Strategic Roadmap Priorities

September 23, 2023

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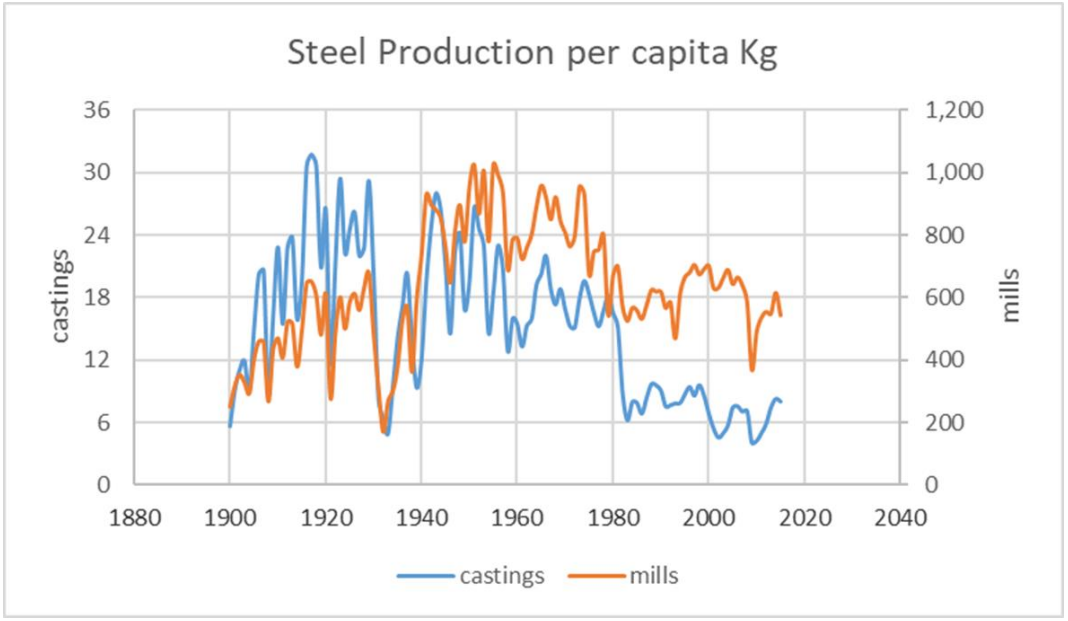
SFSA Strategic Roadmap

- People
  - Workforce
  - Perception
- Capital
  - Trade
  - Profitability
  - Re-investment
- Technology
  - Process
  - Product

Before 1930, steel castings were 2% of steel production and were the premium product. Since 1908, steel castings are 1% of steel production and are seen as problematic.



Workforce Development

- **E.O. 14017: Securing Workforce**
  - The loss of 1,600 U.S. foundries between 1984 and 2018 displaced 324,000 workers. Lack of available employment combined with capability erosion as plants stopped operating led to the remaining workforce losing a wealth of practical manufacturing knowledge over time. The effects on the sector are heightened by the shrinking number of people entering the U.S. manufacturing workforce. Casting and forging expertise is also diminishing in the aging DoD workforce.
- SFSA first identified Workforce as a priority strategic issue in 2015
  - Workforce development- to find ways to fill the shortage of production, skilled and professional people to serve in the steel casting industry.
    - Foundries are losing senior and knowledgeable management and technical staff
    - Attracting new professionals is difficult with idea of declining manufacturing
    - Foundry image is dark, dirty and dangerous set to decline makes us unattractive
    - Production and skilled workers hard to find since emphasis is on college
    - Casting production is labor intensive and needs to be automated to improve quality and lower costs
    - Production needs to be simplified to reduce the skill required and allow more standard work
    - Production workers need to be recruited, retained and trained to have needed skills
- In July 2023, SFSA strategic roadmap identified Workforce as the most pressing issue facing the casting industry..
  - Cast in Steel has been recognized as our most effective outreach to university graduates.
  - Future Leaders is an effective tool for retention and development
  - Understanding and using social media helps change the perception of the industry

Steel Casting and Forging Plants and Employees

Impact of Cast in Steel

DoD IBAS support of Cast in Steel for 2023 allowed a larger program and significant increase in Students and Universities.

Competition Year	School	Teams	Students	Item
2019	16	20	77	Viking Axe
2020	13	17	51	Bowie Knife
2021	18	24	109	Thor's Hammer
2022	26	35	177	Celtic Leaf Sword
2023	31	42	217	African Spear Point
2024	40	55	282	Halligan Bar

(2024 numbers are projected)

NON-FERROUS FOUNDERS' SOCIETY

AFS AND THE INSTITUTE

FORGING INDUSTRY ASSOCIATION

America Makes

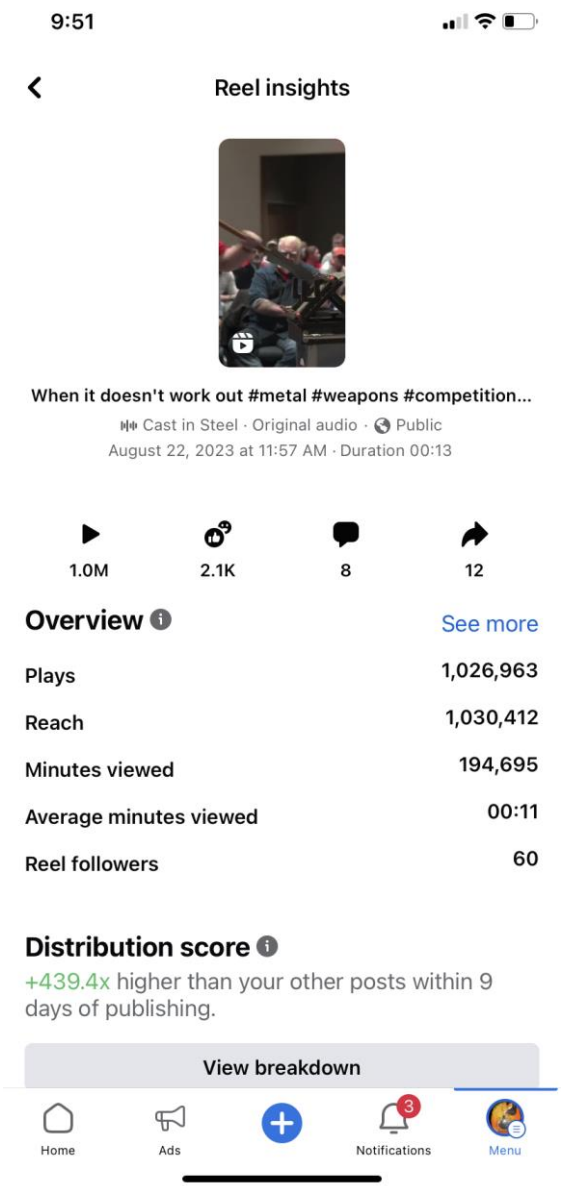
Arizona State University	Instituto Tecnológico de Saltillo	Purdue University	University of California, Irvine
Arts et Méti ers Science et Technologies Cluny	Iowa State University	St Marti ns University	University of Northern Iowa
Baylor University	Kent State University	Saginaw Valley State University	University of Pitt sburgh at Johnstown
California State Polytechnic University, Pomona	Louisiana State University	South Dakota School of Mines & Technology	University of South Alabama
California State Polytechnic University, San Luis Obispo	Michigan Technological University	Texas A&M University	University of Wisconsin - Madison
Central Michigan University	Mississippi State University	Texas State University	University of Wisconsin-Milwaukee
Colorado School of Mines	Missouri University of Science & Technology	The Ohio State University	University of Wisconsin Platt eville
Georgia Southern University	Penn State	Trine University	Virginia Tech
Grand Valley State University	Penn State University – Behrend	University of Alabama at Birmingham	Wentworth Insti tute of Technology
Insti tuto Tecnológico de Morelia	Pitt sburg State University	University of Alabama Tuscaloosa	Western Michigan University
			Youngstown State University

Every University and all students including their non-participating classmates see the value and meaning of manufacturing in general and casting in particular.

How to do we engage university students?

Student enthusiasm drives the Cast in Steel Competition. We get self-selected students who will be the leaders in manufacturing and will understand the capabilities and value of castings. The Universities will see that castings are a sophisticated technology using advanced modeling to assure performance and reliability

Utilizing Cast in Steel on Social Media



All in Steel 2024

All in Steel 2024 competition challenges university students to use modern casting tools to creatively design and produce a functioning version of a Halligan bar – a multipurpose tool used by firefighters to gain access to building spaces, vehicles, and for a multitude of other emergency uses.

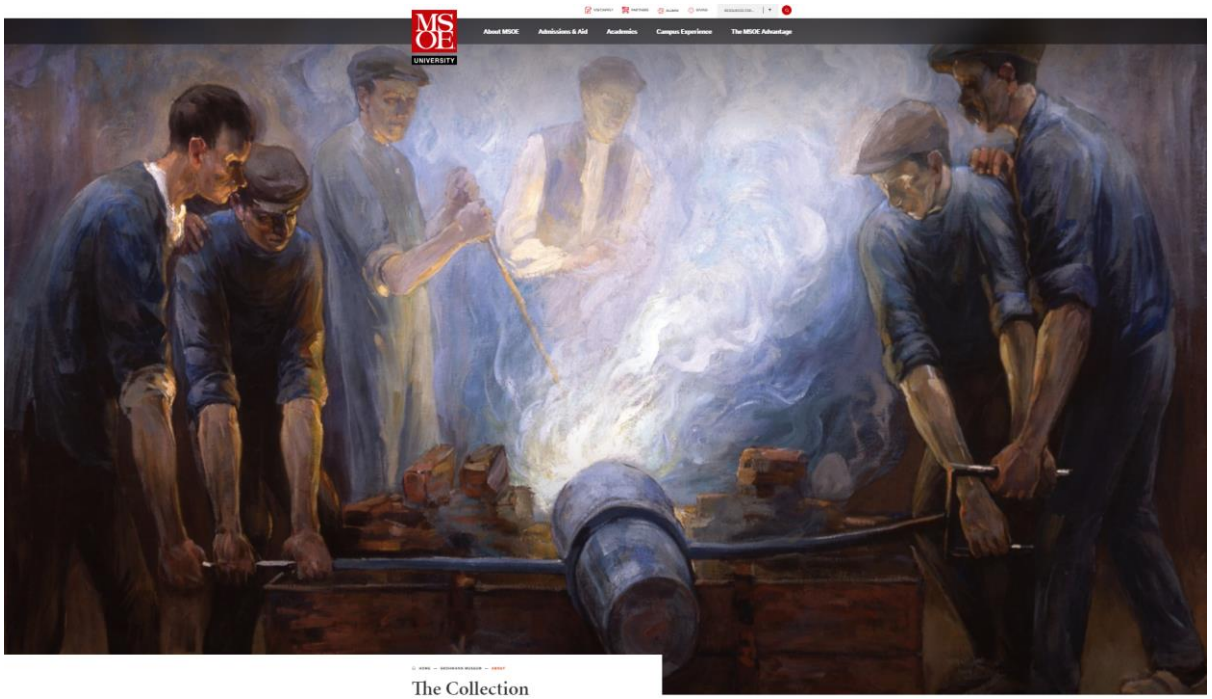
Designed by and named for New York City Fire Department First Deputy Chief Hugh Halligan in 1948, the Halligan consists of a bar with claw or fork, a blade (wedge or adze), and a tapered pick. Some feature a sliding weight for hammering the bar into a gap to facilitate prying.

All in Steel Partnering with MSOE and Grohmann Museum

The Collection

With an ever-growing collection, there is always something new to see.

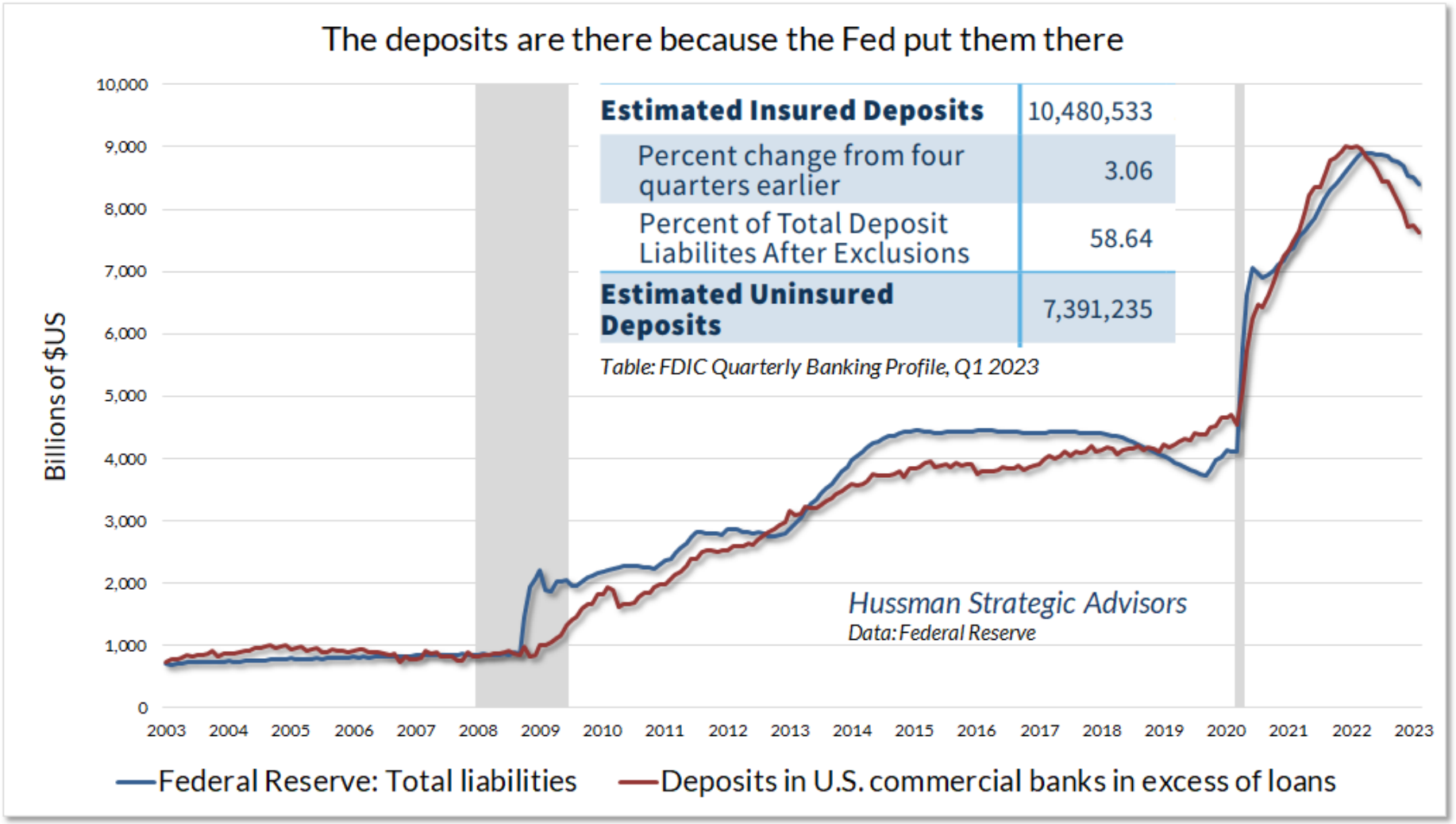
The Grohmann Museum collection currently comprises more than 1,700 paintings, sculptures, and works on paper from 1580 to the present. They reflect a variety of artistic styles and subjects that document the evolution of organized work from manpower and horsepower to water, steam, and electrical power. It was gifted to MSOE in 2001 by Milwaukee businessman and collector Dr. Eckhart Grohmann.



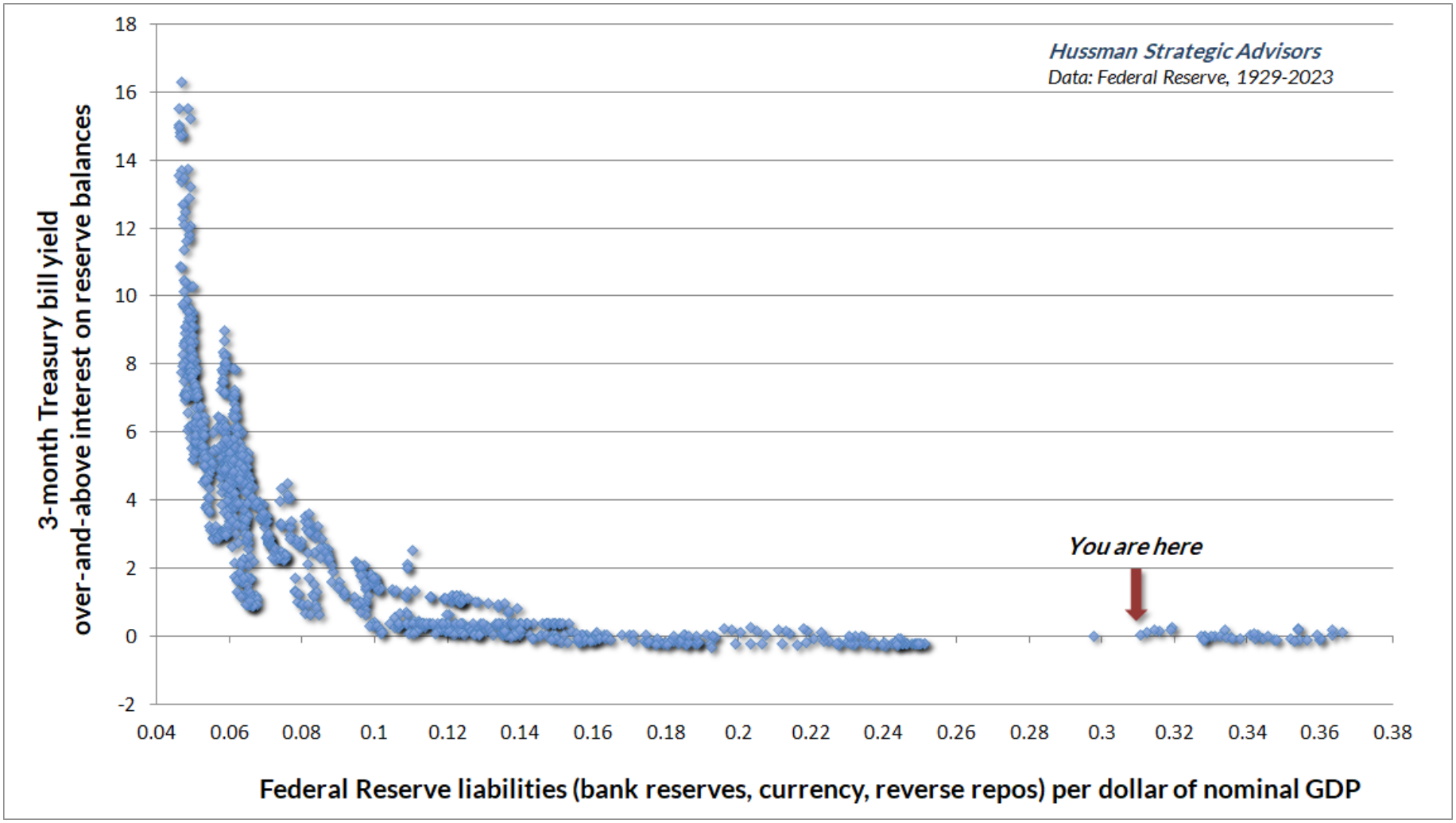
About MSOE

Milwaukee School of Engineering is a private, non-profit university offering bachelor's and master's degrees in engineering, business, and nursing. At MSOE, you will find a caring community of students and faculty. Together, we are committed to fostering a higher standard of academic programming and research, and personalized service, instruction, and guidance.

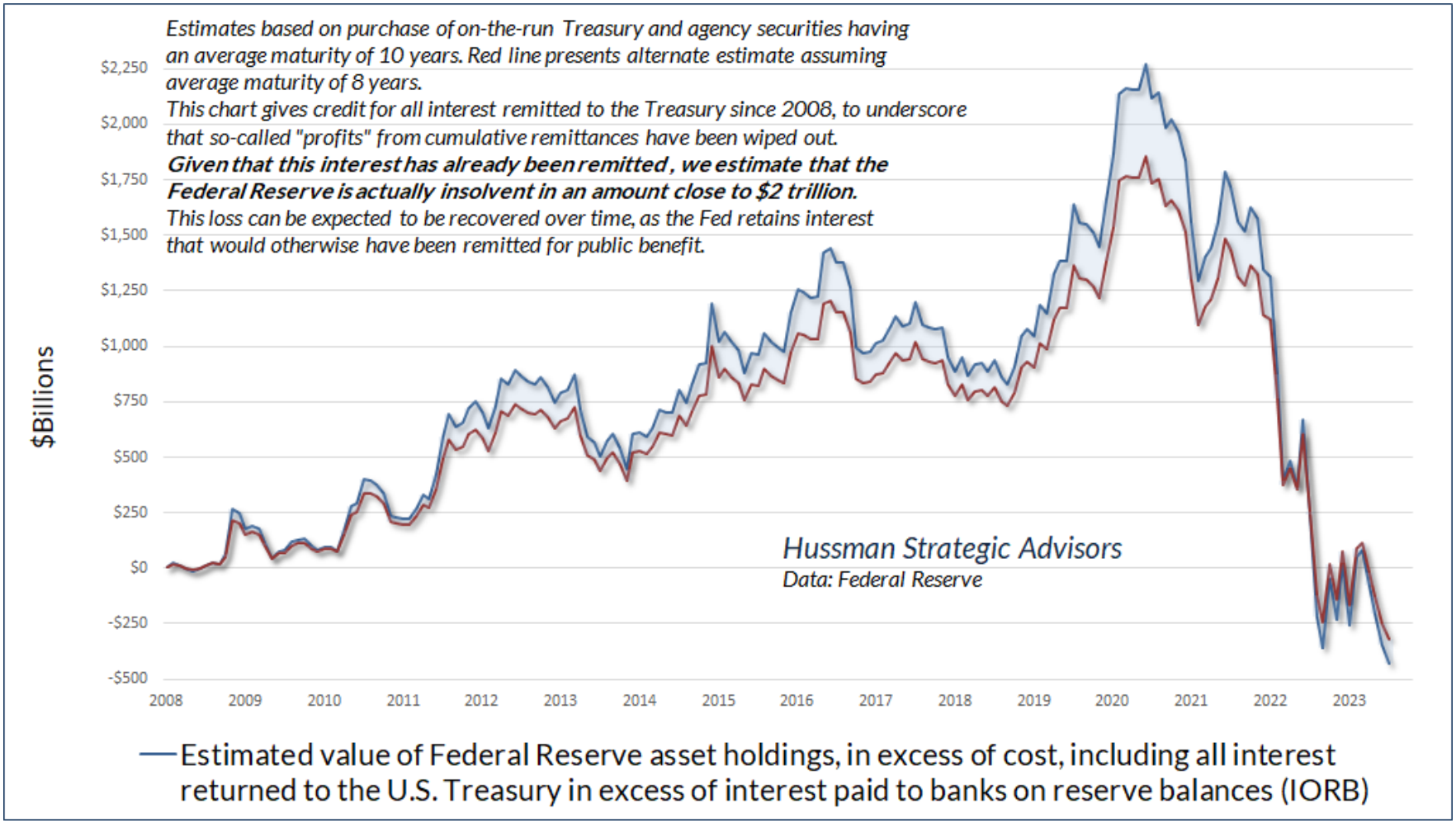
Excess Money established low interest rates to protect the financial system



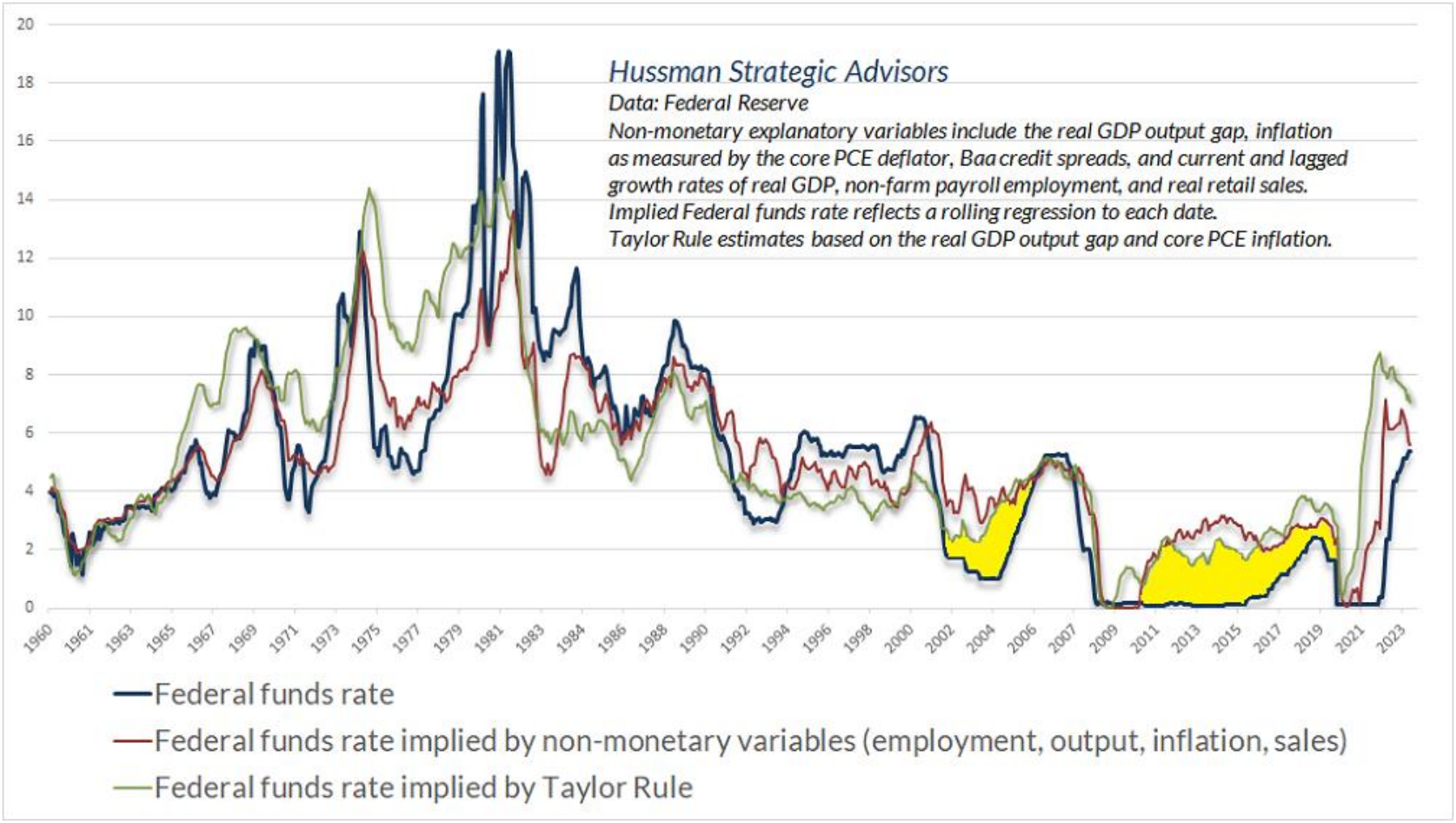
Zero Interest Rates were an intended result of Huge increase in Money



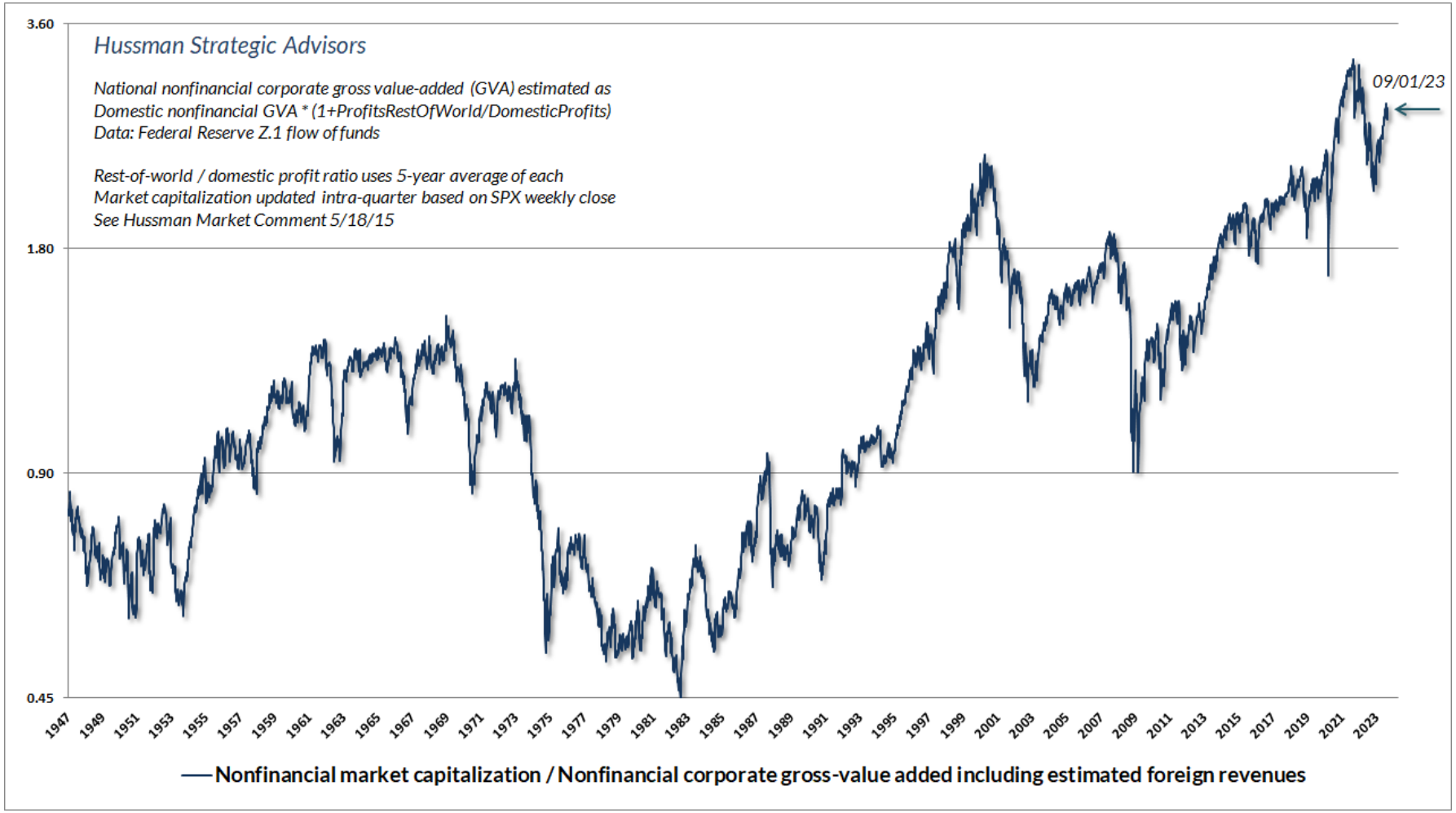
In Addition to the current interest payments on trillions in debt, the loss of value due to increased interest rates means the Fed is Bankrupt and Spending not Earning.



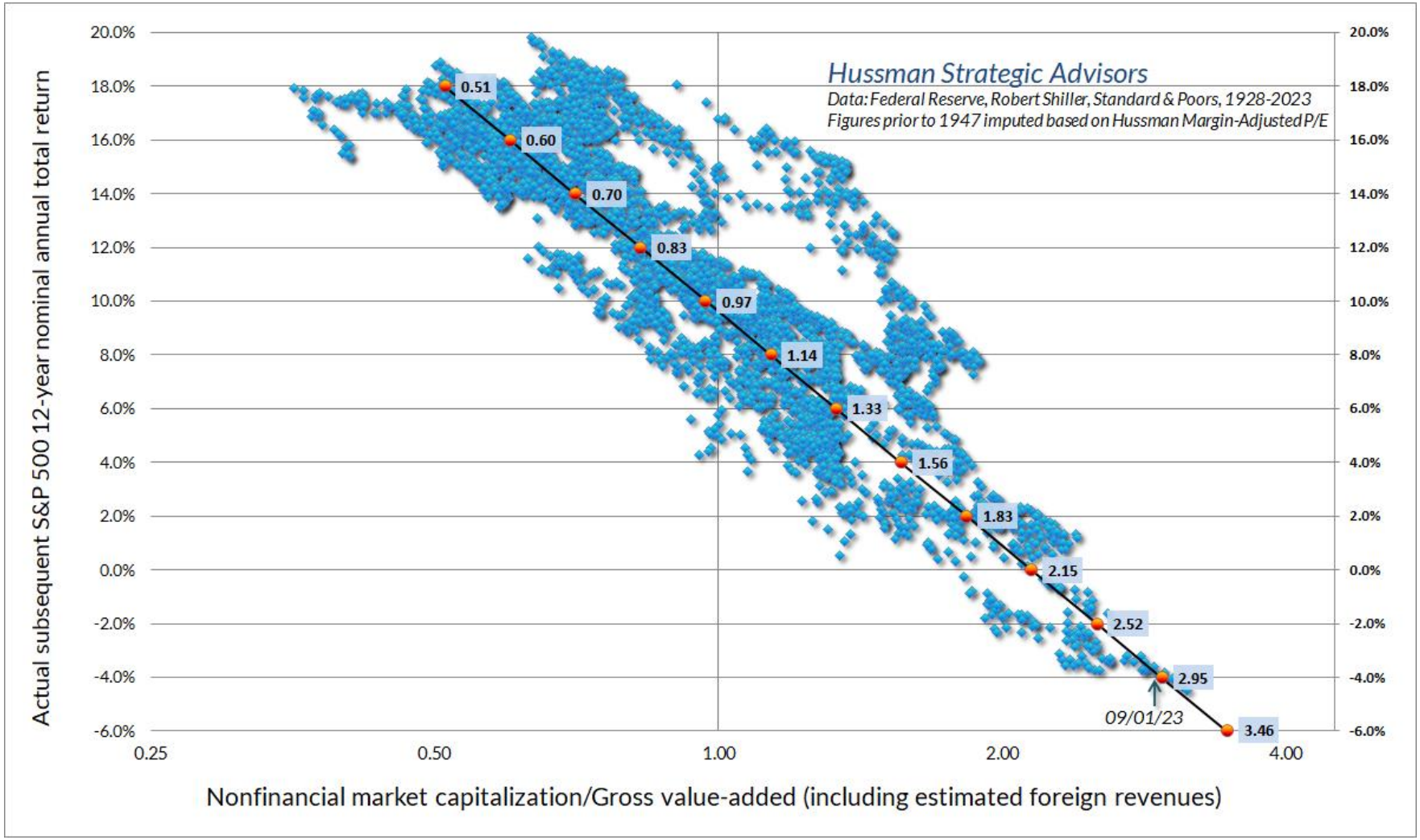
Near Zero Interest Rates were an unprecedented Financial Experiment



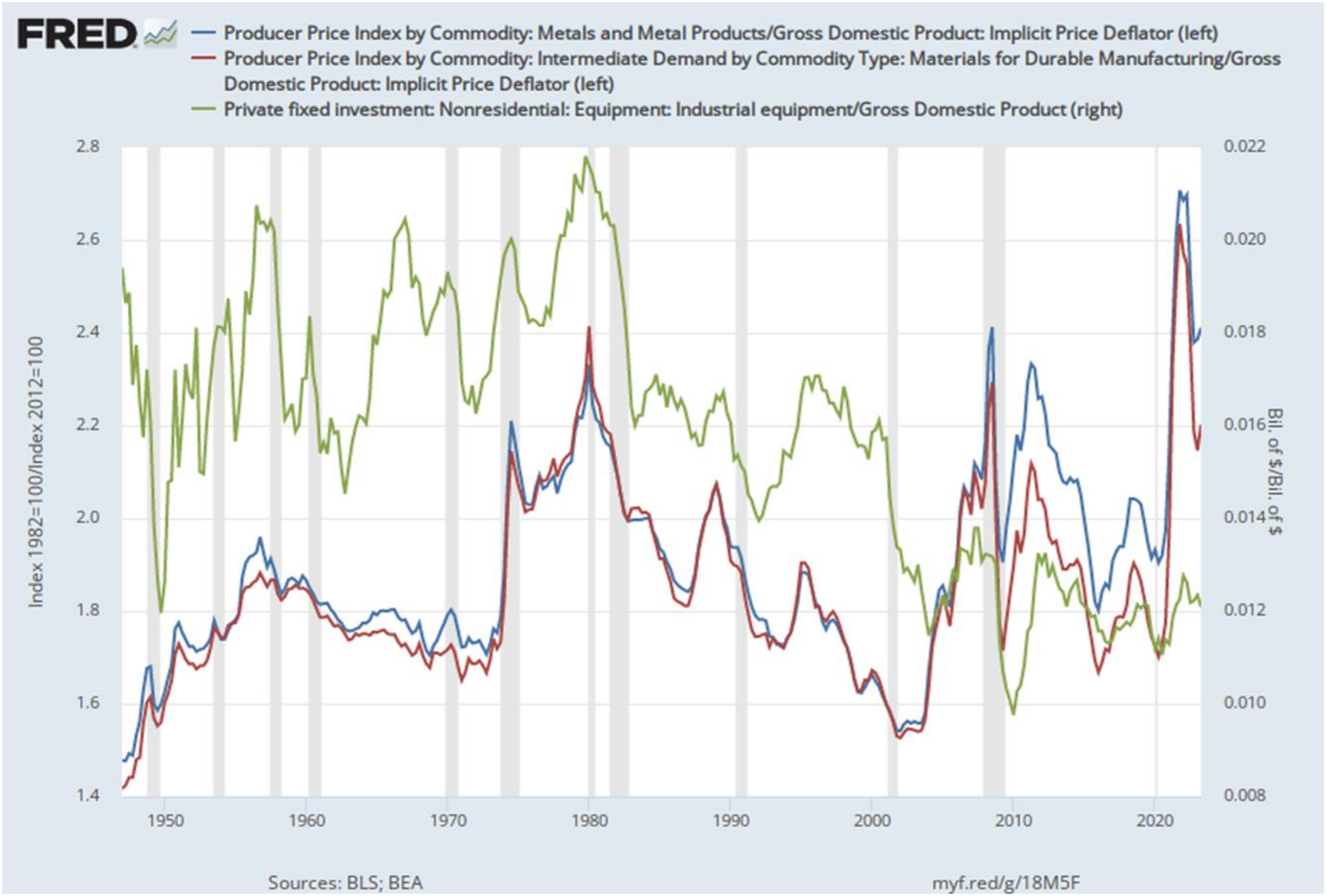
The intent was to support the value of equities and the banking system from ordinary failures to maintain a robust economy that gave the lowest value in history.



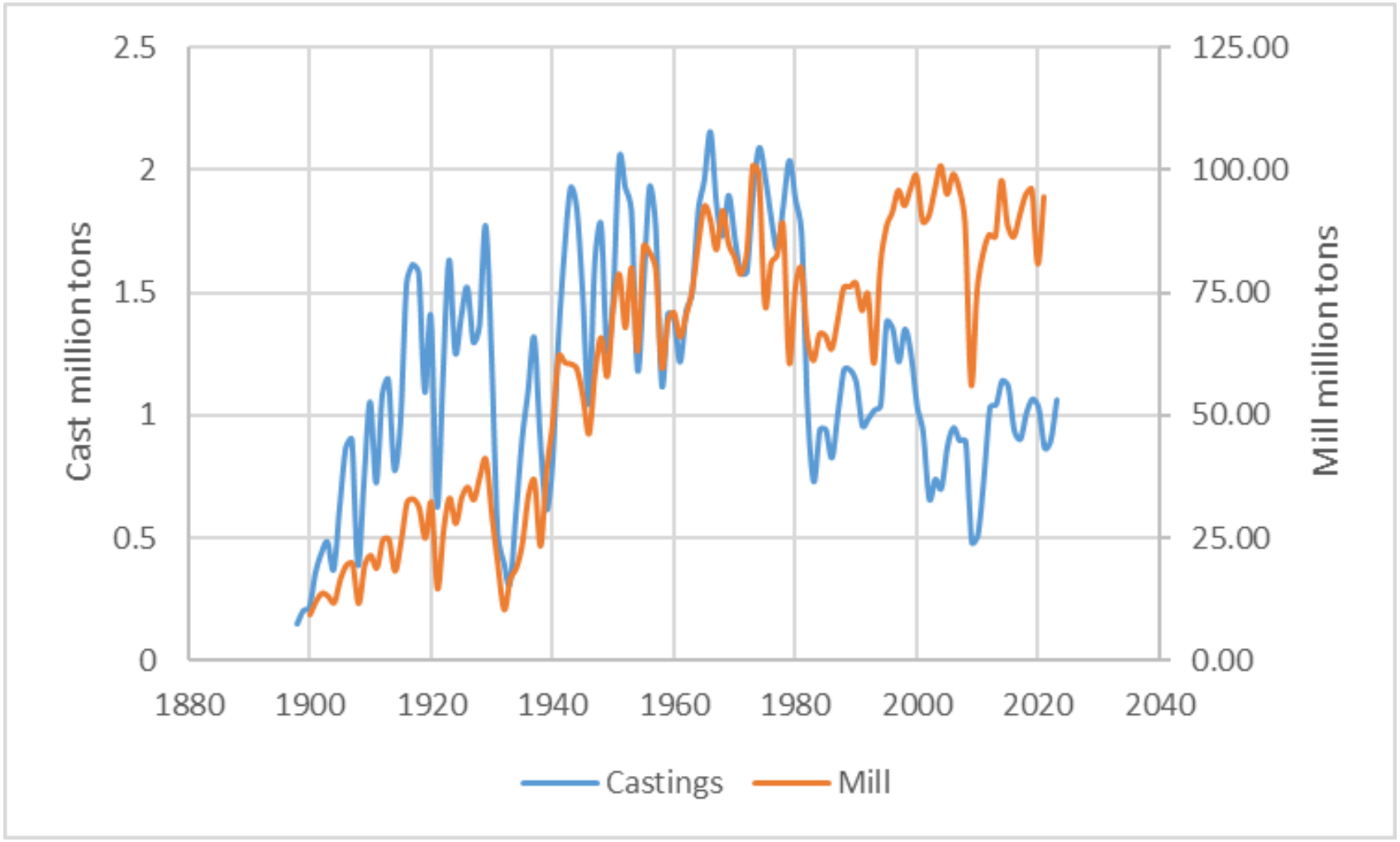
History would suggest that this is unsustainable



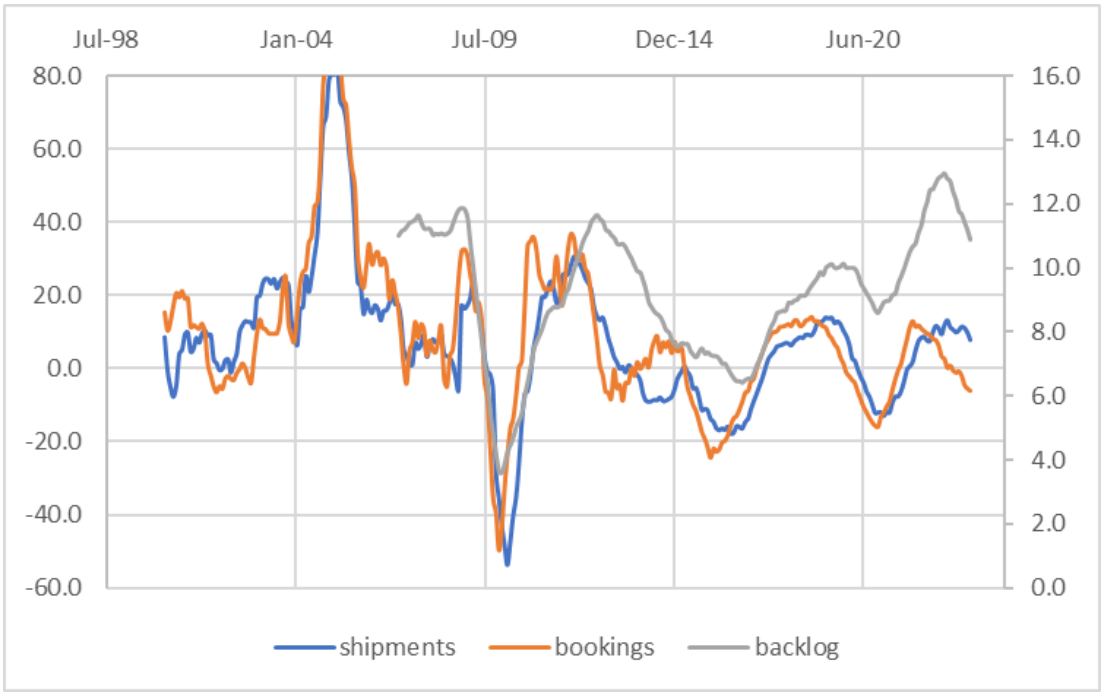
We have been successfully de-industrializing!



We globalized instead of re-capitalized capital-intensive industry from 2004 until 2022.

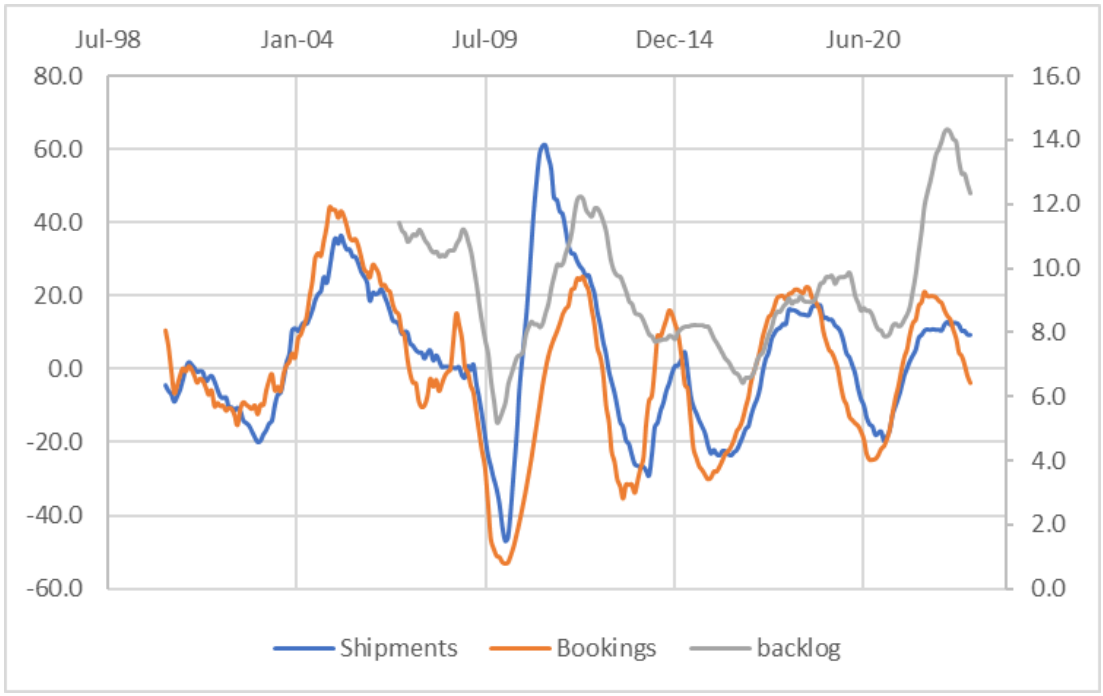

2.5
2
1.5
1
0.5
0
Cast million tons
125.00
100.00
75.00
50.00
25.00
0.00
Mill million tons
1880
1900
1920
1940
1960
1980
2000
2020
2040
Castings
Mill

Steel Casting demand is volatile and highly variable.

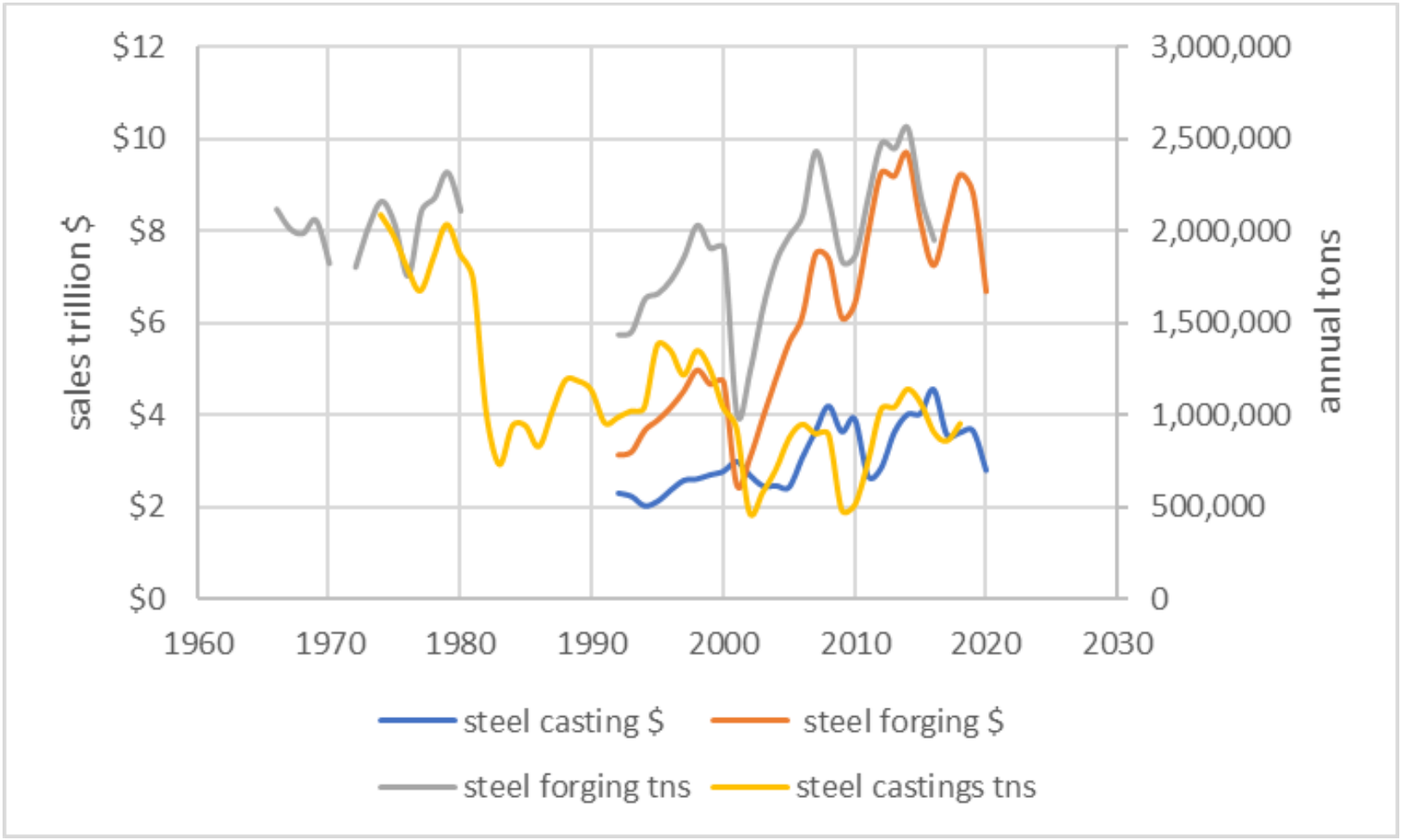


Stainless Castings

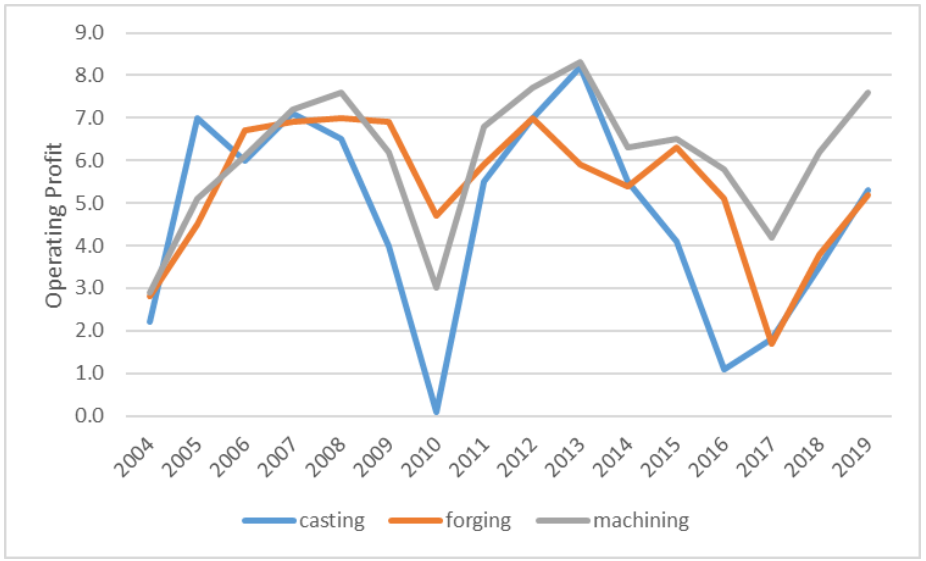
Steel Castings



Steel Casting and Forging Plants can still meet the domestic demand



Major Problem is lack of profitability to support new investment and technology to improve quality and lower costs.



	Sales	Payroll	Benefits	Materials purchased	Capital Investment	Value Added
	Per ton					
Mills	1195.98	89.57	34.51	850.10	30.97	374.49
Foundries	3394.79	676.59	240.95	1720.34	132.55	1948.11
Forge shops	3745.59	492.45	163.03	2080.39	193.04	1658.41
	Per Employee					
Mills	1,044,367	78,212	30,138	742,333	27,043	327,019
Foundries	250,086	49,843	17,750	126,734	9,764	143,513
Forge shops	431,343	56,710	18,775	239,578	22,231	190,982
	Per hour					
Mills	584.98	43.81	16.88	415.80	15.15	183.17
Foundries	146.27	29.15	10.38	74.12	5.71	83.94
Forge shops	263.33	34.62	11.46	146.26	13.57	116.59

DoD Action Plan to respond to E.O. 14017

Castings and Forgings

National Security Significance

Cast and forged (C&F) parts are critical to the development, procurement, and sustainment of all major defense systems by the DIB, including, where applicable, the organic industrial base (OIB). They are used in almost all platforms (e.g., ships, submarines, aircraft, ground combat vehicles, spacecraft, etc.), kinetic weapons and weapon systems (e.g., guns, missiles and rockets, bombs, ammunition, artillery pieces, etc.), and many supporting systems (e.g., vehicles, powered support equipment, etc.). In 2020, the Defense Logistics Agency (DLA) identified 30,061 out of 32,597 specialized end items that contain C&F maintenance, repair, and operations (MRO) parts. Many of these parts are high importance/low-volume and minimal demand items[18] that support "critical go-to-war weapon systems and platforms that affect military readiness."[19] C&F products are essential components of the machine tools and other equipment used to produce and sustain fielded systems and forgings are found in 20 percent of the products representing the gross domestic product of the United States.[20]

Organic Defense Industrial Base (OIB)
The OIB includes government-owned government-operated (GOGO) and government-owned contractor -operated (GOCO) facilities that provide specific goods and services for the DoD.

Casting and Forging
Casting is the process used to create geometrically complex parts by pouring molten or high-temperature metal or composites into a mold.

"About Metalcasting." American Foundry Society

Forging is the process used to develop metal parts by pounding, pressing, or squeezing metals under great pressure; the metals are often preheated before working but are never melted.

"Forging Facts: What is Forging?" Forging Industry Association

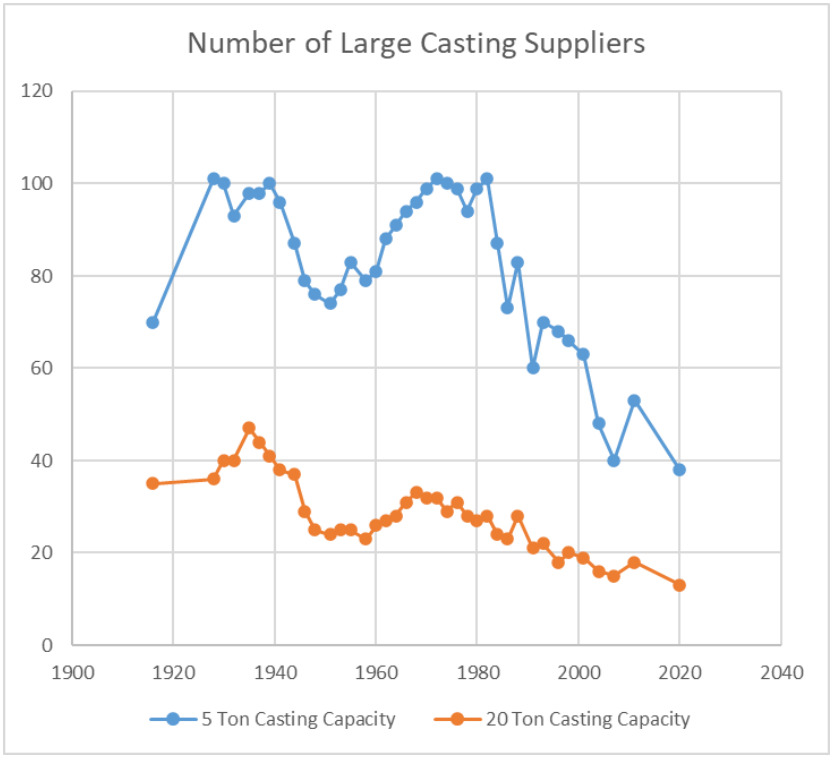
Manufacturers use C&F capabilities to provide specific material properties in intermediate products[21] and end items that cannot be produced by other manufacturing processes. Production of C&F parts often includes

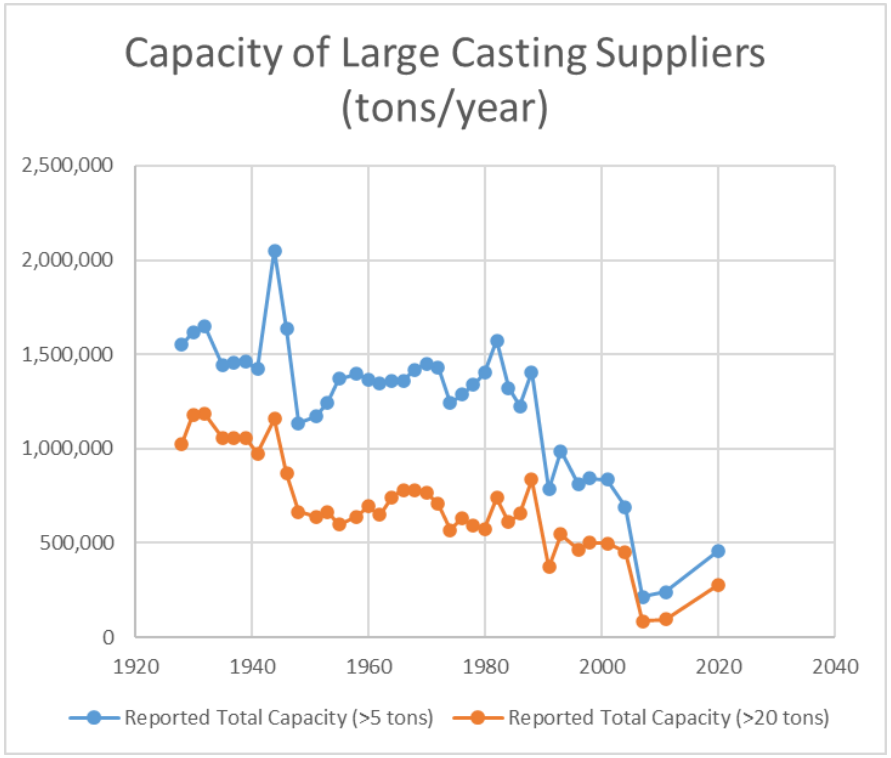
Securing Defense-Critical Supply Chains

An action plan developed in response to President Biden's Executive Order 14017

February 2022

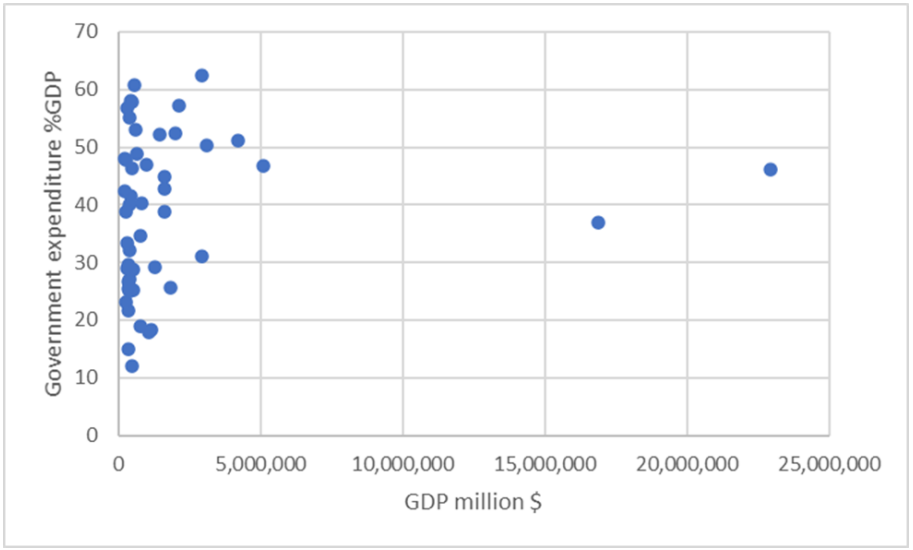
Large Steel Castings for high performance critical equipment

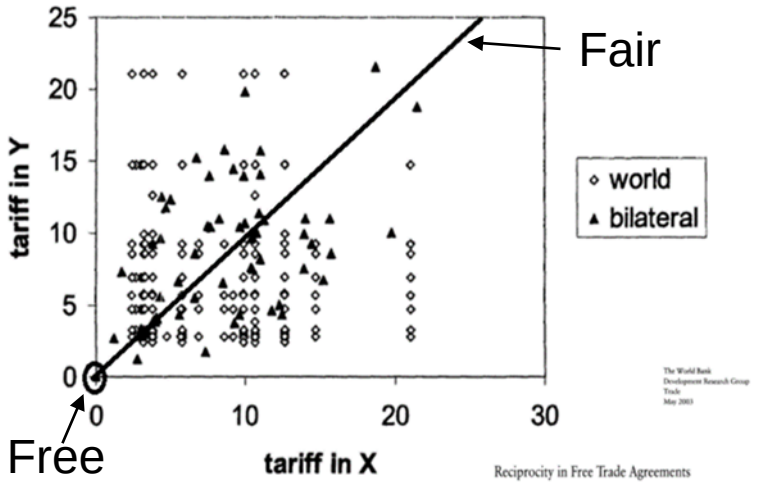


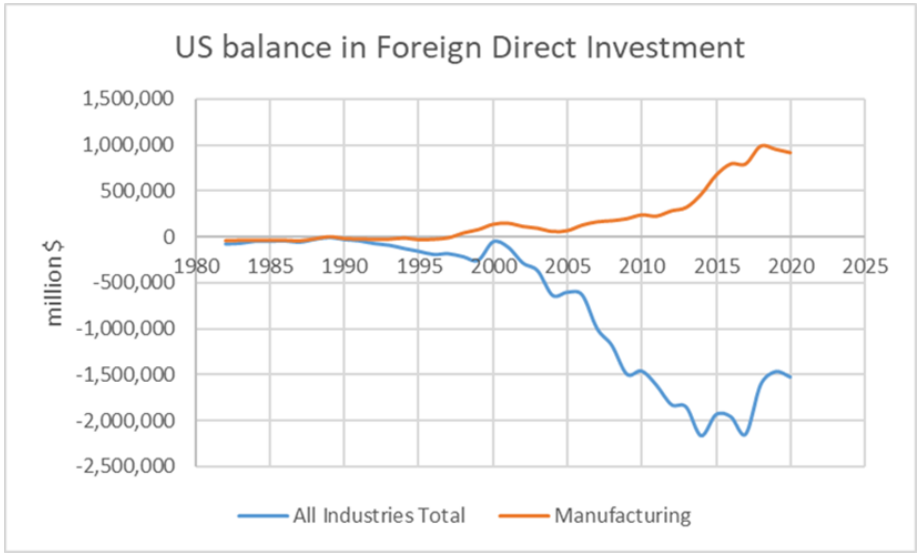


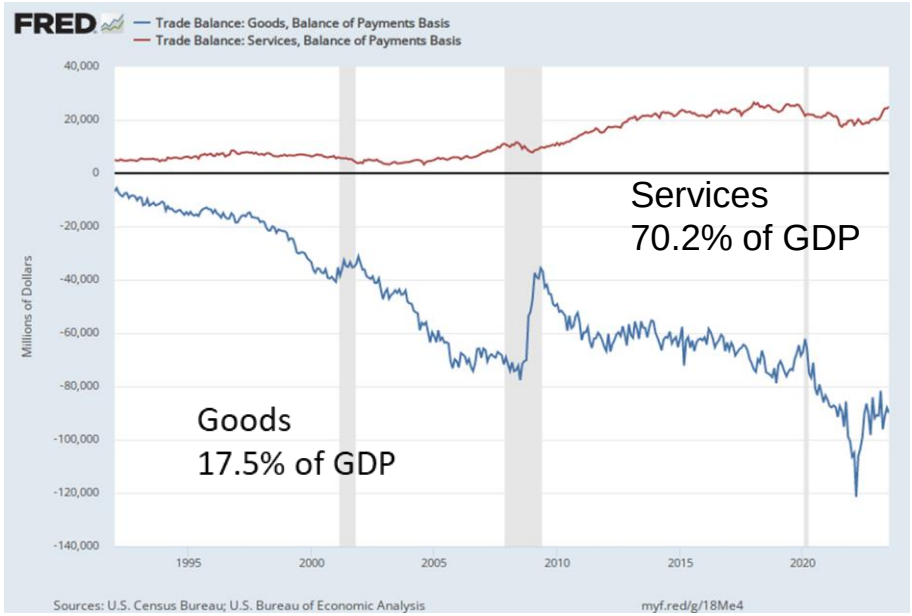
The move from integrated steel mills that made steel from ore to re-cycling scrap in EAF continuous casting reduced the ability to make large steel castings in North America.

Trade is about Policy and National Interest.

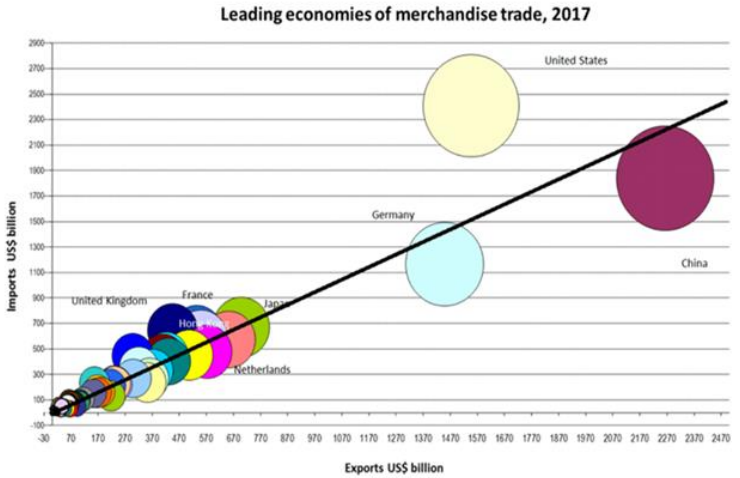


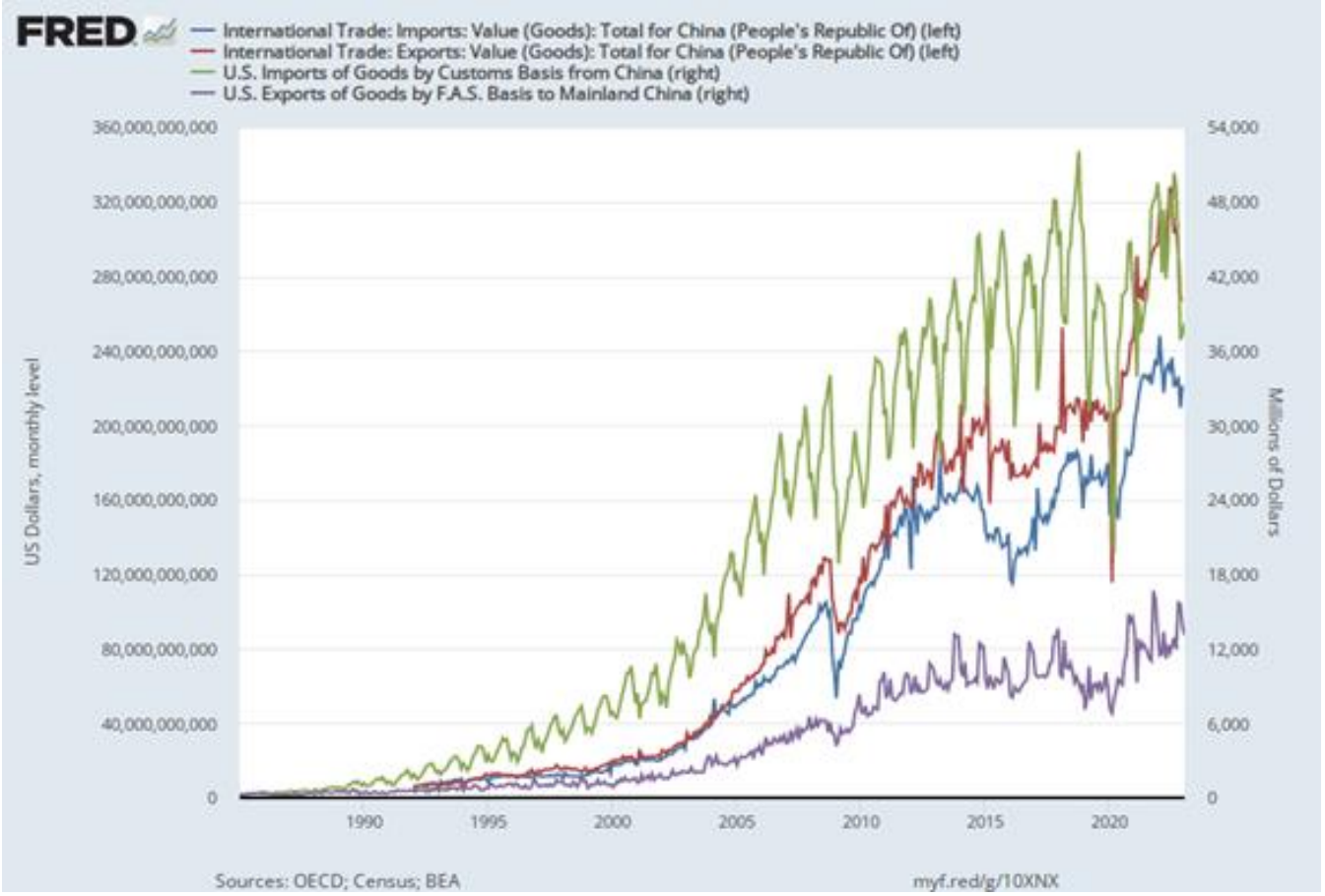




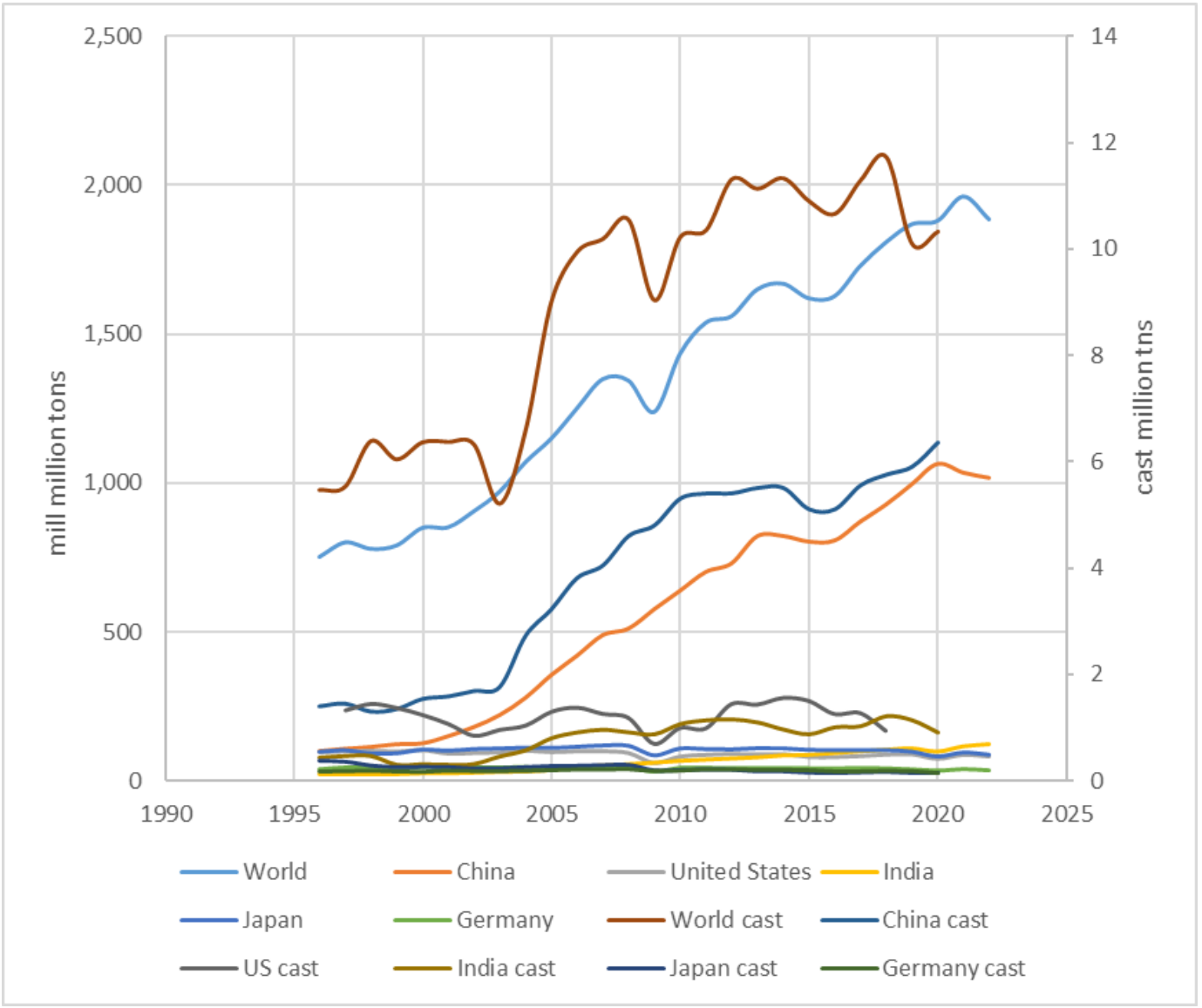


Trade is not a global challenge but a fundamental encounter between the EU (Germany), China and the US.





Globalization was not a free market discovery of best value but a mercantilist geo-political structure.



Steel Additive Manufacturing

Sweet spots

- Fast when away from Amazon or part is not available soon
- Tooling because failure is an option
- Small parts where the model is easy to create
- Non-critical so qualification and quality not necessary barriers
- One-off where engineering, tooling and finishing with conventional methods is slow and costly
- Complex shapes with internal passages
- Weird materials like refractory metals, composites, or constitutionally graded
- Replacing or adding features to conventional components
- Repairing or replacing non-compliant materials in critical components

Limits

- Large parts bigger than a bread box reduces the advantages and increases the post processing required.
- Qualification may require a process+ first article+ machine+ operator+ powder+ etc.?
- Quantities that are large makes the speed of production critical and AM is slow building a layer at a time.
- Quality certification requires undeveloped material and NDT verification for process? part?
- Materials are limited with current powders and wires and expanding the supply is slow.
- Materials and energy required exceeds conventional when including the wire or powder production.

Thanks!
Questions?

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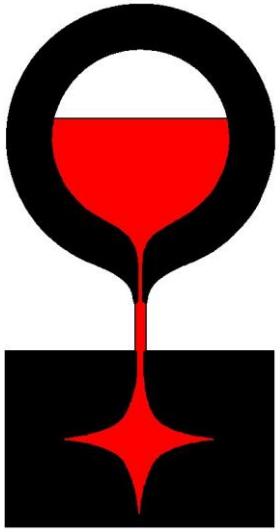
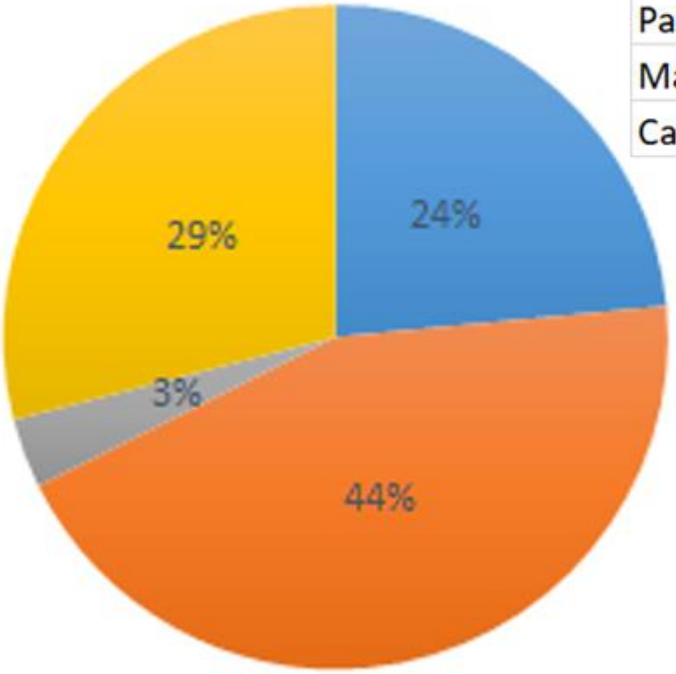


Backup

PROD (tn)	1,182,000
RCP ($million)	4,457
EMP (#)	16,045

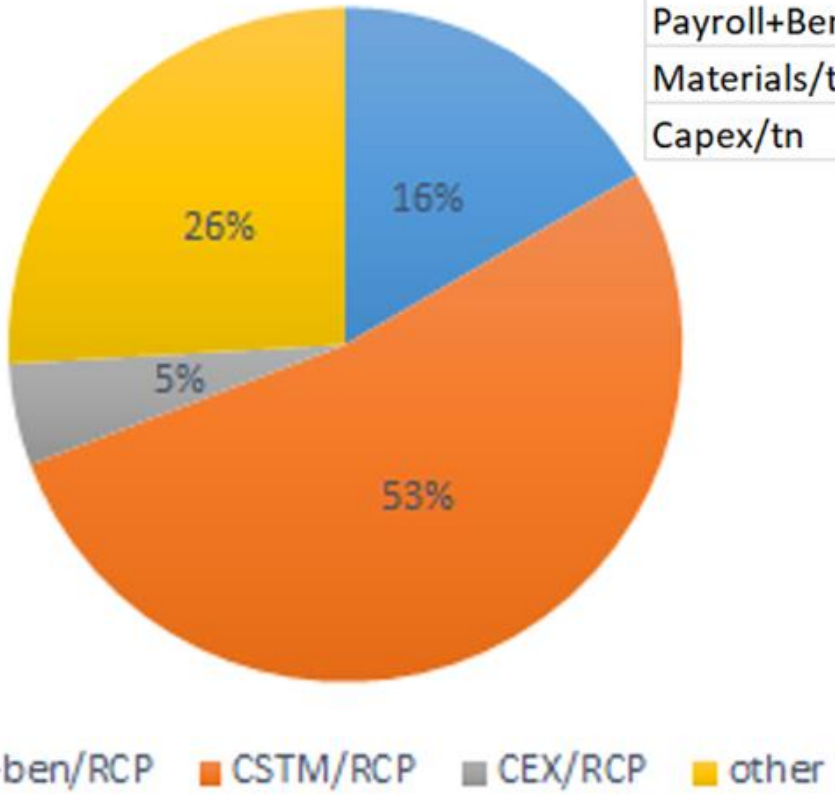
Steel Foundry



RCP/tn	$3,770.92
Prodval/tn	$3,394.79
Valadd/tn	$1,948.11
Payroll+Benefits/tn	$917.54
Materials/tn	$1,720.34
Capex/tn	$132.55

PROD (tn)	2,450,837
RCP ($million)	9,219
EMP (#)	21,282

Steel Forge



RCP/tn	$3,761.41
Prodval/tn	$3,745.59
Valadd/tn	$1,658.41
Payroll+Benefits/tn	$655.48
Materials/tn	$2,080.39
Capex/tn	$193.04