b	-539,634
Government	-$3.1 b	-29,602	-$12.0 b	-111,443
Total, All Industries	**-$110.1 b**	**-662,963**	**-$1,147.3 b**	**-5,057,241**

Source: *US Multi-Regional Econometric Model*, The Perryman Group
Notes: Output, also known as "Real Gross Product" is given in billions of 2017 US dollars. The economic cost of the 2024 heat wave assumes temperatures 2.39 degrees above historical norms through 2024. The economic cost as of 2050 assumes temperatures one degree above historical norms. See page 3 for additional detail on methods and assumptions used.

METHODOLOGY

Available data regarding the reactions of industries across the country to variations in summer temperatures over several decades were studied and utilized in conjunction with baseline forecasts from The Perryman Group's US Multi-Regional Econometric Model. This process allowed robust estimation of the economic effects of excessive heat across a broad spectrum of industries. The model was developed by Dr. M. Ray Perryman, founder and president of the firm, and has been in use for more than 40 years (with updates and refinements) and provides detailed 400-sector projections. Real gross product (or output) is production of goods and services lost in the area as a result of the extreme heat; this measure is parallel to the gross domestic product numbers commonly reported by various media outlets and is a subset of total expenditures. Effects of long-term elevation in temperatures are presented as the amount by which 2050 gross product (in constant 2017 dollars as it is customarily measured) and jobs would be reduced compared to baseline projections under historical weather norms.

THE PERRYMAN GROUP

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M. RAY PERRYMAN, PH.D.

Dr. Perryman is the President and CEO of the Perryman Group and Distinguished Professor of Economic Theory and Method at the International Institute for Advanced Studies. Over the past 40 years, Dr. Perryman has helped recruit corporations providing tens of thousands of jobs through economic development work, resolved billion-dollar legal issues, and revamped public policy through impact assessments and other studies. His firm has measured economic impacts for corporate locations and expansions involving billions in investments, and his economic forecasts are used by corporations and government agencies alike.

He has provided economic analysis and expert testimony for civil litigation across a wide range of practice areas including antitrust and competition, intellectual property disputes, securities, and commercial and complex litigation. His work combines strong expertise in economic damages calculation, asset valuation, market analysis, and statistical methods and econometrics.

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