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Bown, Chad and Denevers, Michele and Harrison, Ann

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WHY FRACKING WON'T BRING BACK THE FACTORIES (YET)

CHAD P. BOWN, MICHELE DE NEVERS, AND ANN HARRISON

Since last fall, President Obama has repeatedly declared that manufacturing jobs are coming back to America. In this article, however, we suggest that the return of U.S. manufacturing is still more promise than reality.

In particular, while the recent increase in natural gas exploration and production has been optimistically linked to a U.S. manufacturing revival, the boom has not led to significant growth in employment. Paradoxically, for the U.S. to reap the greatest benefit possible from the extraction of its natural gas reserves, both more and fewer regulations are needed. On the one hand, current restrictions on natural gas exports must be lifted to provide the right incentives for domestic producers, who receive much lower prices at home than they would abroad. On the other hand, more comprehensive environmental regulations would reassure critics that natural gas does indeed provide

a clean and sustainable promise for the U.S. economy.

TRENDS IN U.S. MANUFACTURING EMPLOYMENT

During the three decades leading up to the 2008 crisis, there was a consistent decline in manufacturing employment in the United States. Figure 1 shows that U.S. multinationals shed more than five million jobs between 1980 and 2008.¹ Those jobs were partially replaced by rising employment abroad. The same U.S. multinationals that shed employment at home added almost three million employees in low income countries and about a million employees in other high income countries.²

ABOUT THE AUTHORS

Chad P. Bown, PhD

Senior Economist, the World Bank

Chad Bown joined the World Bank in September 2009 in the Development Research Group, Trade and International Integration (DECTI). His research spans the economics of international trade agreements, trade policy, laws and cooperative institutions. For a full bio, visit <http://econ.worldbank.org/staff/cbown>.

Michele de Nevers, PhD

Senior Associate, Center for Global Development

Michele de Nevers is a Visiting Senior Program Associate at the Center for Global Development in Washington, DC. In 2011, she was a Visiting Fellow at the Global Economic Governance Programme at University College, Oxford. Prior to that, during her 29 years at the World Bank, Michele worked on industrial organization, environment and climate issues. For a full bio, visit <http://www.cgdev.org/expert/michele-de-nevers>.

Ann Harrison, PhD

Professor of Management, the Wharton School

Ann E. Harrison is a Professor of Management at the Wharton School of University of Pennsylvania, a Research Associate at the National Bureau of Economic Research, and an affiliate of the International Growth Centre in London. Before joining Wharton, she spent two years in Washington, DC as the Director of Development Policy at the World Bank. Prior to that, she served as the head of the research team at the World Bank on international trade and investment. Her research is in the areas of emerging markets, multinational firms, international trade, productivity, and labor markets. For a full bio, visit <https://mgmt.wharton.upenn.edu/profile/1751>.

The research suggests that both import competition and offshore employment by U.S. companies have led to wage and employment declines in highly impacted sectors. Of course, it is difficult to know whether these companies might not have survived without their ability to hire lower wage workers abroad. Other factors also played an important role in driving the decline in manufacturing employment. In particular, companies replaced people with machines and raised productivity to unprecedented levels. Economists Ann Harrison and Margaret McMillan show that the falling prices of investment goods accelerated this rise in productivity and fall in manufacturing employment.³

Has this trend in falling manufacturing employment been reversed in the years following the 2008-2009 financial crisis? We don't think so. The total number of manufacturing jobs in the United States has fallen from a peak of 25 million in 1984 to nearly 12 million when the latest figures were released by the BLS in February 2013. While the economy has added just over 500,000 manufacturing jobs from the bottom of the recession in December 2009 to today, it is difficult to call this a "manufacturing revival."

Another way to think about this is to look at the share of manufacturing jobs in the economy. Figure 2 shows that the share of manufacturing jobs in total employment has steadily declined over the last three decades, from nearly 25 percent of the labor force in the early 1980s to 11 percent in early 2013.

While it is true that in the United States, manufacturing retained its share in employment in 2011 and 2012, that share has not yet begun to increase. So while jobs have indeed grown over the last two years in manufacturing, they have not grown faster than aggregate employment growth. An optimist would argue that we have finally stopped the decline in share of manufactur-

ing jobs in our economy. A pessimist would claim that the figure shows no real turnaround in manufacturing.

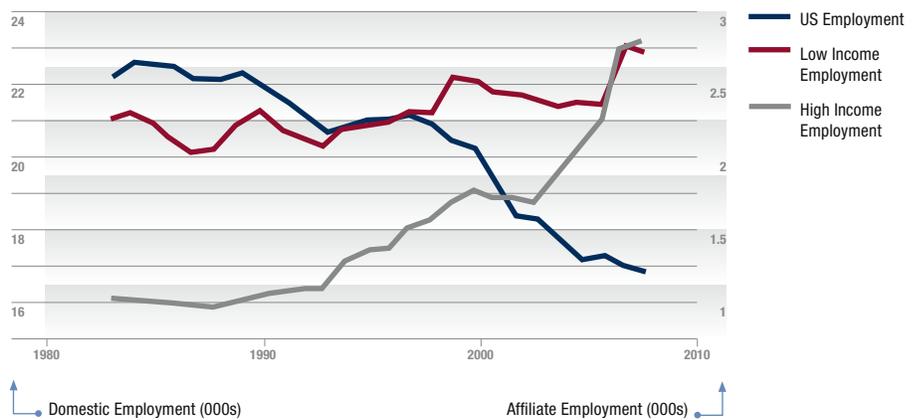
ENTER THE SHALE REVOLUTION

With the shale revolution, however, some people think that could change. In the late 1980s, a Texas oilman by the name of George P. Mitchell developed a technique to

ceased importing natural gas, as domestic production had replaced imports. This is truly a "shale revolution."

The implications of the shale revolution are profound. On the positive side, exploitation of these shale deposits has the potential to promote job growth and downstream activities that benefit from natural gas or cheap energy, such as the petrochemical

FIGURE 1: TRENDS IN US MANUFACTURING AND US MULTINATIONAL AFFILIATE EMPLOYMENT ABROAD



extract natural gas and crude oil from shale deposits. This process, known as hydraulic fracturing, or "fracking," combines deep vertical drilling, down sometimes as far as 8,000 feet, with horizontal drilling to access different shale deposits.

This technological breakthrough has made it possible to economically extract natural gas or light oil from the enormous shale deposits scattered throughout the United States. Some important deposits include the Barnett in Texas, the Marcellus located in Pennsylvania and New York, and the Bakken formation in North Dakota. As a result of the ability to exploit shale deposits located under the ground throughout the U.S., combined with the ingenuity of American oilmen and women, McKinsey estimates that the U.S. could be self-sufficient in energy by 2025. Already, by the end of 2012, the United States had essentially

industry. In March of this year, *National Geographic Magazine* showcased the revival of ghost towns in North Dakota and described the emergence of highly paid jobs in the natural gas extraction sector. The magazine highlighted the experience of Susan Connell, whose pay as a trucker jumped from \$600 to \$2,000 per week.⁴

Rhonda Zygocki, executive vice president for policy and planning of Chevron Corporation, says that in less than 10 years, fracking of shale gas has created 1.7 million jobs, with the potential to create a million more before the decade is over.⁵ A study by the research firm IHS, cited in the *Economist*, indicates that unconventional oil and gas accounted for 1.7 million jobs in 2012, which "includes the exploration and extraction itself, the supply chains they rely on and the extra spending by all those newly employed oilmen."⁶ However, other studies

¹ See also Justin R. Pierce and Peter K. Schott, "The Surprisingly Swift Decline of U.S. Manufacturing Employment," NBER Working Paper No. 18655 (Cambridge: National Bureau for Economic Research, 2012).

² See Avraham Ebenstein, Ann Harrison, Margaret McMillan, and Shannon Phillips, "Why are American Workers getting Poorer? Estimating the Impact of Trade and

Offshoring Using the CPS," NBER Working Paper No. 15107 (Cambridge: National Bureau for Economic Research, 2013); Avraham Ebenstein, Ann Harrison, Margaret McMillan, and Shannon Phillips, "Estimating the Impact of Trade and Offshoring on American Workers Using the Current Population Surveys," *The Review of Economics and Statistics*, forthcoming.

³ See Ann Harrison and Margaret McMillan, "Offshoring Jobs? Multinationals and U.S. Manufacturing Employment," *The Review of Economics and Statistics*, 93(3): 857-875.

⁴ <http://ngm.nationalgeographic.com/2013/03/bakken-shale-oil/dobb-text>

⁵ <http://www.climate-one.org/transcripts/driving-growth->

[edf-chevron](http://www.economist.com/news/special-report/21573279-shale-gas-and-oil-bonanza-transforming-americas-energy-outlook-and-boosting-its)

⁶ <http://www.economist.com/news/special-report/21573279-shale-gas-and-oil-bonanza-transforming-americas-energy-outlook-and-boosting-its>

⁷ http://www.energizingentrepreneurs.org/library/files/DSU%20Energy/Background/Weber_Natural_Gas_Boom_EE.pdf.

are more cautious. One study indicates that “a large increase in the value of gas production [from fracking] caused modest increases in employment, wage and salary income, and median household income. The results suggest that in Colorado, Texas and Wyoming each million dollars in gas production created 2.35 jobs in the county of production, which led to an annualized increase in employment that was 1.5% of the pre-boom level for the average gas boom county. Comparisons show that ex-ante estimates of the number of jobs created by developing the Fayetteville and Marcellus shale gas formations may have been too large.”⁷

What can we conclude from these mixed assessments? While not enough to offset the loss of 13 million manufacturing jobs between 1984 and 2012, the shale revolution still brings some of the best news to manufacturing employment in recent history.

BUT AT WHAT COST?

Despite the possible economic benefits, there is an ongoing debate over the possible health and environmental costs of hydraulic fracturing, some of it brought to public attention through feature films such as Matt Damon’s *Promised Land*. In order to extract natural gas from shale deposits, it is necessary to inject into the rocks large quantities of chemicals, sand and water at high pressure. After injection, the fluid (also known as “dirty water”) is pushed back to the surface as part of the process called “flowback,” and then must be disposed of safely. If proper disposal procedures are not followed, or the pipes used in these processes are not sealed adequately, or the well casings lack integrity or there are surface chemical spills, fracking can result in contamination of local groundwater and air pollution.⁸ Moreover, the demand for water, which can add up to two million gallons in the life of one well, can be problematic, particularly in regions already plagued with drought. Hydraulic fracturing

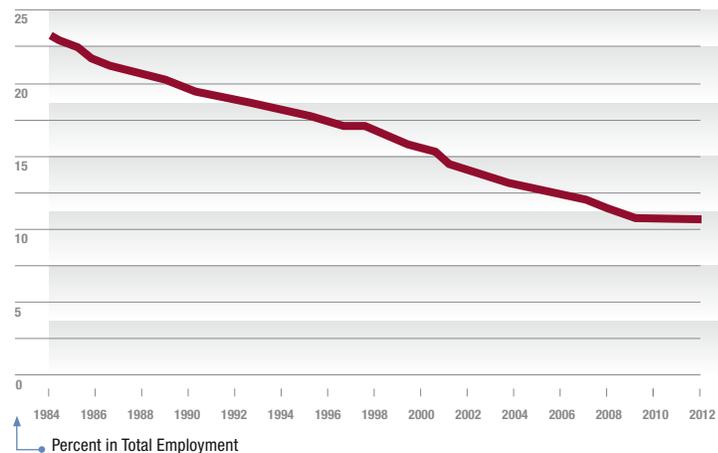
also may be responsible for tremors or earthquakes induced by the high pressure process.

There is also concern about the impact of fracking on emissions of methane, the main component of natural gas and a potent contributor to climate change. Switching from coal to natural gas for power generation can be beneficial for climate change, provided that methane emissions from the

place, e.g., if pipes are properly sealed and the methane gas is captured and properly stored.¹²

In April 2012, the U.S. Environmental Protection Agency (EPA) issued national standards to reduce harmful air pollution associated with oil and natural gas production, requiring operators of new fractured natural gas wells to use cost-effective tech-

FIGURE 2: MANUFACTURING SHARE OF TOTAL EMPLOYMENT (TO FEBRUARY 2013)



production and transport of natural gas are contained.⁹ However, a key criticism of fracking by environmentalists is that the process releases high levels of methane gas emissions. In addition to being a possible health hazard, methane is a potent greenhouse gas, with much more global warming potential than carbon dioxide, especially in the short term. Recent studies by Cornell and NOAA show that if high levels of fugitive methane emissions from the process are not captured, the net climate impact of fracking throughout the life of a project could be worse than the greenhouse gas emissions from coal.^{10, 11} These studies question the premise that shale gas is a cleaner fuel that can help the transition from coal to renewable energy. Other studies suggest that these methane emissions may be overstated and climate damages can be avoided if relatively inexpensive measures are put in

nologies and practices to reduce emissions of volatile organic compounds (VOCs), which contribute to smog formation, and air toxics, including benzene and hexane. While this may also lead to reducing fugitive emissions of methane,¹³ environmentalists are pushing for explicit EPA rules covering fugitive methane emissions from the drilling, fracking and transport of natural gas.¹⁴

A more frequent concern is pollution of groundwater by the toxic chemicals used in fracking. Because of the critical importance of dispensing with flowback water safely, the EPA is undertaking a national study with the Department of Energy and the Department of the Interior to understand the potential impacts of hydraulic fracturing on drinking water resources and to develop rules for dealing with water pollution appropriately. In fact, a recent NBER study of shale gas fracking in Pennsylvania showed

⁸ One of the most often discussed risks associated with shale gas development is the potential for groundwater contamination. Faulty well casings or cement could provide a pathway for contaminants to reach a drinking water aquifer. See Secretary of Energy Advisory Board, Shale Gas Production Subcommittee Second Ninety Day Report, November 18, 2011; Stephen G. Osborn,

Avner Vengosh, Nathaniel R. Warner, and Robert B. Jackson, “Methane Contamination of Drinking Water Accompanying Gas-Well Drilling and Hydraulic Fracturing,” PNAS (2011). Another arises if hydraulic fracturing occurs too close to a drinking water aquifer or if there are naturally occurring hydraulic pathways between the formation and the drinking water aquifer [Warner et al.,

2012; Myers, 2012]. See “EPA Releases Draft Findings of Pavillion, Wyoming Ground Water Investigation for Public Comment and Independent Scientific Review,” EPA News Release, December 8, 2011; Nathaniel R. Warner, Robert B. Jackson, Thomas H. Darrah, Stephen G. Osborn, Adrian Down, Kaiguang Zhao, Alissa White, and Avner Vengosh, “Geochemical Evidence for

Possible Natural Migration of Marcellus Formation Brine to Shallow Aquifers in Pennsylvania,” PNAS (2012); Lucija Muehlenbachs, Elisheba Spiller, and Christopher Timmins, “Shale Gas Development and Property Values: Differences across Drinking Water Sources,” NBER Working Paper 18390 (Cambridge: National Bureau for Economic Research, 2013).

that economic benefits (royalties) from leasing land for shale gas were offset by the loss in property values due to groundwater contamination.¹⁵

In light of the uncertain health and proven negative environmental impacts, some states—like Vermont—have imposed a ban on fracking. New York state currently has a moratorium on fracking. Governor Andrew Cuomo is waiting for additional evidence on the possible costs before allowing the state to proceed. And New York Attorney General Eric T. Schneiderman has announced his intent to sue the U.S. Environmental Protection Agency for failing to address methane emissions from the oil and natural gas industry, including fracking. Schneiderman is leading a coalition of seven states (Connecticut, Delaware, Maryland, Massachusetts, Rhode Island, and Vermont) under the charge that the agency violated the Clean Air Act when it ignored methane on a recent update to air pollution standards.¹⁶ Looking outside the U.S., France and Bulgaria do not allow fracking either.

In part because the technology¹⁷ was not widely used until the last several years, research on the evidence about the possible environmental effects is only starting to be published. That is likely to change soon. The University of Pennsylvania, under the direction of Dr. Trevor Penning, has initiated large scale studies to explore the toxicity of flowback water that emerges from gas wells, as well as the health outcomes for populations living near natural gas installations. New York state is also awaiting the conclusions of a one million dollar study conducted by Geisinger Health System. Finally, the EPA has ordered an investigation, which will be released in 2014.

STATE OR FEDERAL OVERSIGHT?

The reason why New York and Vermont have no activity at all, while fracking in North Dakota and northern Pennsylvania is booming, is because the oversight for high

volume hydraulic fracturing rests with the states. The appropriate role for federal oversight in shale exploration and extraction is now being hotly debated. Take, for example, the response to the rules that the Department of the Interior has been developing to govern fracking on public lands. The draft rules contain requirements on oil and gas well integrity, to verify that fluids from the fracking process aren't escaping into nearby water supplies, and require that companies have management plans for large volumes of flowback water.¹⁸ But these proposed rules for federal lands have faced heavy criticism from industry groups and some Republicans, who say state oversight is sufficient. Chevron executive Rhonda Zygocki, for instance, calls

If the U.S. wishes to become a major energy exporter, trade restrictions are not the answer.

for a “commitment to responsible development by companies . . . in our industry,” saying, “It will take strong regulation and the enforcement of that regulation by the states.” Not surprisingly, some states too are very resistant to federal regulation. When we asked MIT chemistry professor and former CIA director John Deutch what he thought of introducing federal oversight, he said he thought that would be “goofy.”

The current system, based on state oversight, actually leaves much of the regulation up to the individual companies. And as Deutch wrote in an article published in 2011 in *Foreign Affairs*, “If the industry is to avoid onerous regulation, it should establish safety and environmental standards on its own.” However, when asked if the industry had established those standards, he said, “No.”¹⁹ Yet estimates by the International

Energy Agency, as reported by the *Economist*, suggest that imposing safety regulations to the tune of only 7 percent of the cost of an average shale gas well could turn this lucrative industry into a much safer one.

All companies should have a significant interest in establishing spotless reputations for ethical behavior. However, self-regulation is likely to be much more costly for small contractors, and they are also less visible to regulators. The majority of companies engaged in fracking are small “mom and pop” operations. According to Fred Krupp, President of the Environmental Defense Fund, the industry is very fragmented. “There are 40 companies that make up 50 percent of U.S. onshore production. To get to 75 percent, it’s 300 companies. To get to 100 percent, it’s well over a thousand, maybe as many as 2,000.”²⁰ And there are many thousands of individual wells. To avoid giving hydraulic fracturing a bad name, the large companies may realize that it is in their interests to subject the entire industry to consistent federal oversight and to support the enforcement of common standards on all fracking operations.

Because of the widely different attitudes and approaches to fracking across states, we believe that it will be important to have adequate federal regulations that cover both toxic chemical pollution of local groundwater and local air pollution. Such regulations would protect those who live near fracking sites from water contamination and air pollution. The EPA should also adopt a rule that requires the capture of the fugitive emissions of methane from natural gas drilling, fracking and transport.

TRADE POLICY AND THE SHALE REVOLUTION

In part due to lower extraction costs, as well as a technology advantage, large resource endowments, and a relatively unregulated environment, the price of stranded natural gas in the United States is up to five

⁹ <http://www.pnas.org/content/109/17/6435>

¹⁰ <http://www.eeb.cornell.edu/howarth/Marcellus.html>

¹¹ <http://www.nature.com/news/methane-leaks-erode-green-credentials-of-natural-gas-1.12123>

¹² <http://blogs.cfr.org/levi/2012/10/12/revisiting-a-major-methane-study/>

¹³ <http://yosemite.epa.gov/opa/admpress.nsf/d0c->

[6618525a9efb85257359003fb69d/c742df7944b37c50852579e400594f8f%21OpenDocument.](http://www.pnas.org/content/109/17/6435)

¹⁴ <http://bloom.bg/ZKXkH8>.

¹⁵ See Muehlenbachs, Spiller, and Timmins, “Shale Gas Development and Property Values: Differences across Drinking Water Sources.”

¹⁶ <http://bit.ly/15RyBvR>.

¹⁷ Shale gas exploitation combines two long established technologies: hydraulic fracturing and horizontal drilling.

¹⁸ <http://thehill.com/blogs/e2-wire/e2-wire/278107-interior-pumps-brakes-on-gas-fracking-rule-plans-revision>.

¹⁹ <http://fam.ag/11Vpfl1>.

²⁰ <http://www.climate-one.org/transcripts/driving-growth-edf-chevron>.

²¹ Dieter Helm, *The Carbon Crunch: How We're Getting Climate Change Wrong – And How to Fix It* (New Haven: Yale University Press, 2012).

²² http://theenergycollective.com/sbattaglia/202226/time-jump-fracking-bandwagon?utm_source=hootsuite&utm_medium=twitter&utm_campaign=hootsuite_tweets.

times lower than in Europe or Asia.²¹ One important question is whether such a price advantage, which also has allowed U.S. energy-intensive manufacturing companies to benefit from lower input costs, is likely to be maintained. One factor that could reduce price disparities and encourage continued growth of the natural gas sector is liberalization of U.S. natural gas exports.

While the decision on whether to allow fracking is left to each individual state, trade in crude and natural gas is regulated at the federal level. The United States currently bans exports of crude oil. For natural gas, trade is unregulated with free trade partners, but firms are required to obtain a licence if they intend to export to other countries. In the last several years, only one in 17 requests was granted, and the application process took several years.

If the U.S. wishes to become a major energy exporter, trade restrictions are not the answer. Trade restrictions, which prevent companies from selling liquefied natural gas to non-free trade agreement partners, are likely to discourage additional exploration and drilling. Current trade policies are promoting artificially low energy prices, which will lead to over-investment in downstream energy-intensive sectors. Another unintended consequence is to reduce incentives to invest in energies such as solar and wind power as well as even newer renewable technologies. In his *Foreign Affairs* article, John Deutch wrote that “in the long run, the world will need to transition from fossil fuels to carbon-free sources of energy, such as wind, solar, geothermal, and nuclear energy. In this sense, shale gas is a way station en route to a new energy future—not a permanent solution to the problem.”

Allowing free trade in natural gas exports would lead to increased prices, and consequently, increased exploration and extraction. But without simultaneous public policy designed to address the environmental externalities of fracking, such a shift

in trade policy will only exacerbate those particular environmental concerns. The best policy would be to allow free trade in gas, but for public policy to attack the environmental pollution at its source through a production tax or similarly tailored policy.

Shale deposits exist all over the world, including in Canada, Latin America, Australia, China, North Africa, and Europe. Foreign firms are eager to acquire the new technology for hydraulic fracturing and horizontal drilling and to apply it to their own reserves. While the U.S. has a head start and has been able to quickly build the infrastructure necessary for extracting and transporting natural gas, other countries are sure to follow. A U.S. future as a net natural gas exporter will not be helped by interventionist policies that discourage investment at home.

One country that is already taking action to exploit new shale technologies is China. China is the world’s largest energy consuming nation and one of the top importers of oil. Its oil fields may be drying up, but the U.S. Energy Information Administration estimates 1,275 trillion cubic feet (over 36.1 trillion cubic meters) of shale gas can be found there. China has a plan to produce 6.5 billion cubic meters of shale gas each year by 2015, and by 2020 it may be extracting 100 billion cubic meters. China is slowly moving away from its smog-producing coal plants and PetroChina has taken that initial step by recently signing its first production agreement with Shell.²² As shale gas exploitation expands to developing countries, it will be important to encourage them to regulate the health and environmental impacts. Getting the regulatory standards in the U.S. right can encourage the adoption of good practices elsewhere – especially in China – so that shale gas exploitation doesn’t lead to huge increases in greenhouse gases.

Several weeks ago, Dow CEO Andrew Liveris asked for continued limits on natural

gas exports in an opinion piece published in the *Wall Street Journal*. The petro-chemical industry is a significant beneficiary of low natural gas prices, and Mr. Liveris wants to keep it that way. But in calling for continued regulation of natural gas, Mr. Liveris got it only half right. Laws to ensure that the industry develops safely and sustainably are a good idea. But a policy that restricts U.S. exports will encourage firms to export the technology abroad, rather than employing it more fully here, and allow firms like Dow to gain an artificial edge through low cost natural gas. Restricting energy exports may accelerate the decline of U.S. manufacturing, rather than revive it.

BRIEF IN BRIEF

- The “shale revolution,” spurred by the development of hydraulic fracturing, brings some of the best news to U.S. manufacturing employment in recent years, and gives the U.S. the potential to become a major energy exporter.
- But current trade restrictions, which promote low energy prices, only discourage the exploration of U.S. natural gas reserves.
- And the potential of “fracking” to produce negative health and environmental effects is a grave concern.
- The best policy would be to allow free trade in gas, while using federal regulation to monitor the fracking industry and deploying public policy to tackle the negative externalities of fracking through a production tax or similar measure.

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