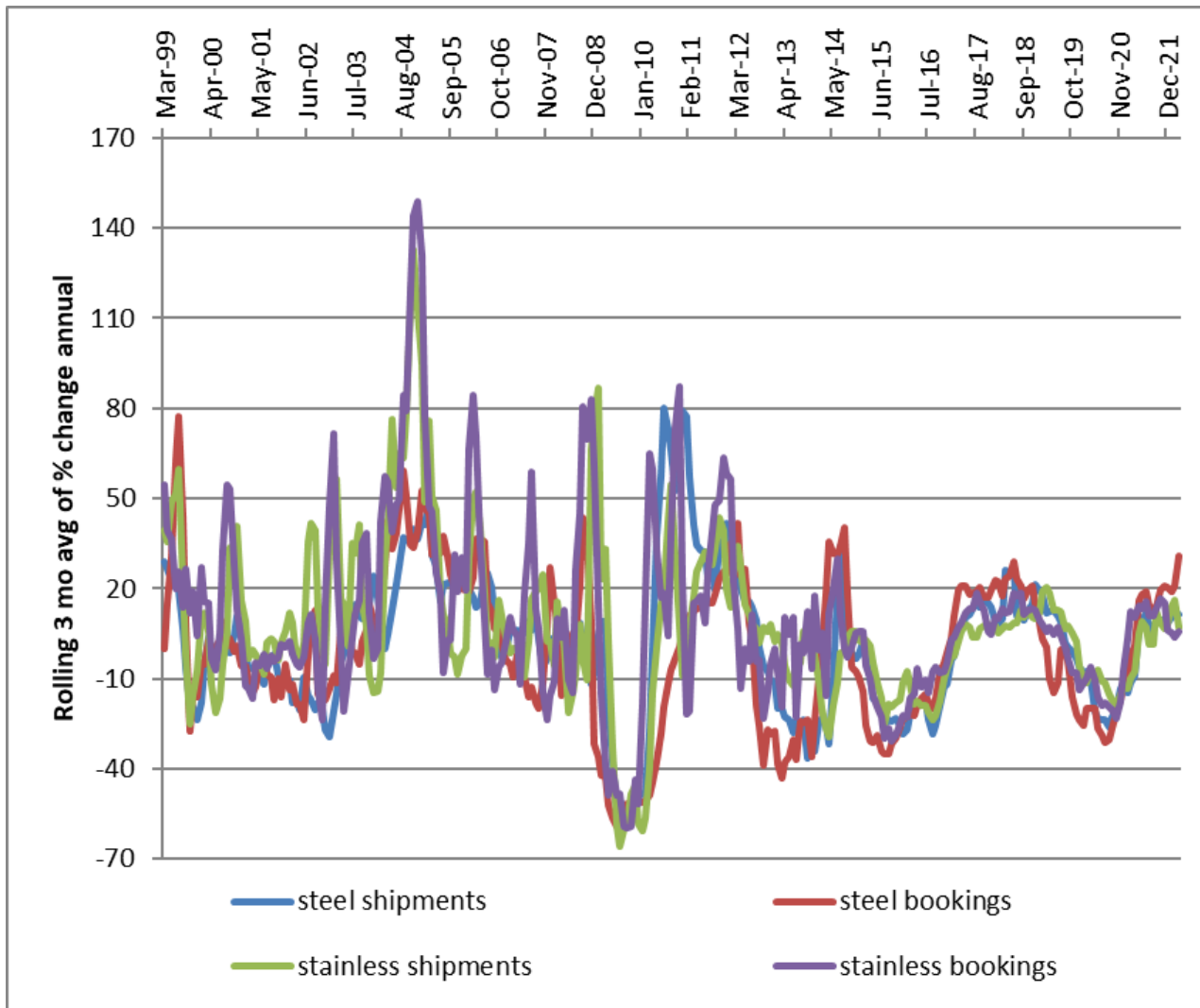
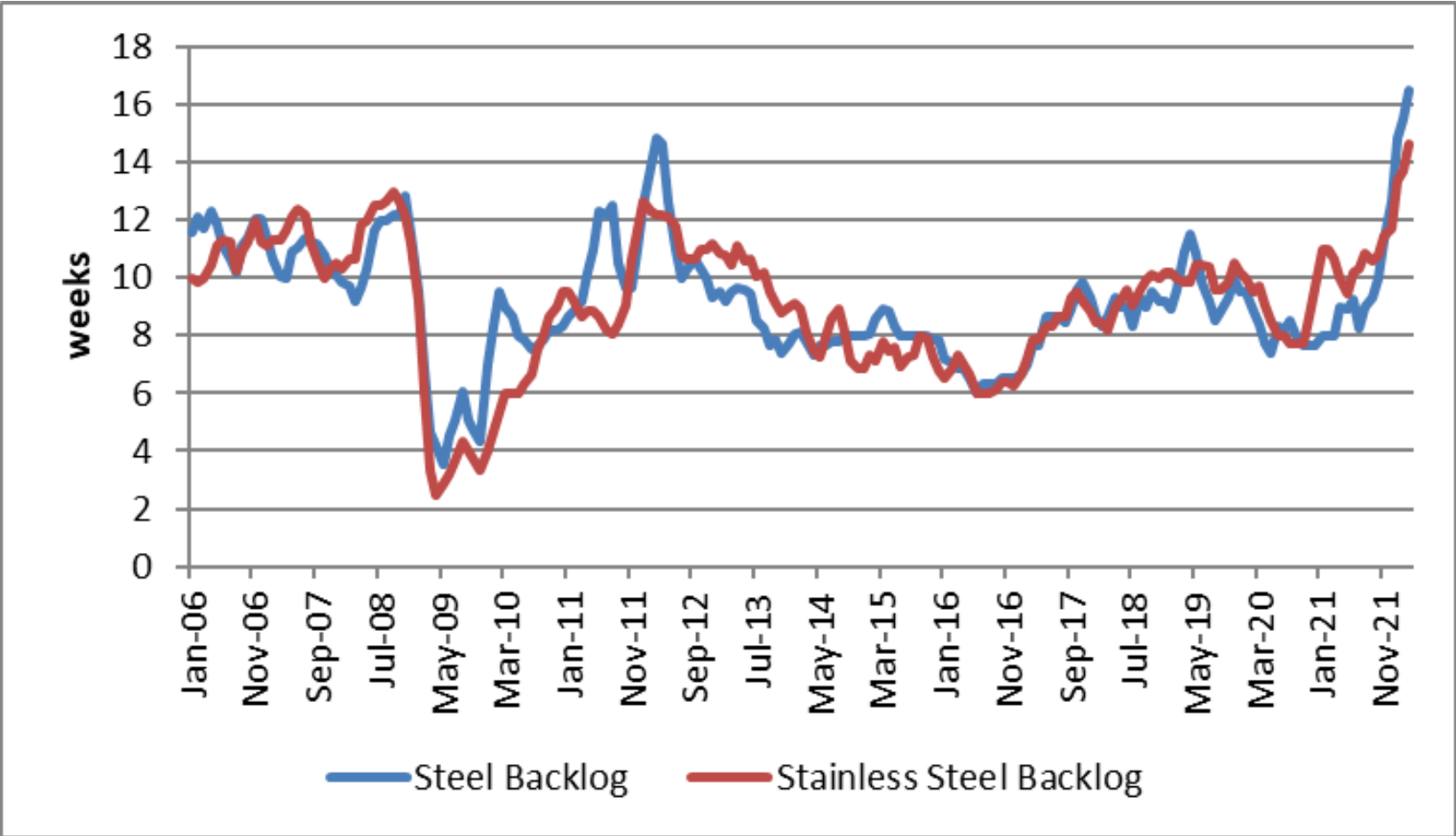


Steel Casting Industry 2022

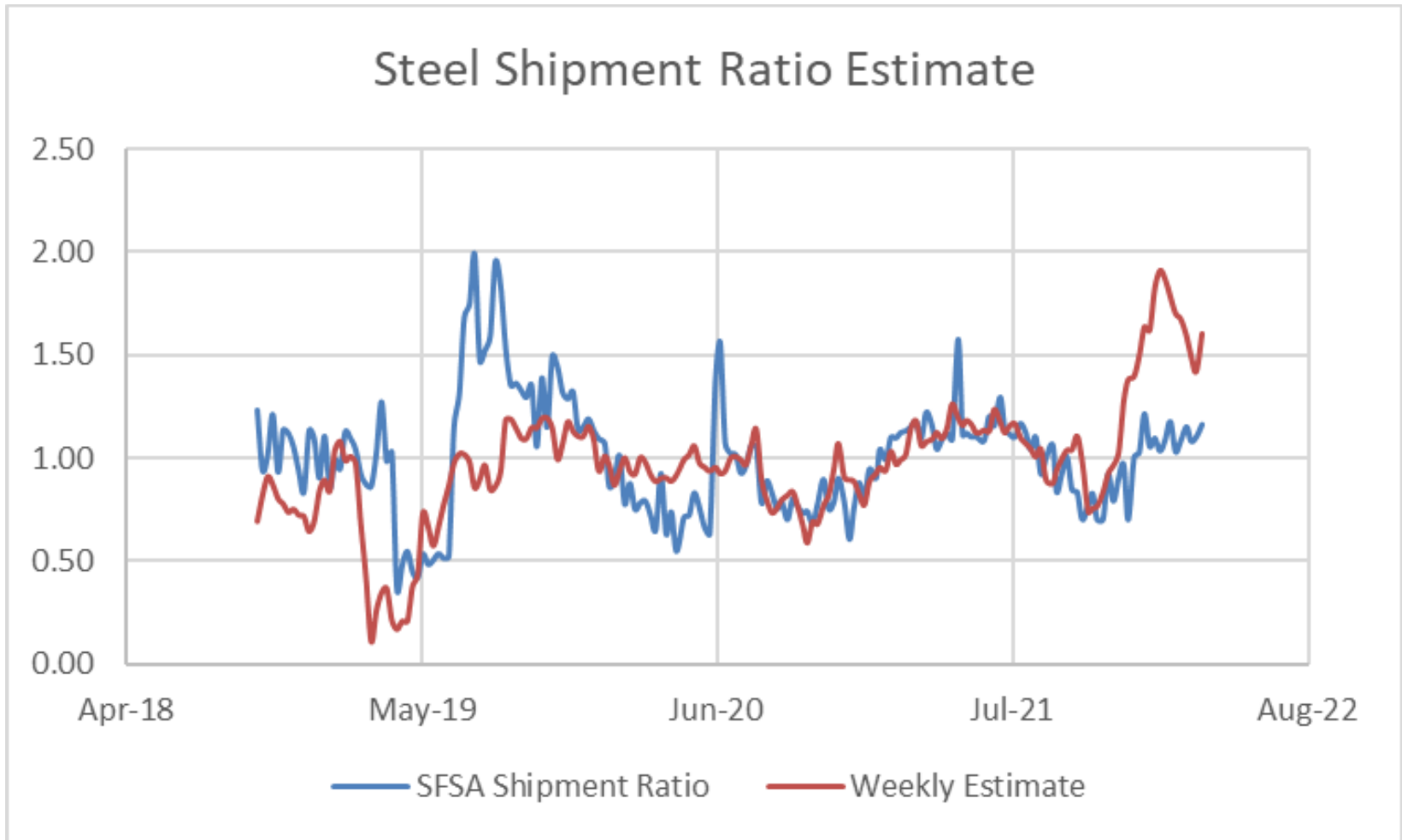
SFSA Trend Cards



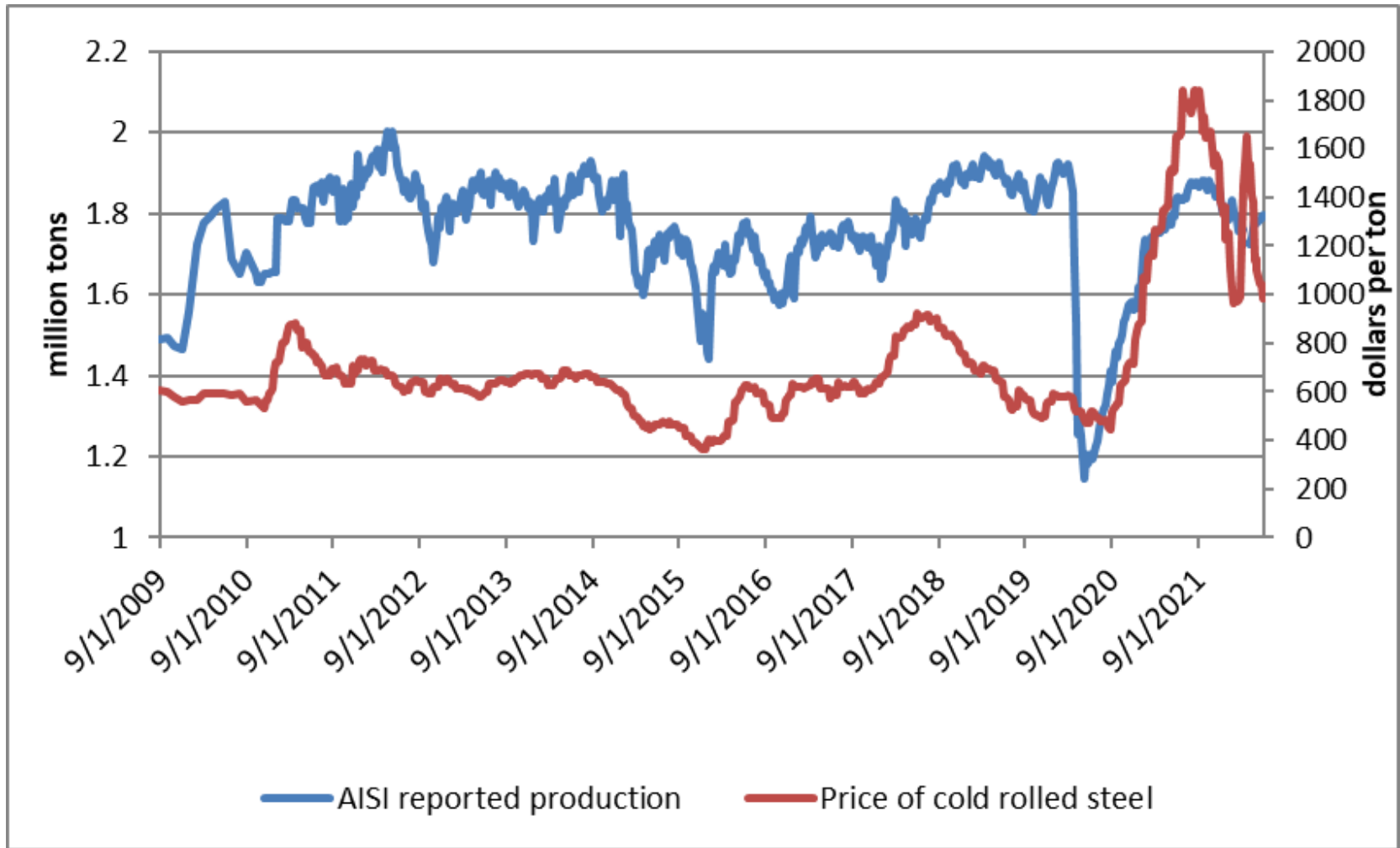
SFSA Trend Cards Backlog



Weekly Estimate of Shipments



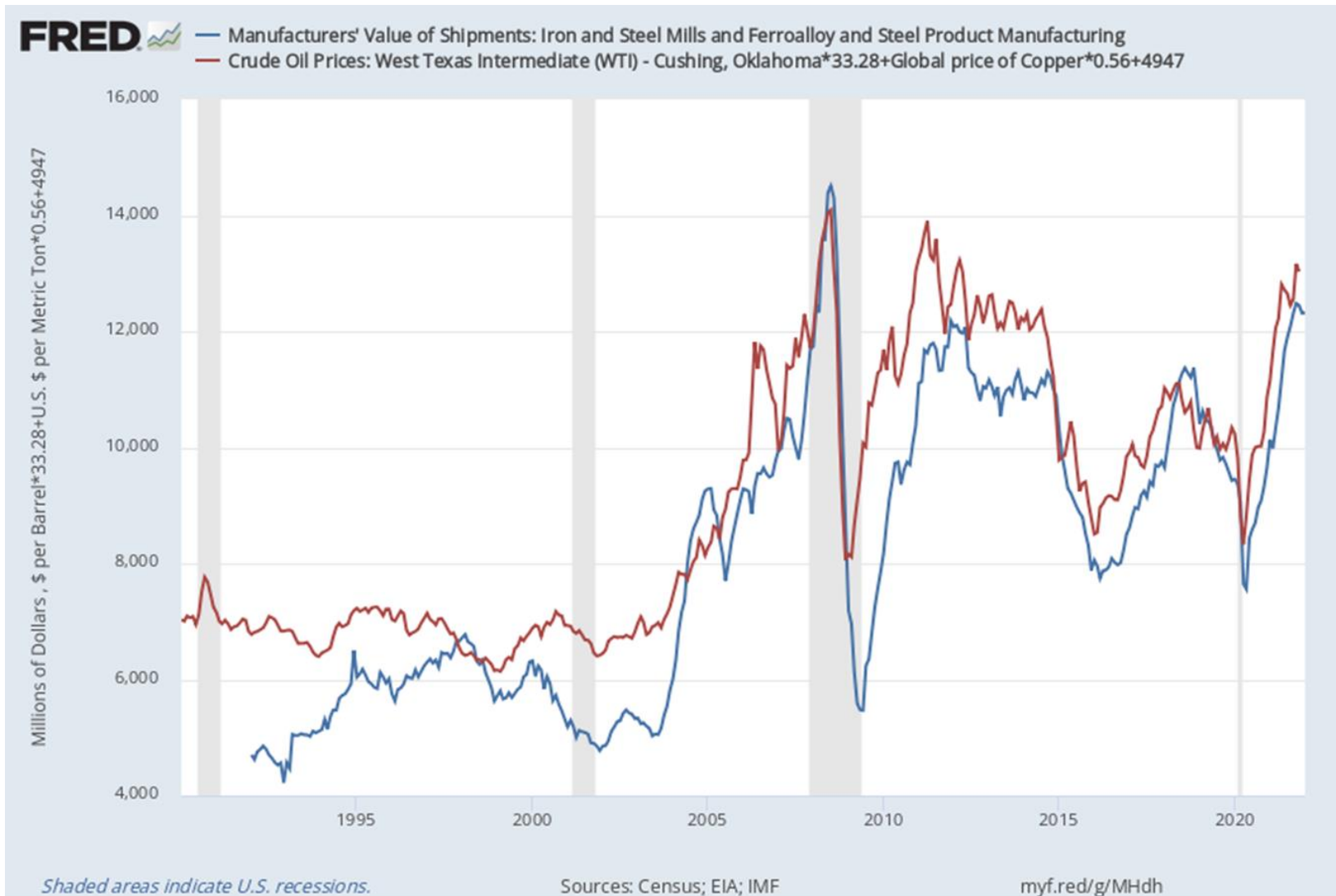
Price - Production of steel in U.S.



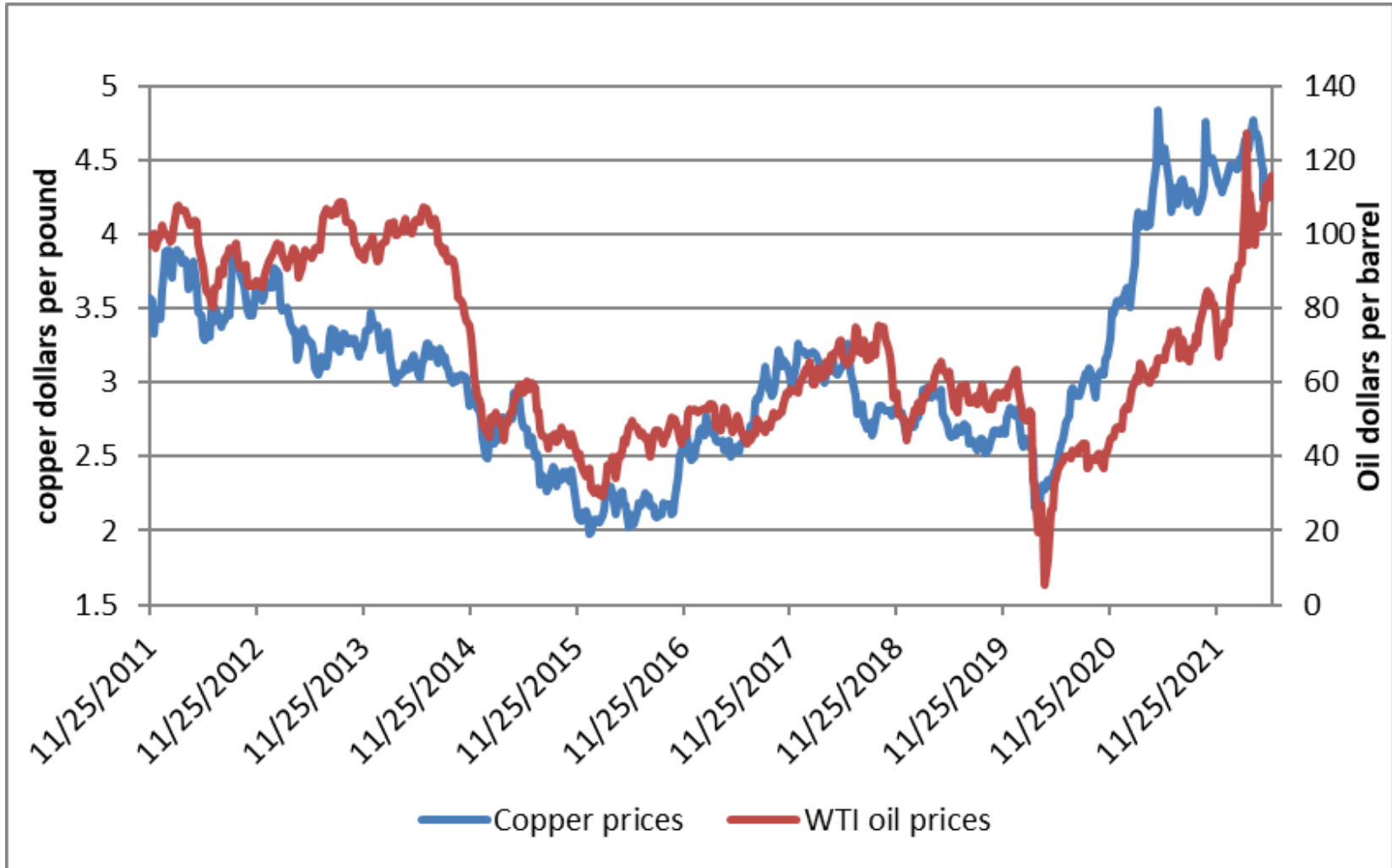
Steel Mill Shipments (tons*price\$)



Steel production correlated with Oil and Copper



Week's price of oil and copper



Steel Casting and Forging Plants and Employment

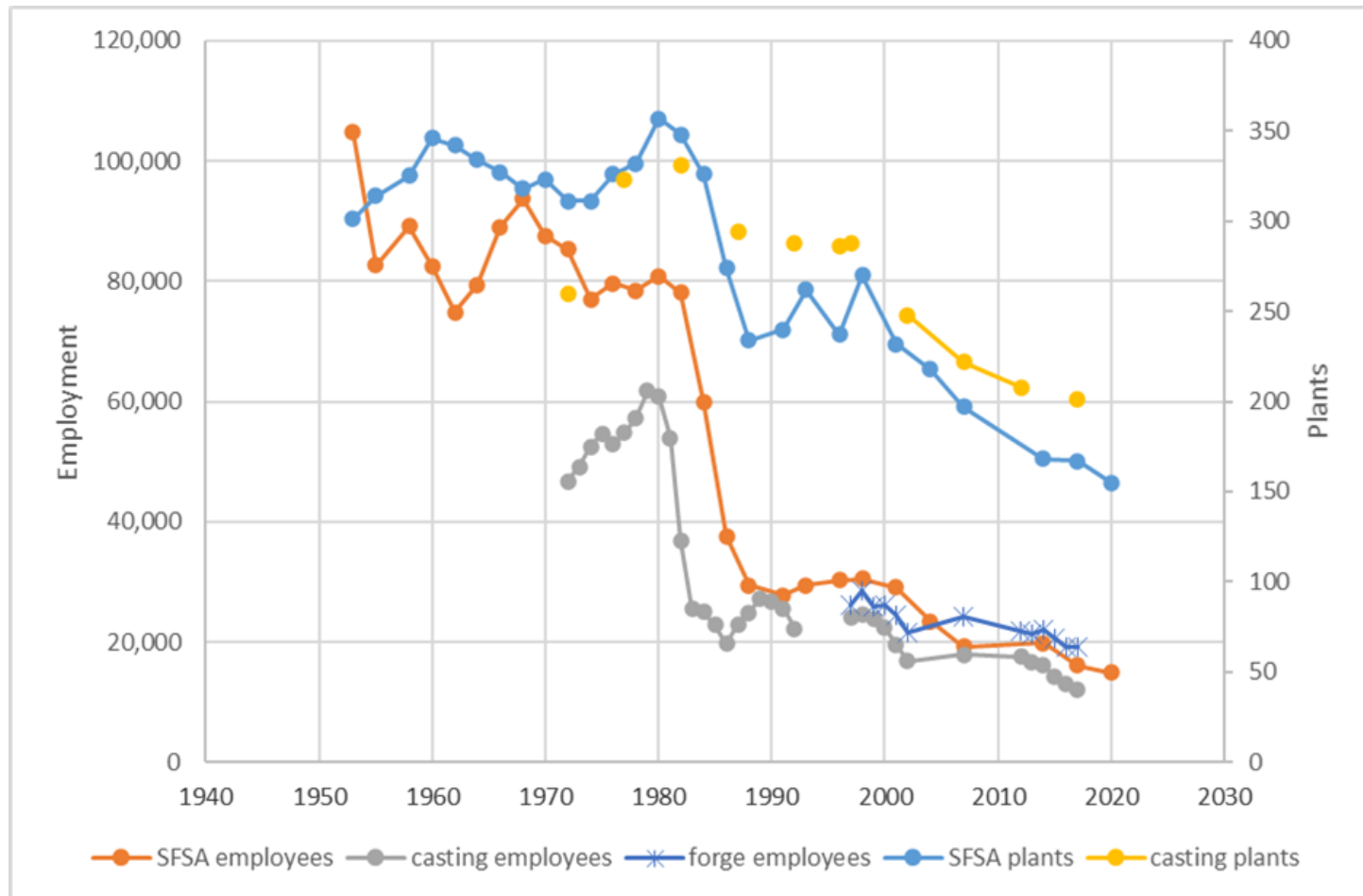


Figure 1 Decline in Employment and Number of Plants in Steel Castings and Forge shops. SFSAs Employees and Plants are from SFSAs records, other lines are from Census



Steel Production Tons

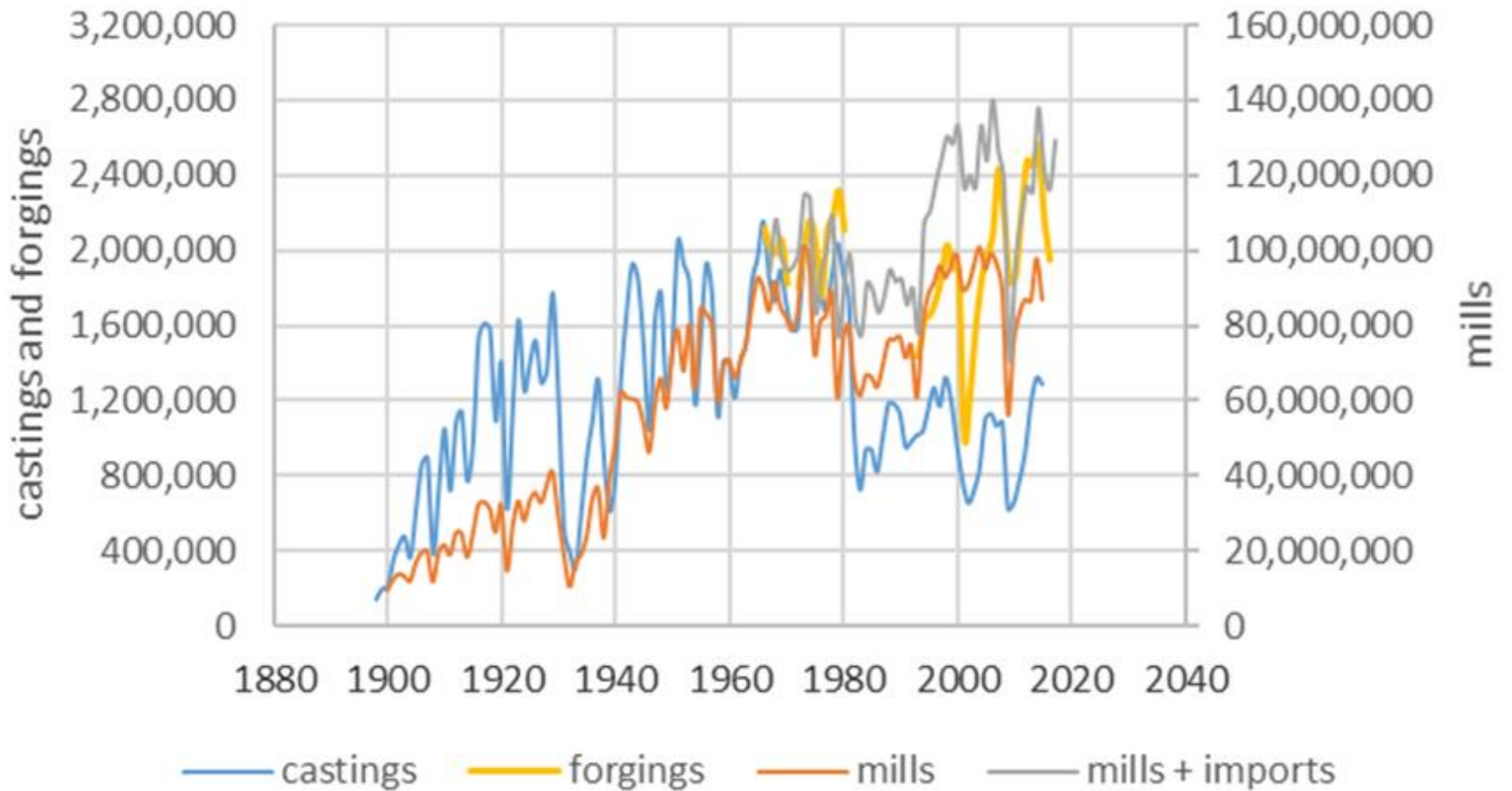


Figure 1 Historical Production of Steel Mill, Cast and Forged products with Imports added to Mill products after 1980



Steel Foundry Capacity and Production

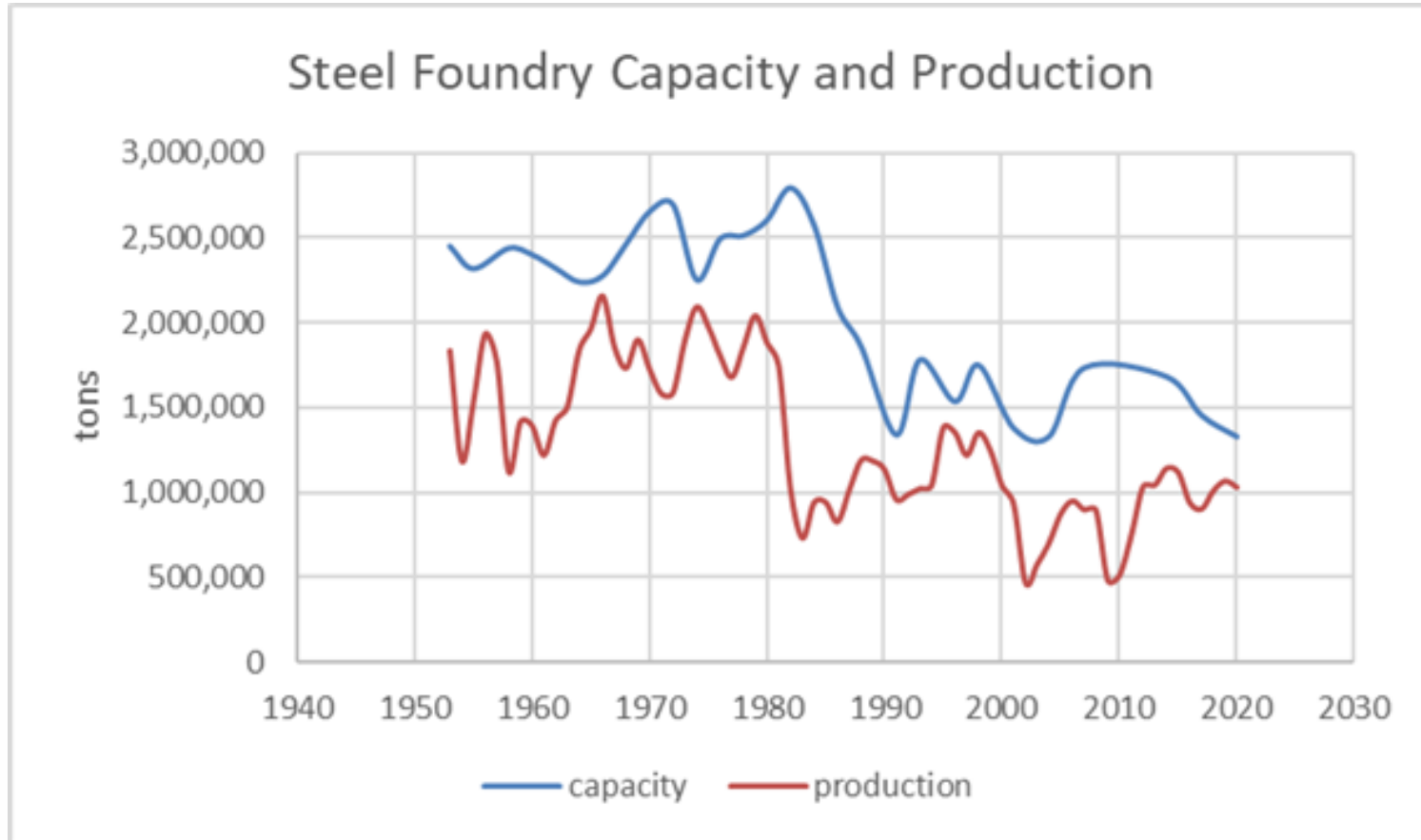
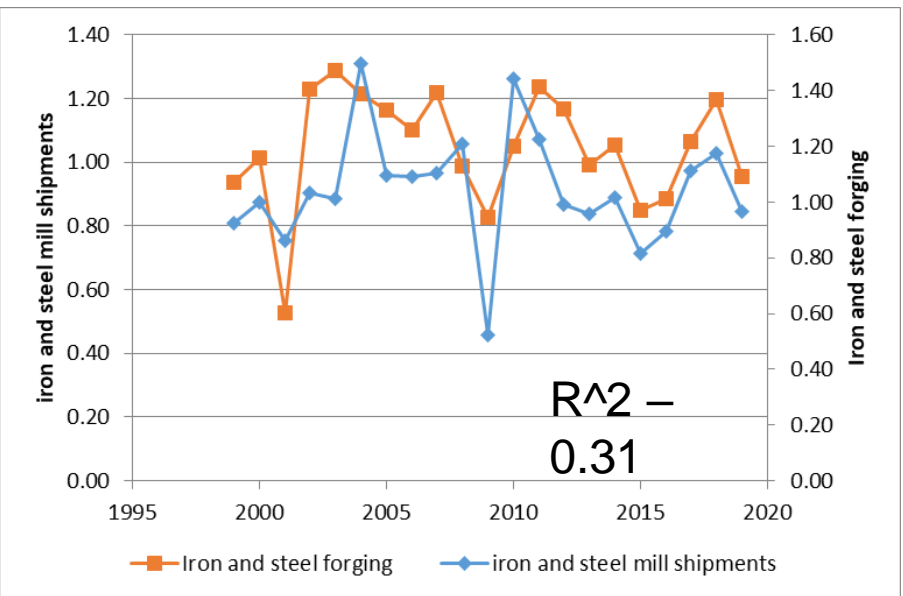
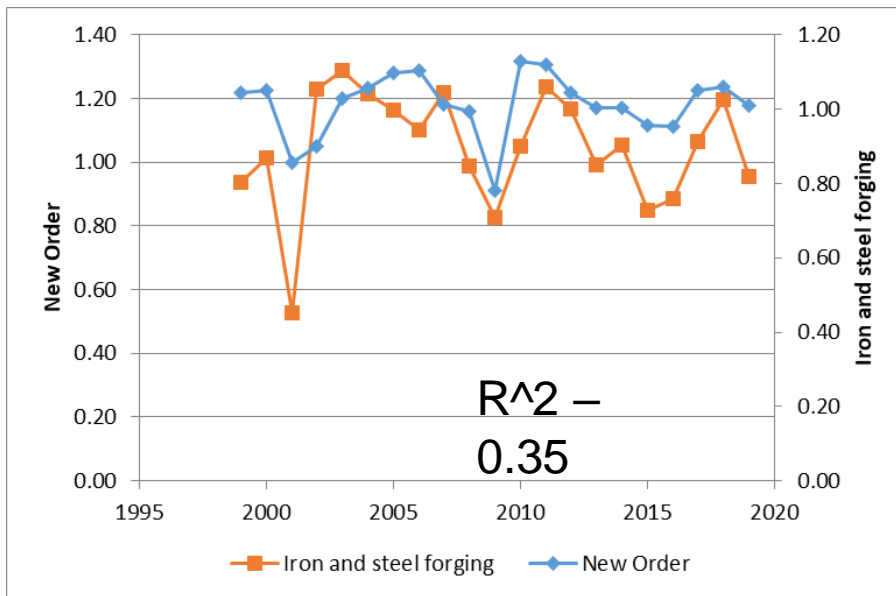


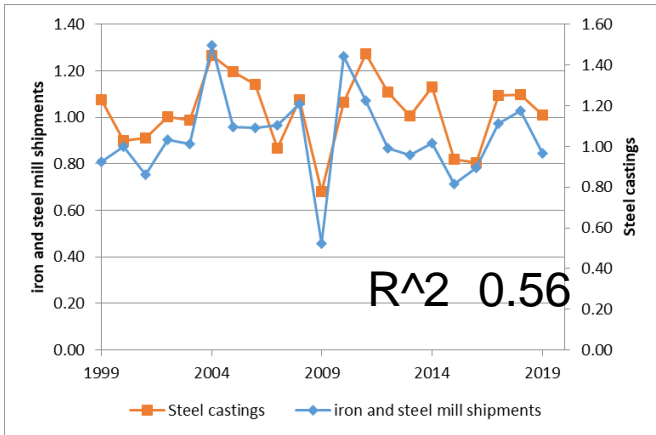
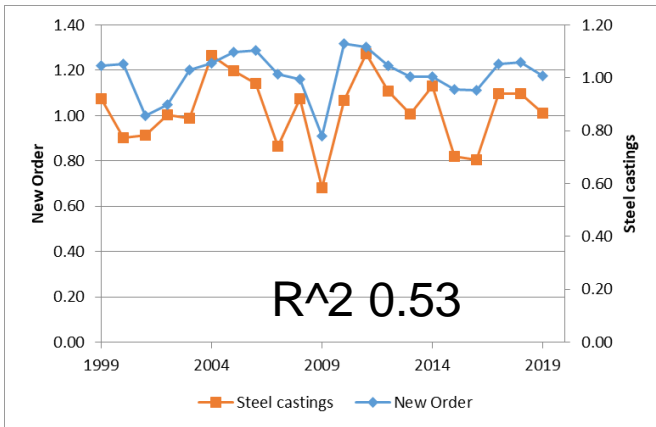
Figure 1 Steel Casting Production and Capacity in the U.S.

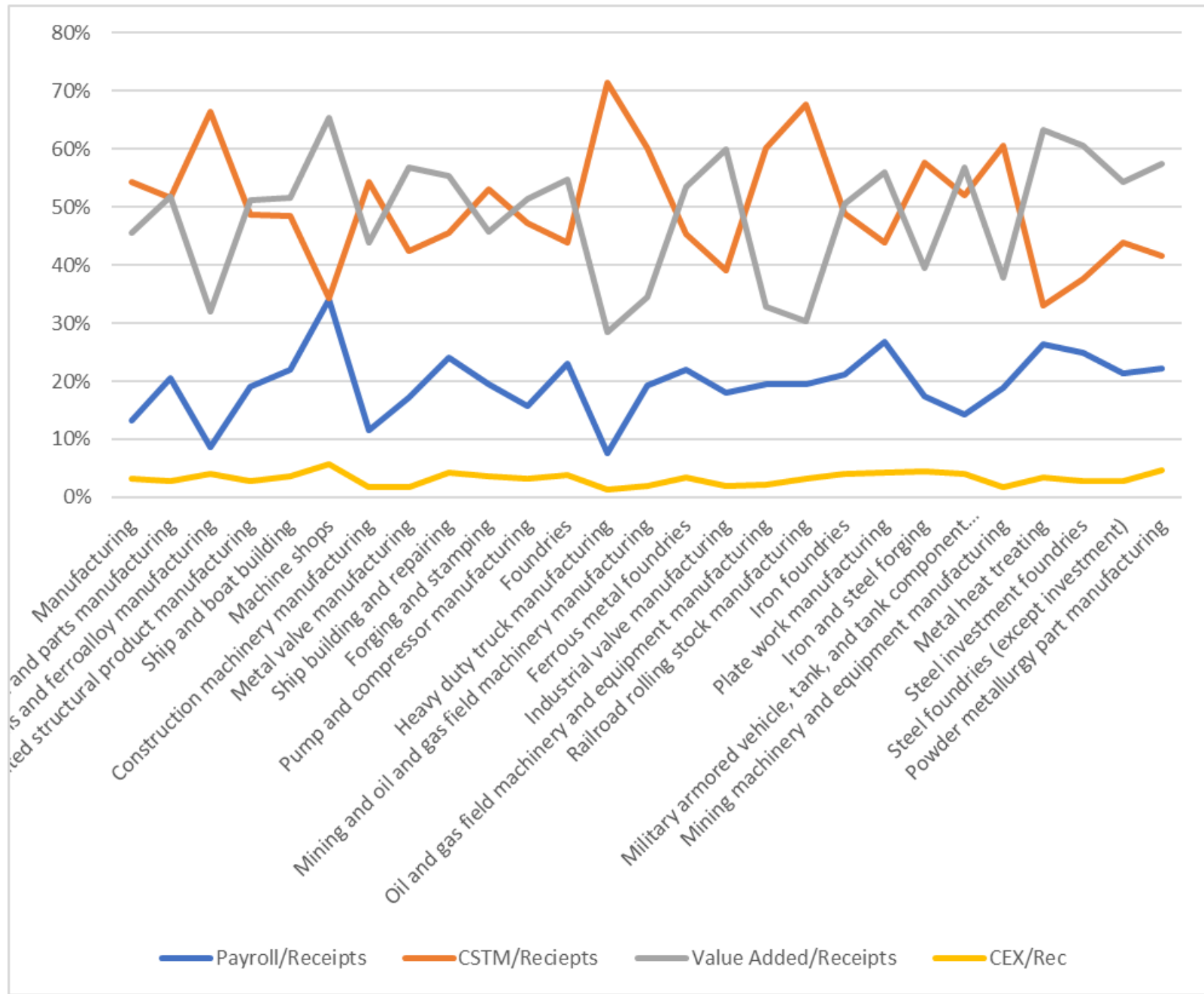


U.S. Iron and Steel Forging

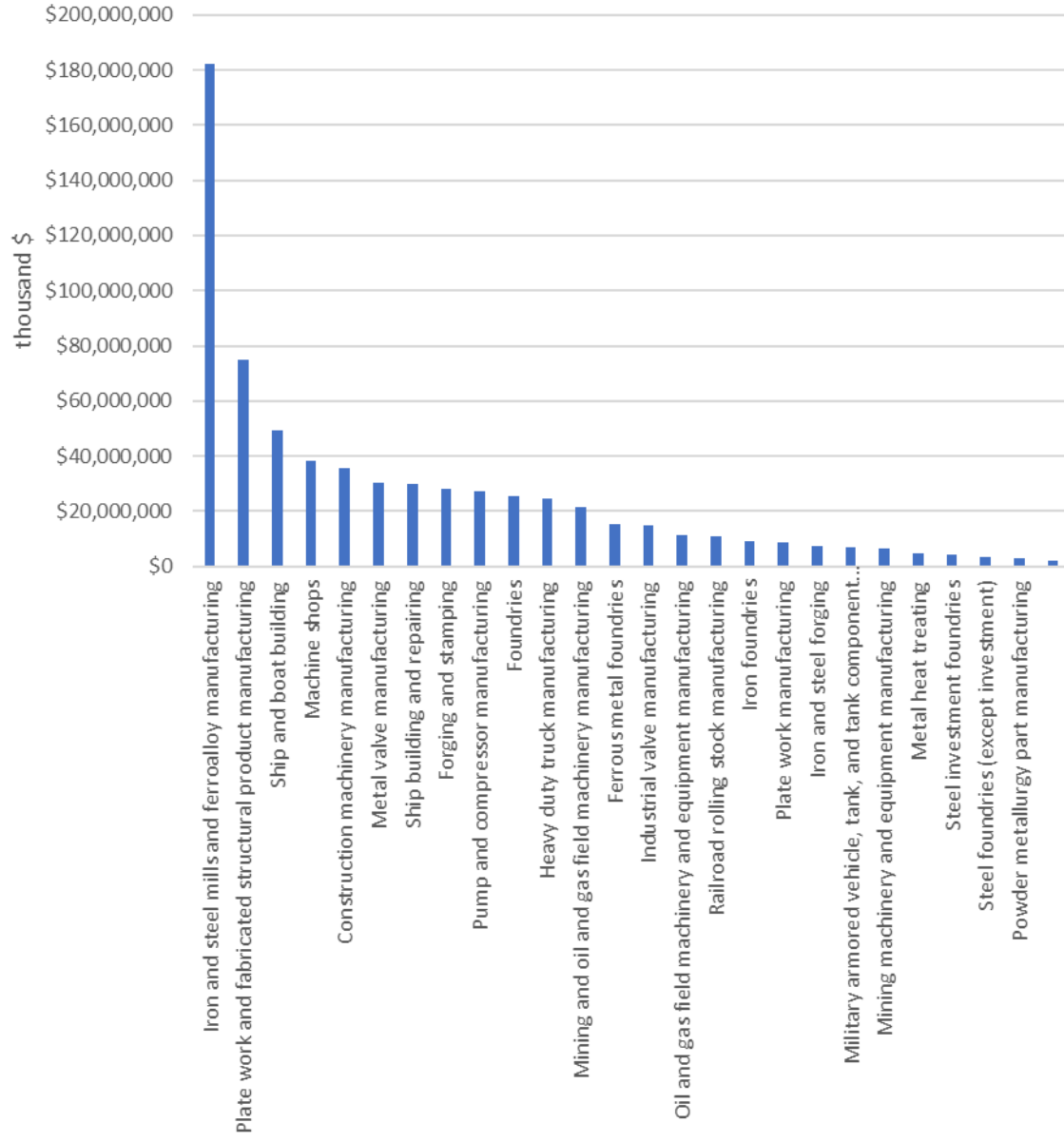


Steel Casting Sales 331513

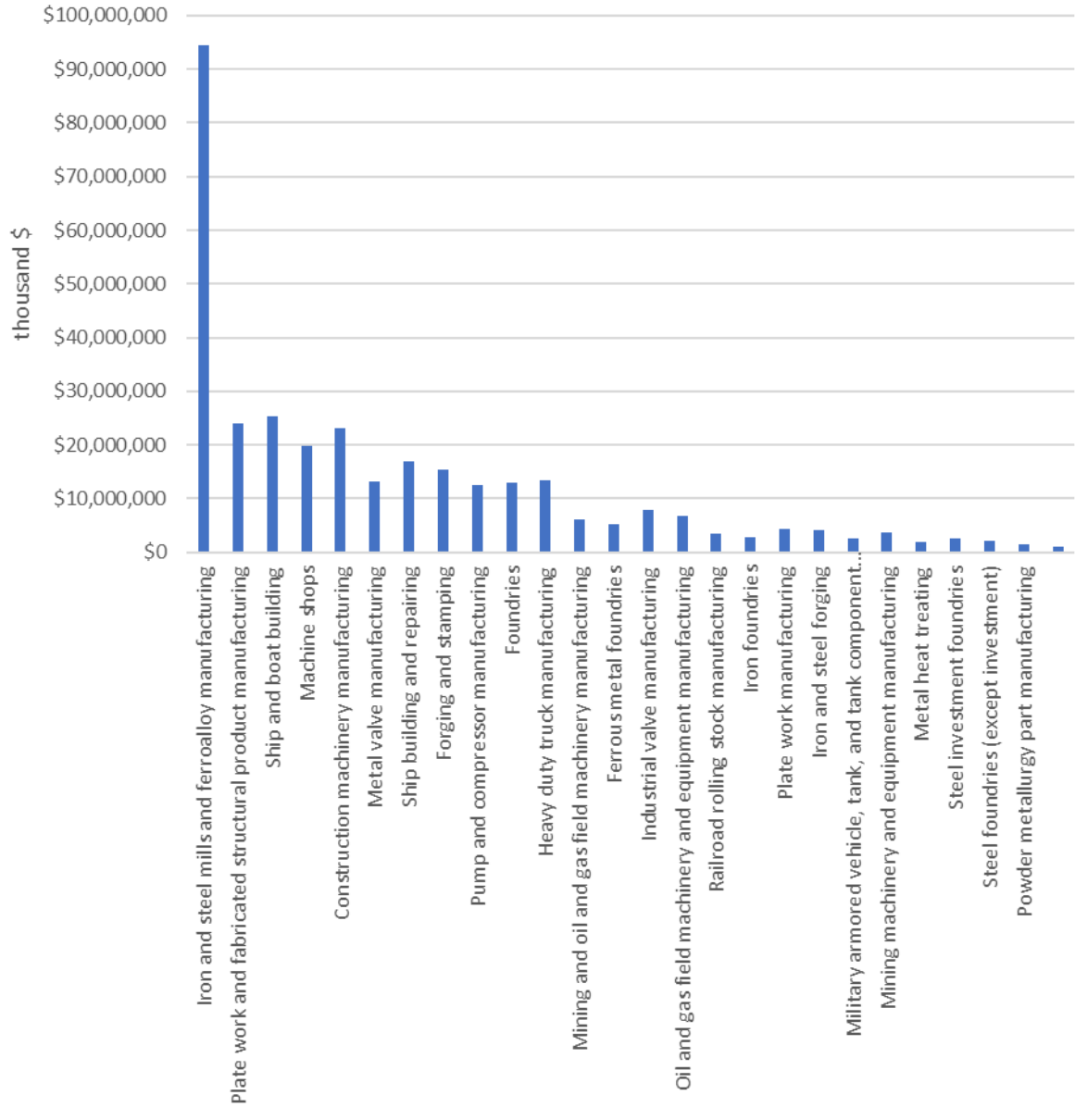




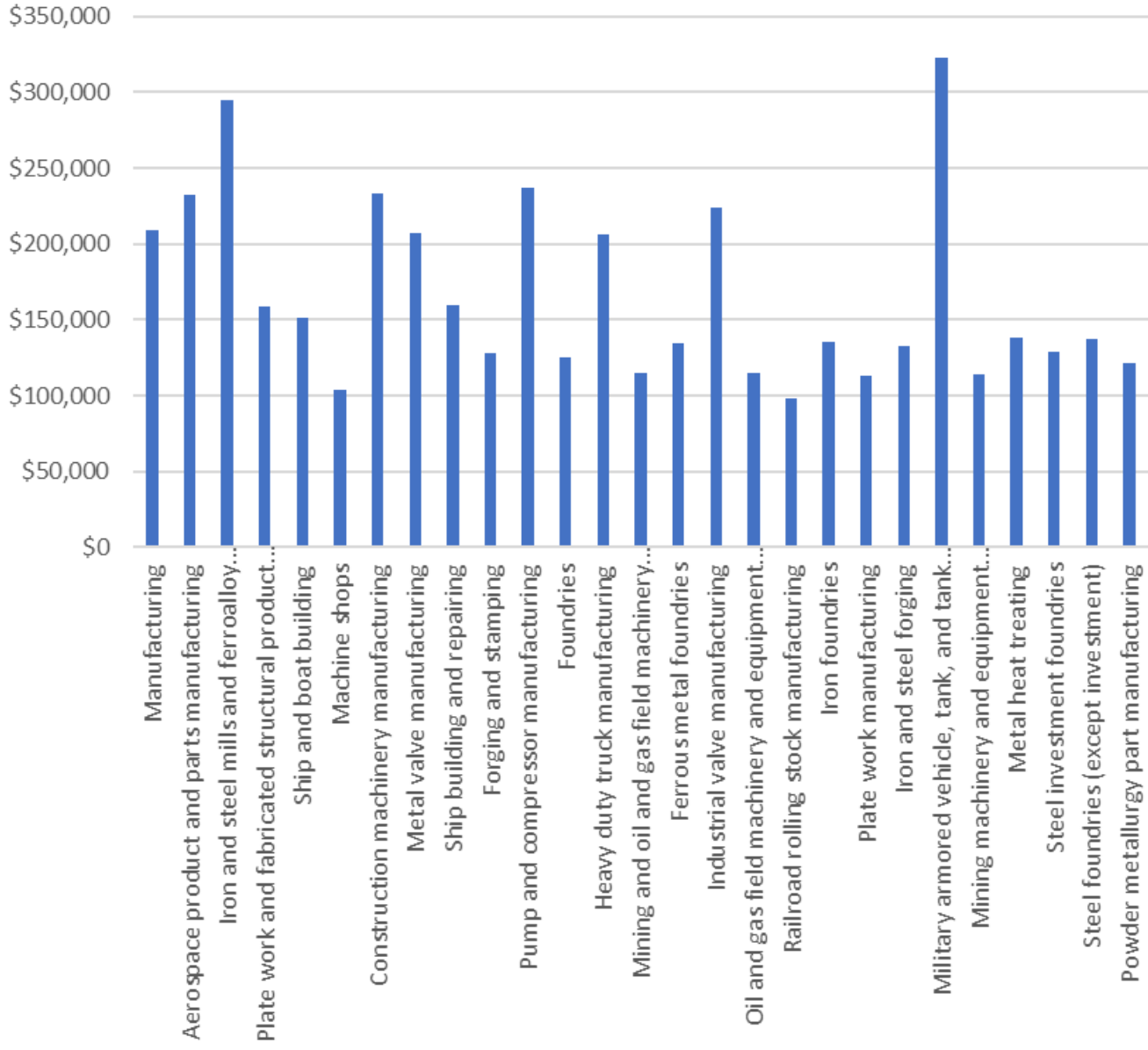
receipts



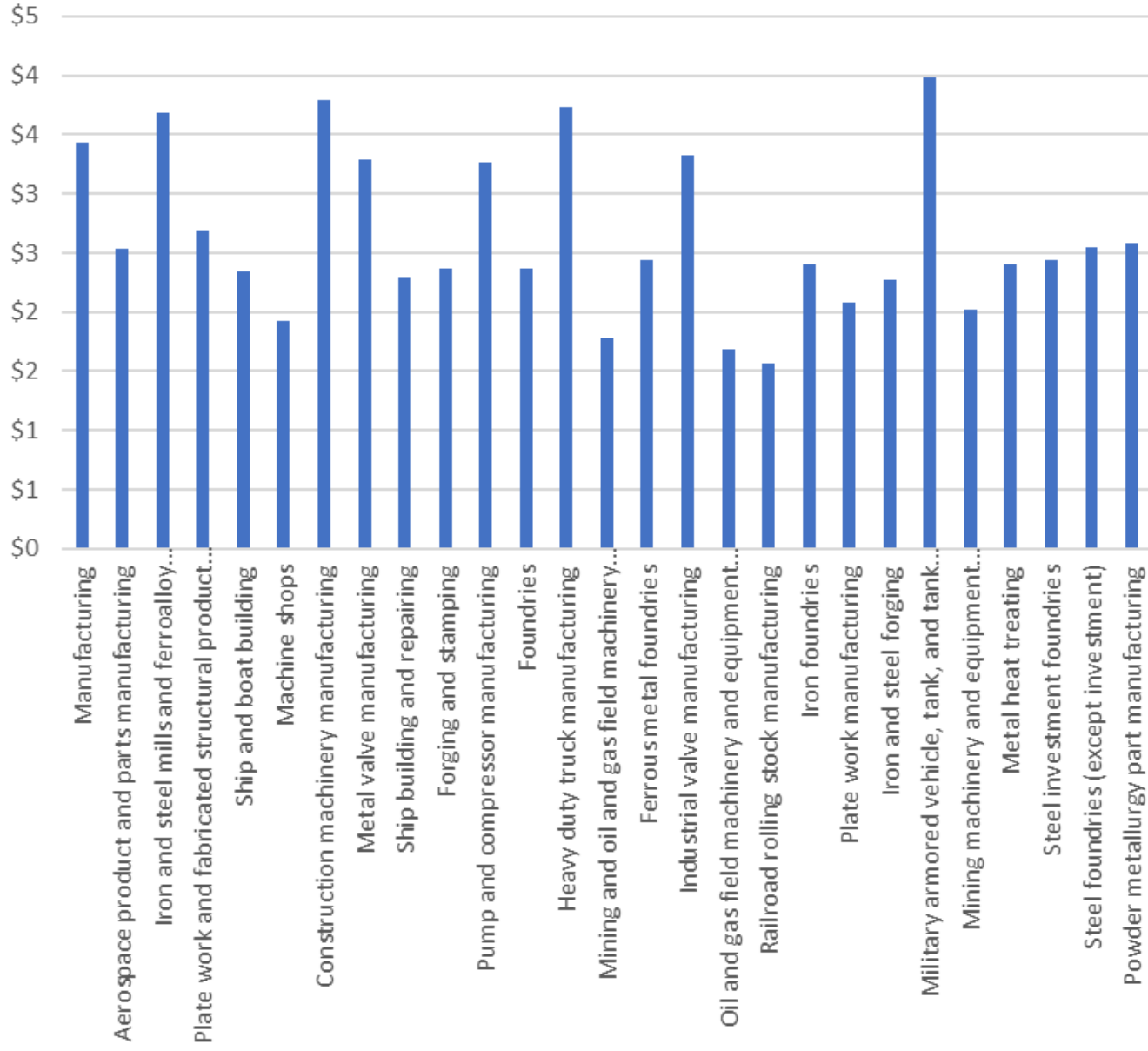
value added

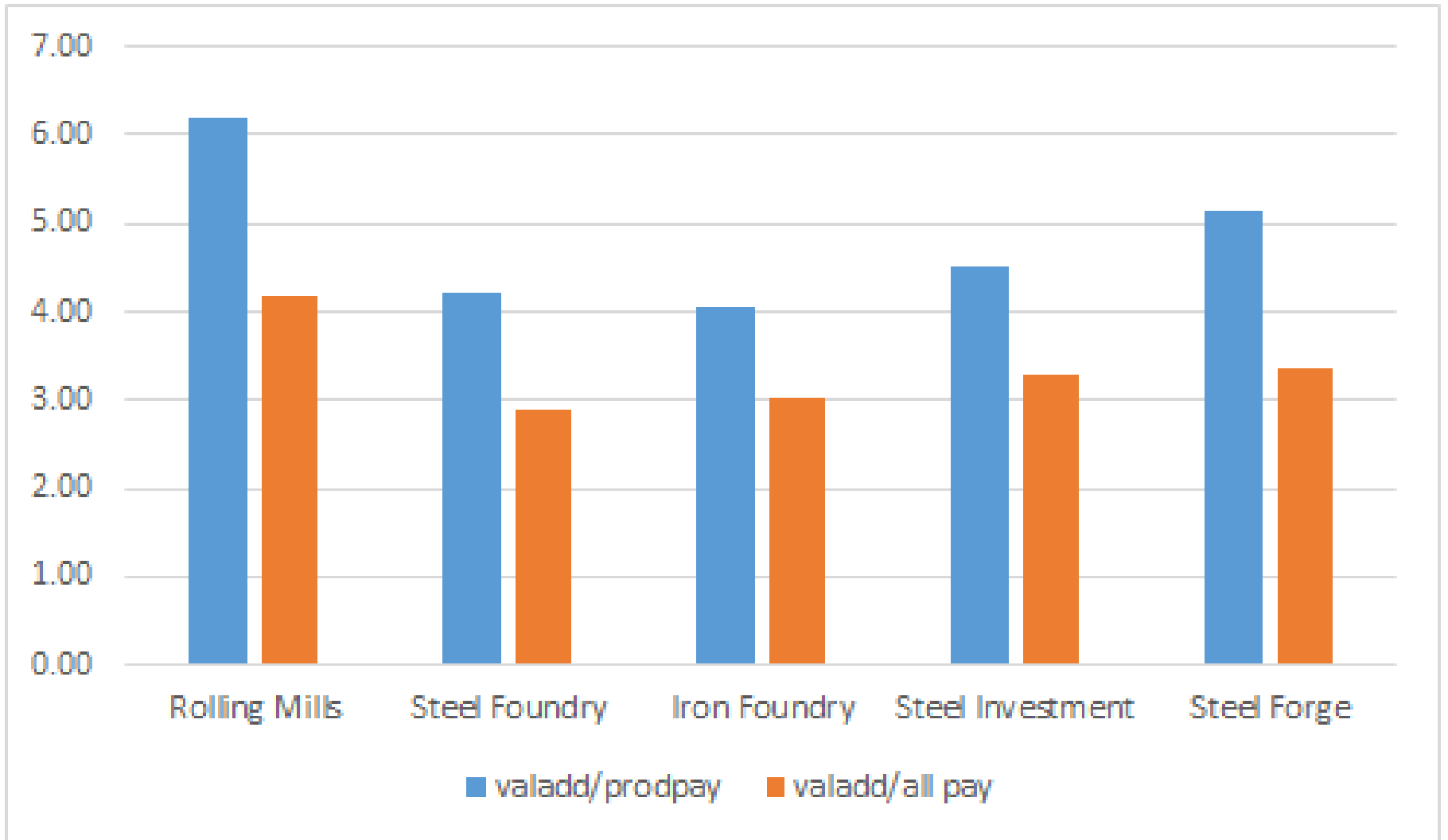


value added per employee

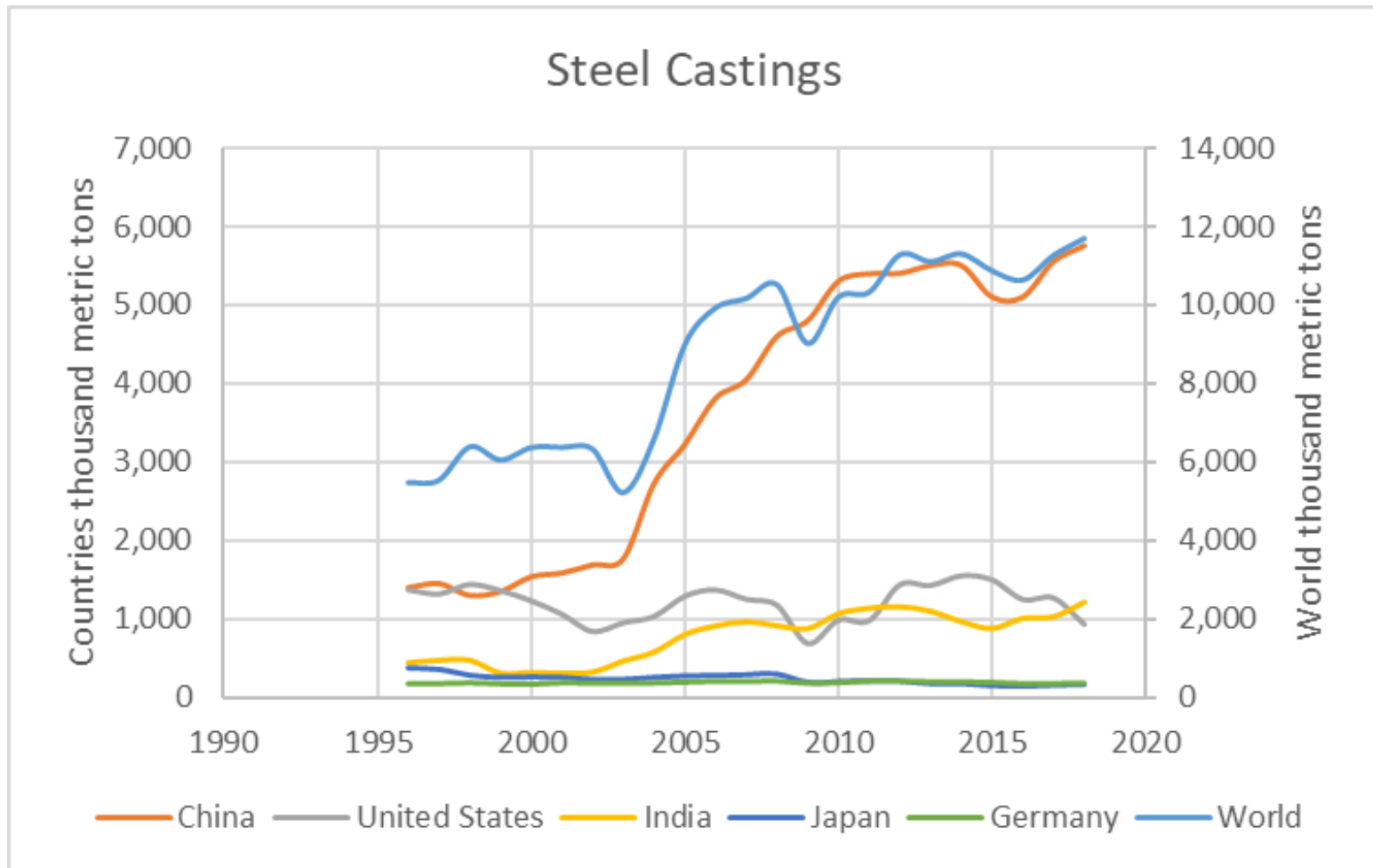


value added per payroll dollar

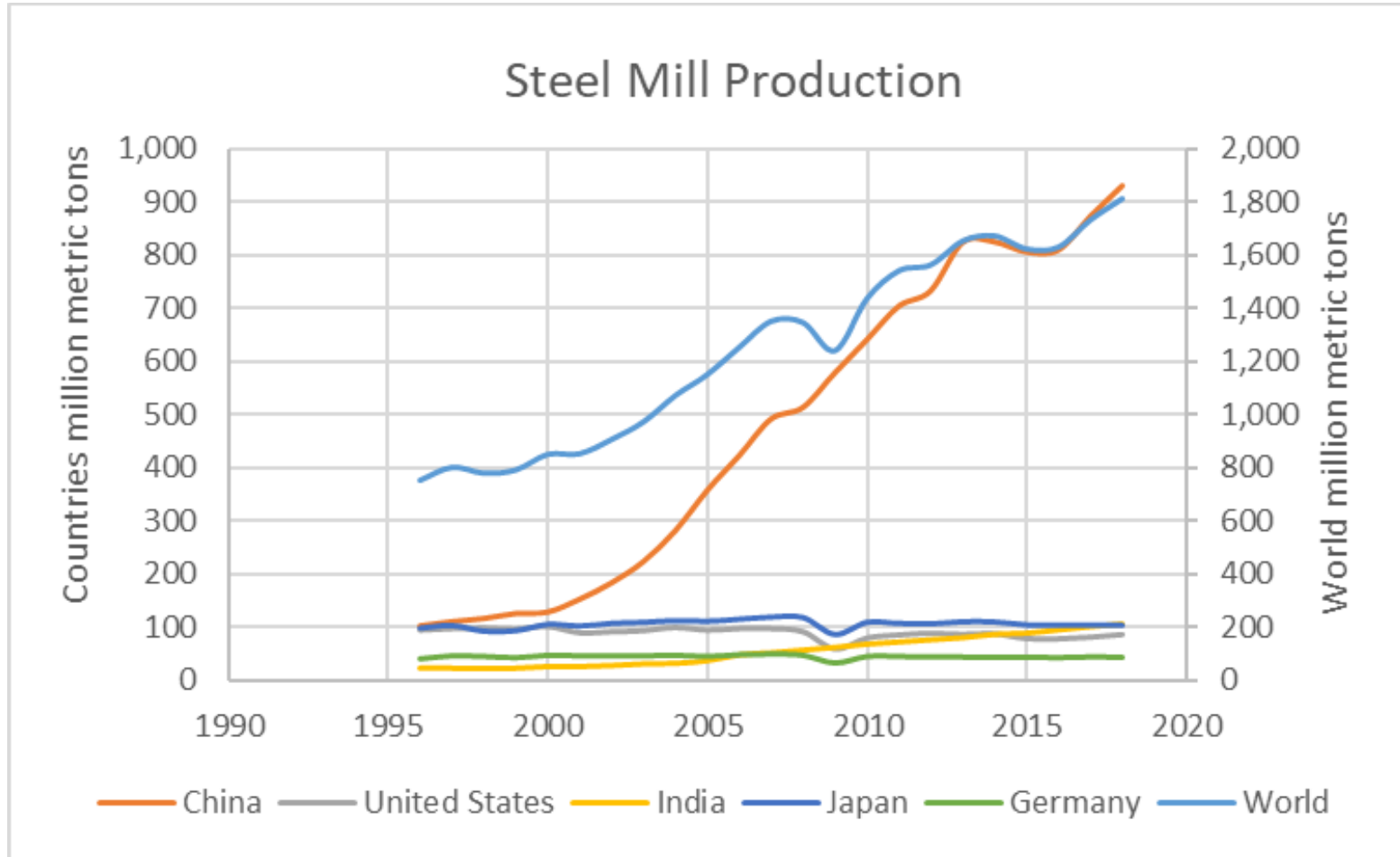




Steel Castings

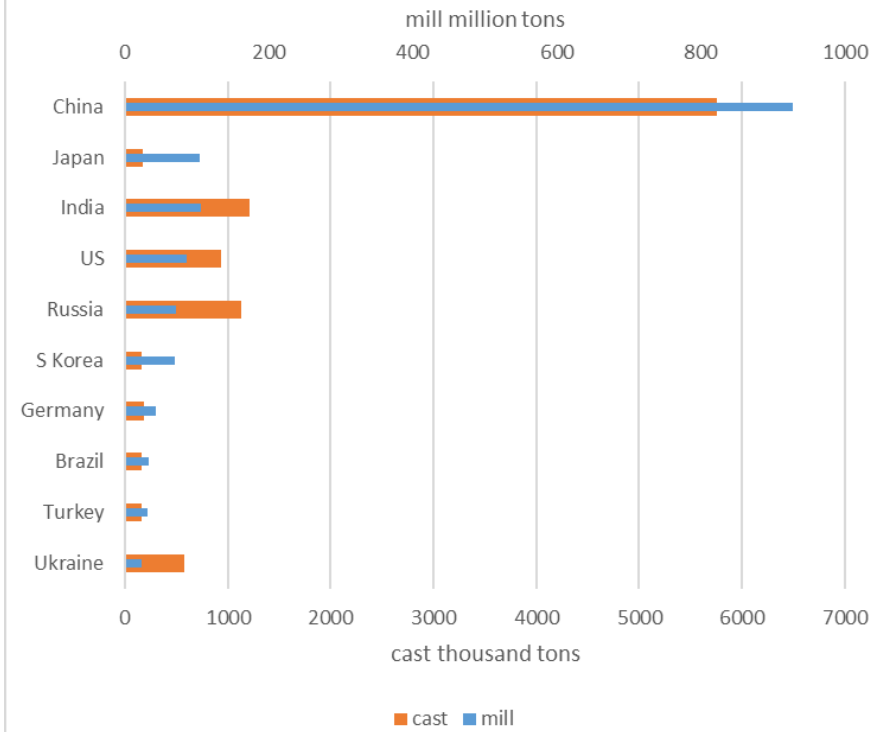


Steel Mill Production

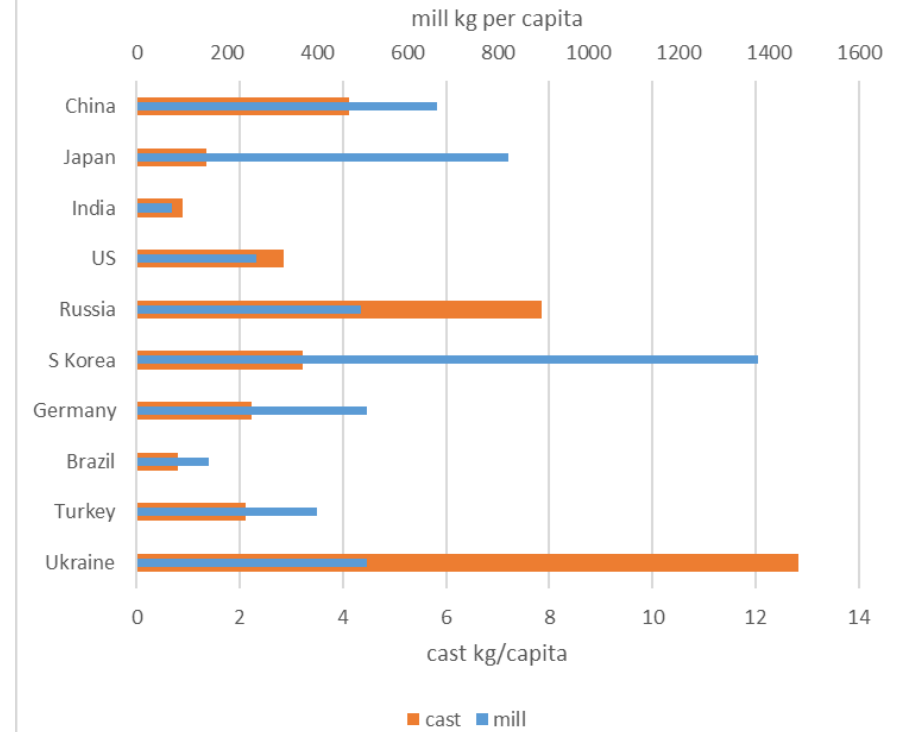


Steel Production

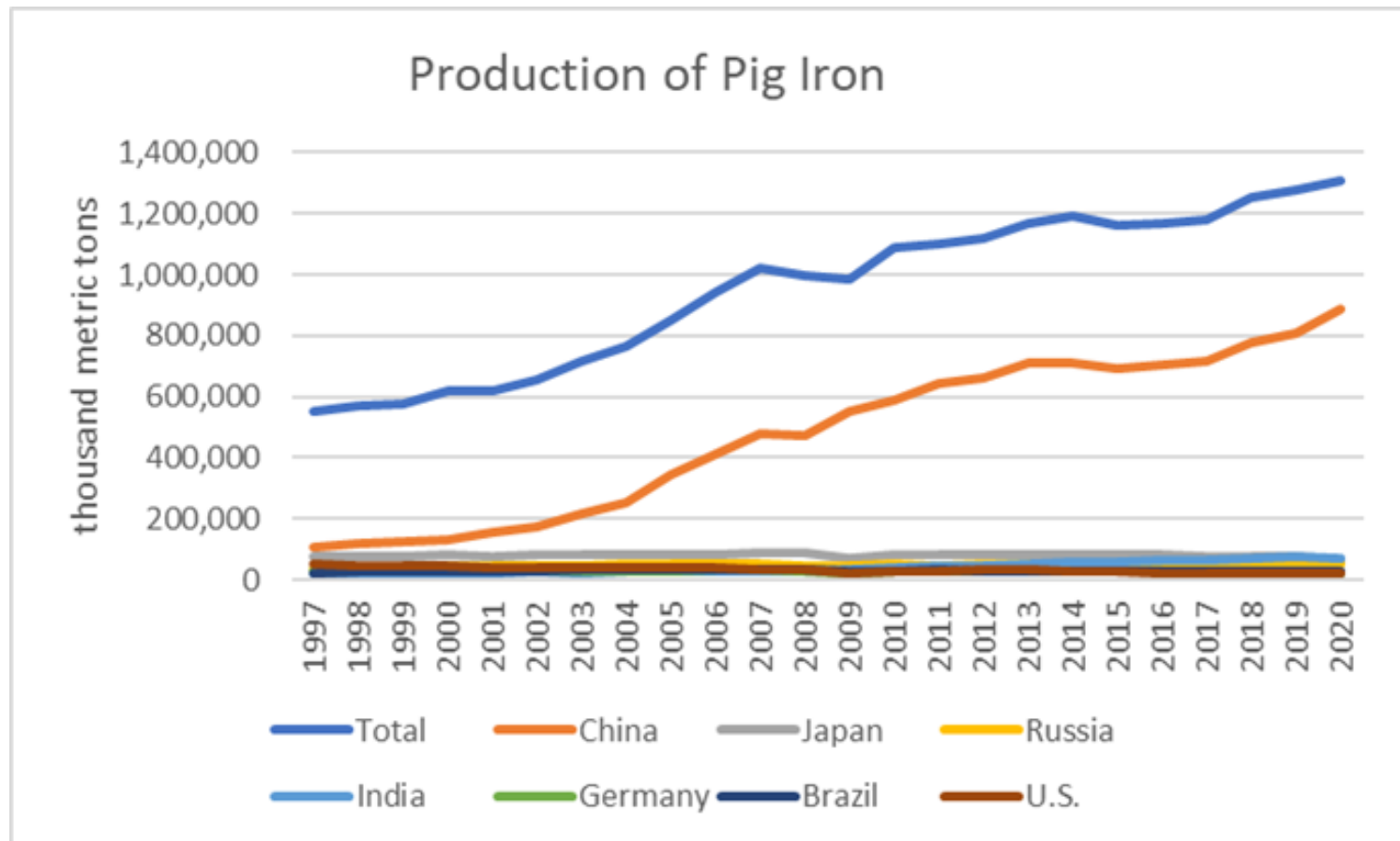
2018 Steel Mill and Casting Production



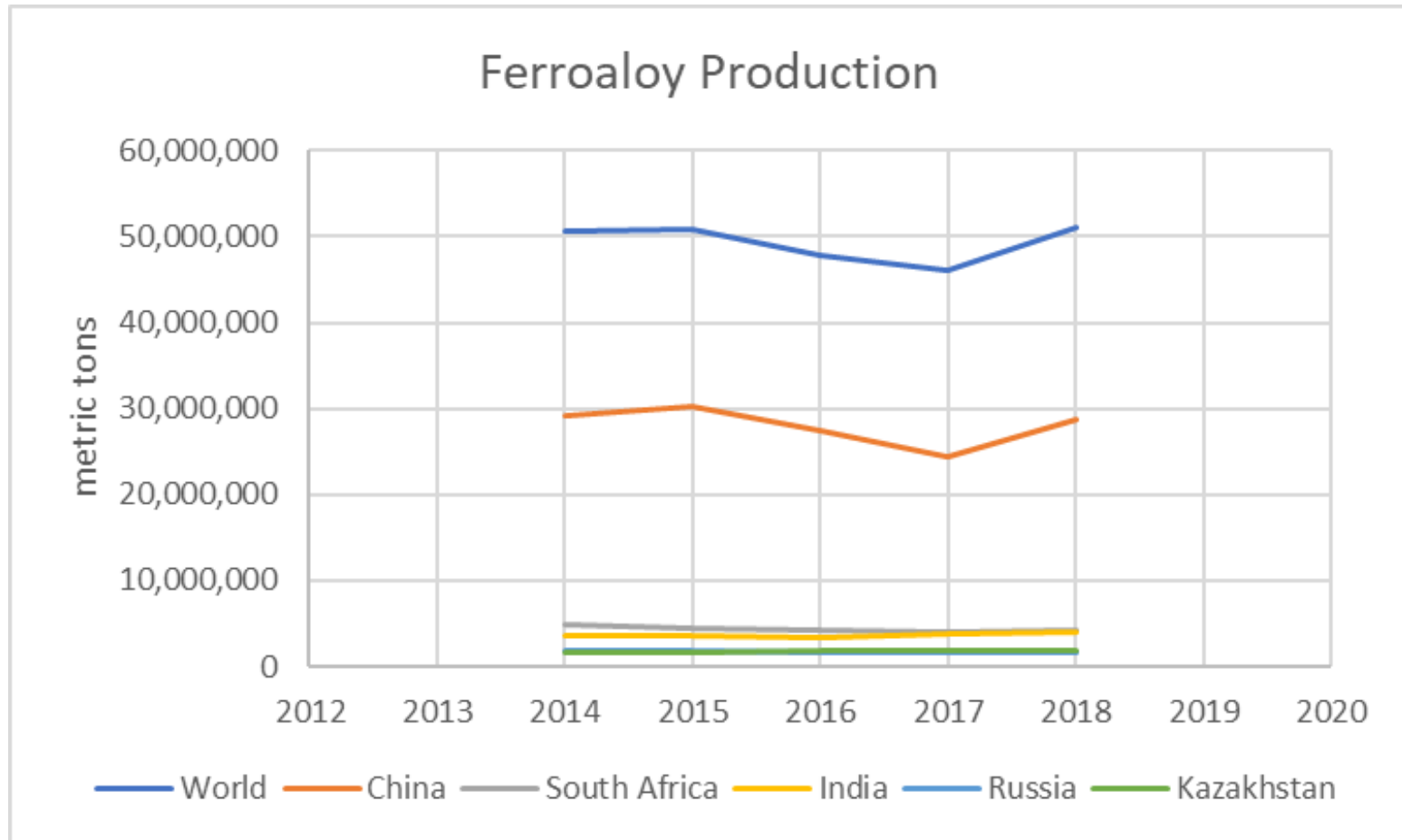
2018 Steel Mill and Casting Production per Capita



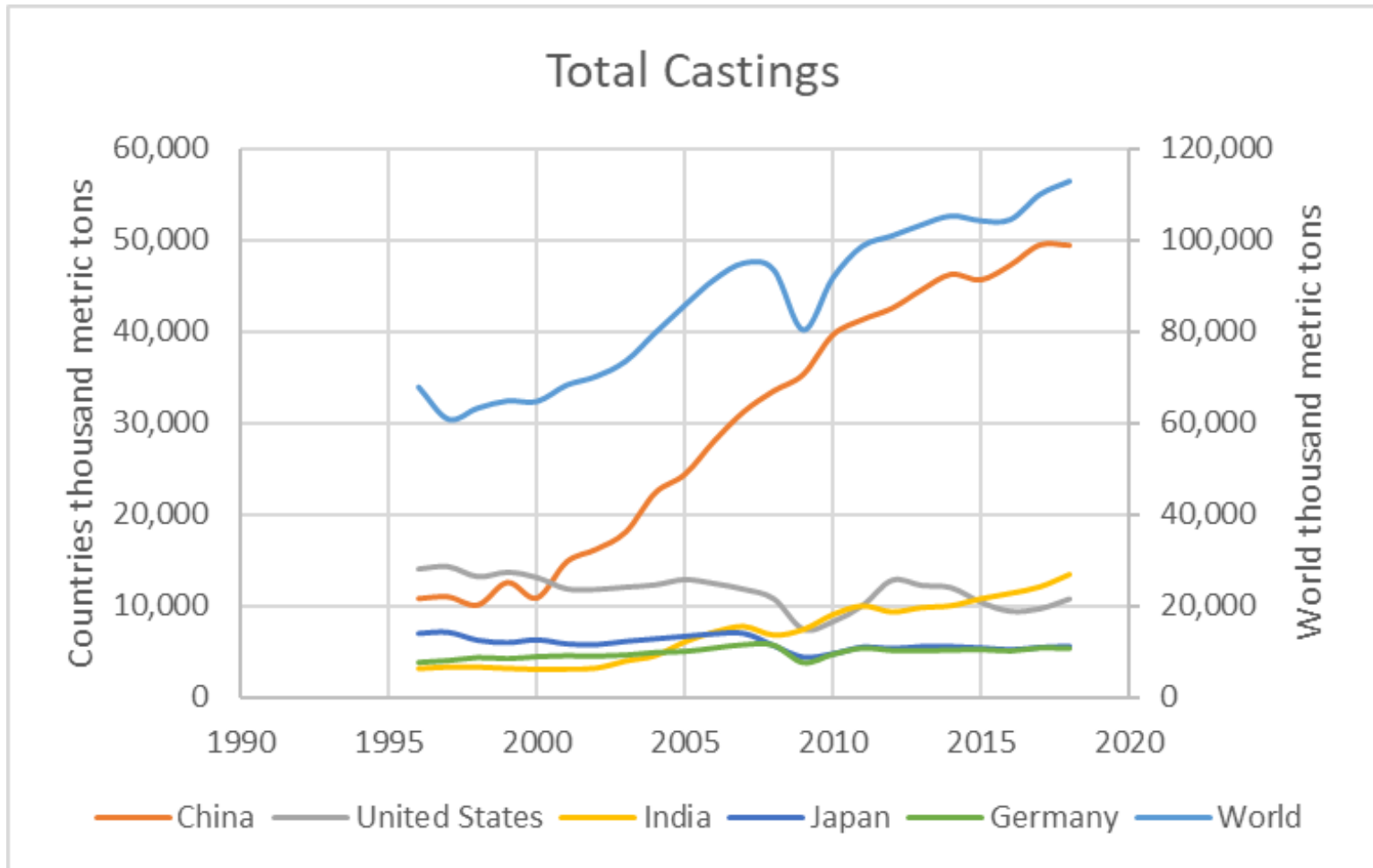
Global Pig Iron Production



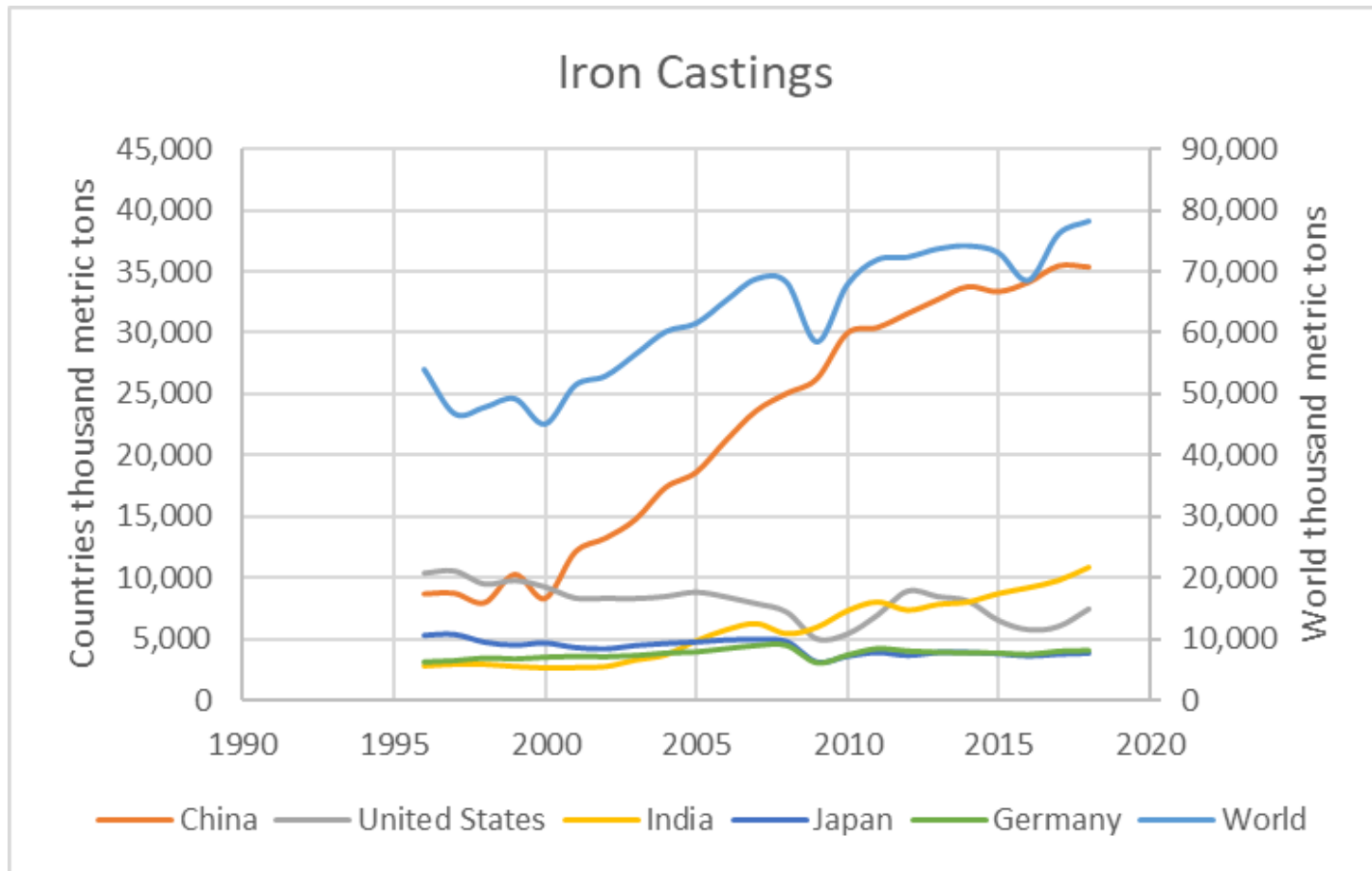
Global Ferroalloy Production



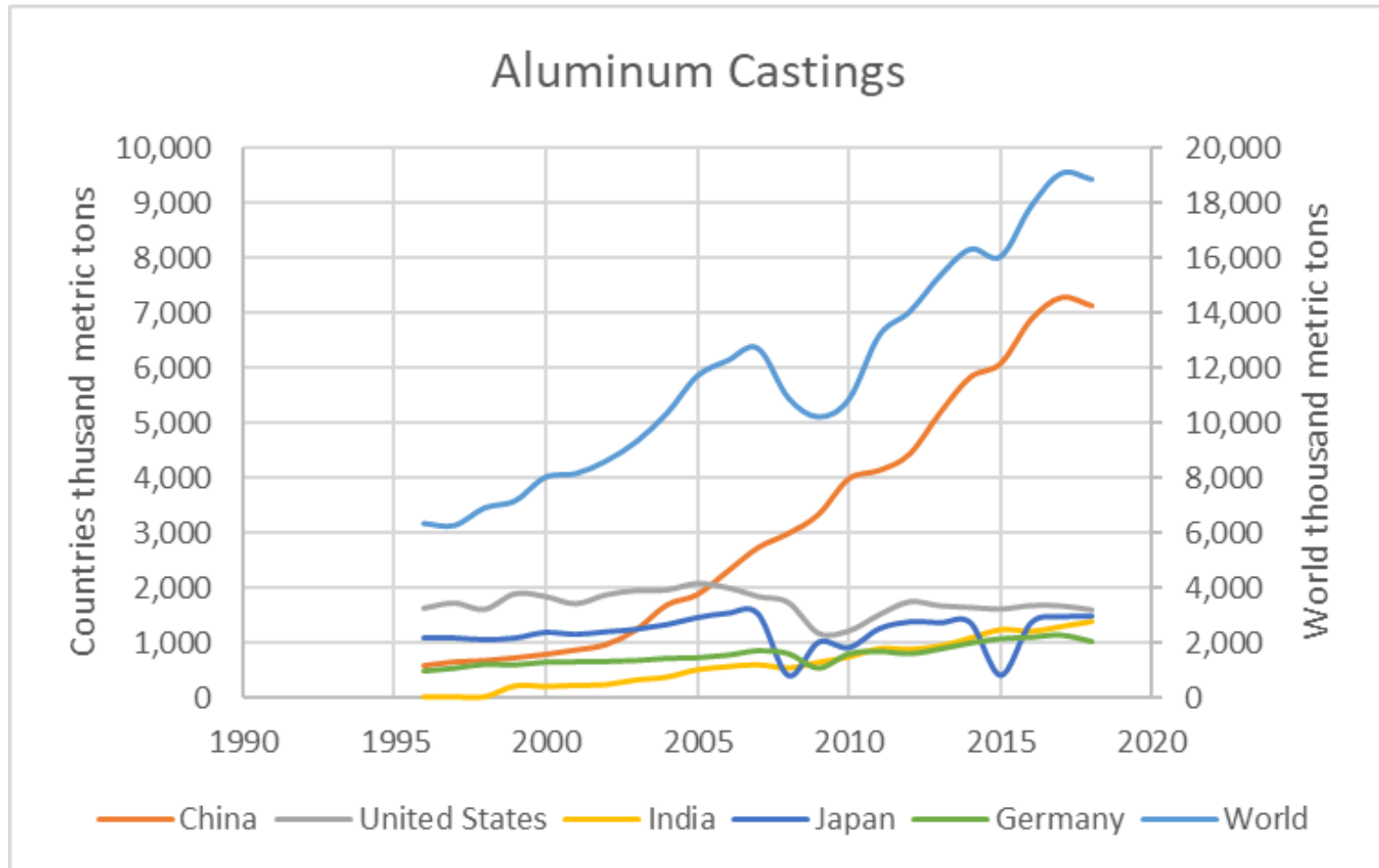
Total Casting Production



Iron Castings



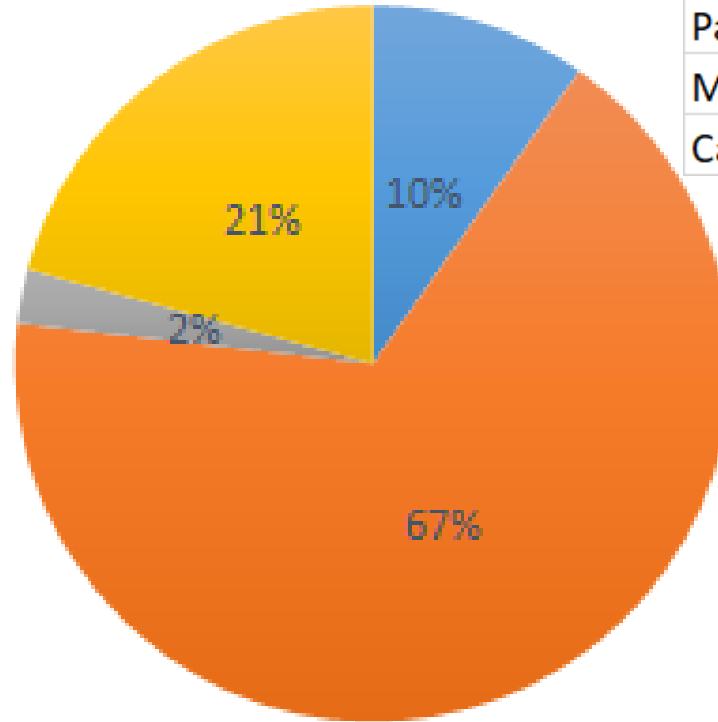
Aluminum castings



PROD (tn)	87,000,000
RCP (\$million)	107,677
EMP (#)	99,630

Rolling Mills

RCP/tn	\$1,237.67
Prodval/tn	\$1,195.98
Valadd/tn	\$374.49
Payroll+Benefits/tn	\$124.08
Materials/tn	\$850.10
Capex/tn	\$30.97



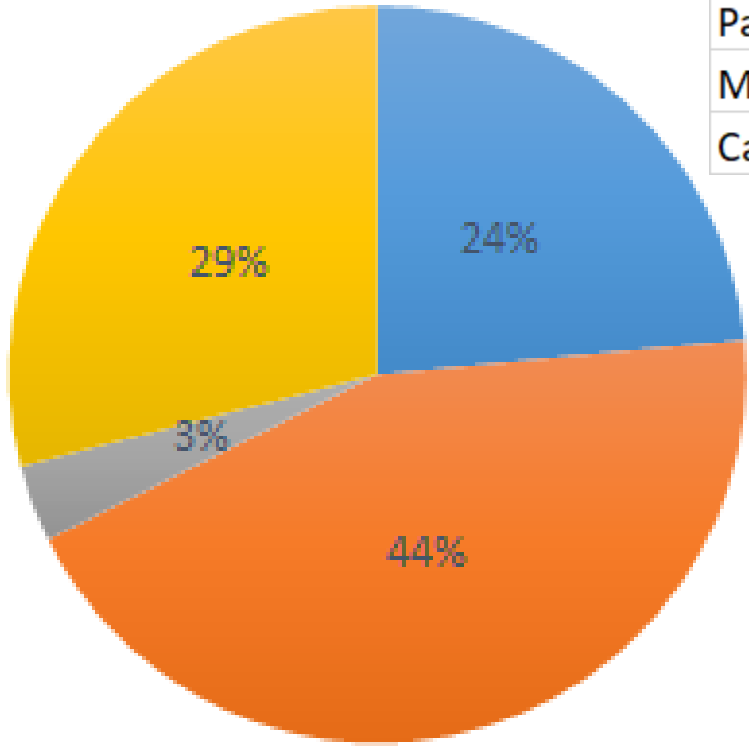
■ pay+ben/RCP
 ■ CSTM/RCP
 ■ CEX/RCP
 ■ other



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



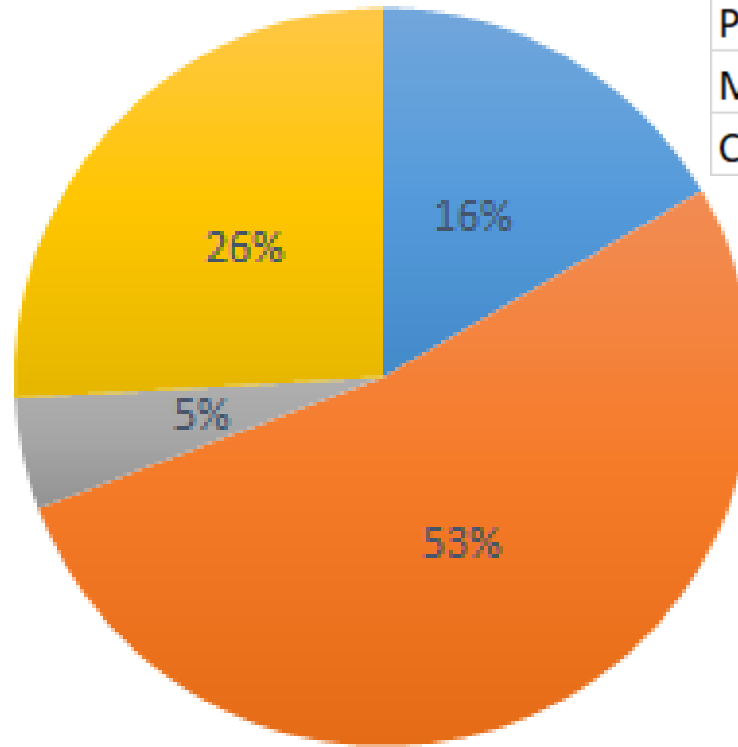
■ pay+ben/RCP
 ■ CSTM/RCP
 ■ CEX/RCP
 ■ other



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



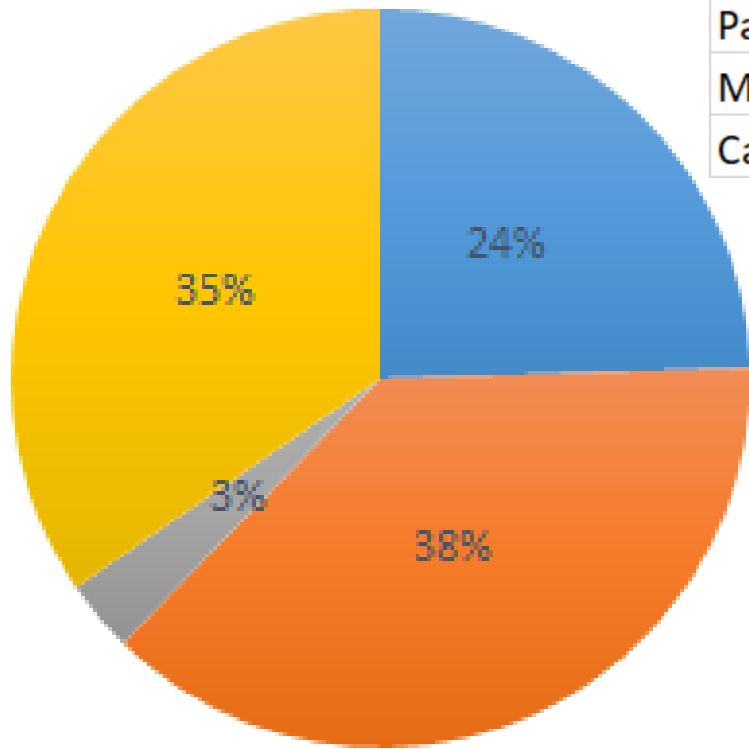
■ pay+ben/RCP
 ■ CSTM/RCP
 ■ CEX/RCP
 ■ other



PROD (tn)	1,940
RCP (\$million)	3,746
EMP (#)	13,493

Steel Investment

RCP/tn	\$71,028.59
Prodval/tn	\$73,570.32
Valadd/tn	\$44,744.14
Payroll+Benefits/tn	\$17,997.95
Materials/tn	\$27,663.76
Capex/tn	\$2,305.44



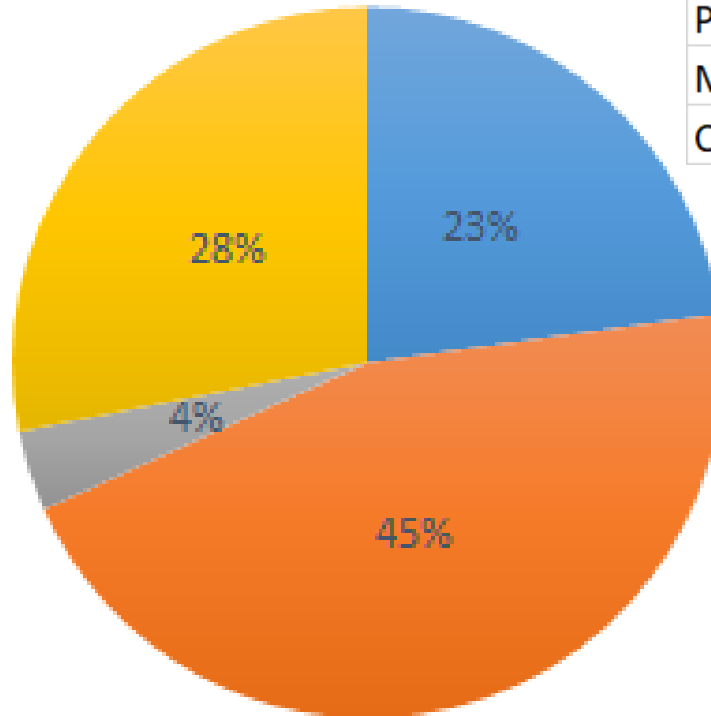
■ pay+ben/RCP
 ■ CSTM/RCP
 ■ CEX/RCP
 ■ other



Iron Foundry

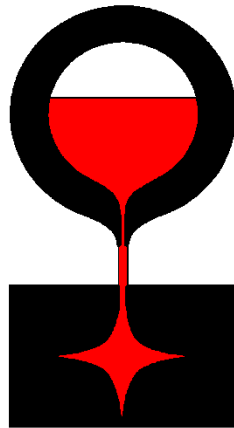
PROD (tn)	8,057,000
RCP (\$million)	10,691
EMP (#)	36,760

RCP/tn	\$1,326.90
Prodval/tn	\$1,231.16
Valadd/tn	\$704.90
Payroll+Benefits/tn	\$314.13
Materials/tn	\$625.28
Capex/tn	\$50.44



■ pay+ben/RCP ■ CSTM/RCP ■ CEX/RCP ■ other





Raymond Monroe

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Manufacturing Size

NAICS2017	NAICS2017_LABEL	EMP	PAYANN	EMQP1PW	HOURS	PAYANPW	CSTMTOT	RCPTOT	VALADD	INVTOTB	CEXTOT
2017 NAICS code	Meaning of NAICS code	Number of employees	Annual payroll (\$1,000)	Production workers, for pay period including March 12	Production workers hours (1,000)	Production workers, nonleased employees wages (\$1,000)	Total cost of materials (\$1,000)	Sales, value of shipments, or revenue (\$1,000)	Value added (\$1,000)	Total inventories, beginning of year (\$1,000)	Total capital expenditures (\$1,000)
31-33	Manufacturing	11,352,590	693,180,866	8,098,245	15,156,366	400,409,983	2,833,295,173	5,221,325,198	2,377,064,560	692,391,902	162,225,829
3364	Aerospace product and parts	406,627	37,281,947	237,932	429,050	17,631,820	94,017,263	182,290,774	94,361,667	88,249,965	5,116,606
3311	Iron and steel mills and ferro	81,116	6,487,754	66,117	132,521	5,063,124	49,675,082	74,883,475	23,914,013	15,628,152	3,061,416
33231	Plate work and fabricated str	159,164	9,389,356	116,940	229,490	5,808,545	23,976,230	49,300,926	25,254,914	5,380,696	1,379,904
33661	Ship and boat building	131,574	8,453,736	89,048	161,560	4,740,124	18,640,248	38,418,677	19,856,498	3,256,147	1,422,405
33271	Machine shops	223,955	12,096,281	175,681	311,045	8,432,817	12,155,492	35,499,905	23,219,087	5,428,159	2,027,305
33312	Construction machinery man	56,875	3,495,134	38,311	70,625	1,950,356	16,427,961	30,217,265	13,246,758	5,841,926	552,051
33291	Metal valve manufacturing	81,918	5,162,077	58,136	106,472	2,852,834	12,698,758	29,888,662	16,955,375	6,250,143	517,838
336611	Ship building and repairing	96,739	6,733,550	60,151	111,199	3,533,755	12,708,188	27,895,963	15,420,638	1,693,003	1,182,783
33211	Forging and stamping	97,132	5,280,955	73,871	133,373	3,408,459	14,440,435	27,219,198	12,473,438	5,473,103	962,225
33391	Pump and compressor manu	54,795	3,990,206	32,177	55,789	1,788,153	11,942,093	25,272,975	13,010,212	5,321,669	809,507
3315	Foundries	107,170	5,664,015	85,232	156,377	3,954,845	10,762,400	24,508,644	13,439,077	4,034,714	911,938
33612	Heavy duty truck manufactur	29,485	1,628,364	23,433	37,487	1,190,673	15,327,227	21,434,315	6,085,981	1,969,639	264,280
33313	Mining and oil and gas field r	46,177	2,979,852	30,317	50,667	1,566,040	9,290,465	15,424,531	5,311,315	6,733,522	309,013
33151	Ferrous metal foundries	59,210	3,265,265	47,225	89,096	2,289,397	6,737,640	14,840,638	7,953,147	2,479,129	517,183
332911	Industrial valve manufacturir	29,813	2,010,844	20,456	39,943	1,069,587	4,365,787	11,144,990	6,685,005	2,529,827	210,402
333132	Oil and gas field machinery a	30,413	2,088,756	19,452	31,164	1,110,503	6,414,677	10,672,694	3,509,617	5,107,497	227,066
3365	Railroad rolling stock manufe	28,273	1,776,116	19,666	36,008	1,035,631	6,201,293	9,163,065	2,771,168	2,841,950	291,052
331511	Iron foundries	31,968	1,812,591	25,919	52,543	1,284,496	4,198,165	8,584,499	4,346,108	1,190,237	338,704
332313	Plate work manufacturing	35,592	1,928,712	27,647	53,926	1,319,887	3,157,247	7,184,319	4,018,025	1,034,878	303,397
332111	Iron and steel forging	20,069	1,169,962	15,026	24,092	739,281	3,877,346	6,722,816	2,658,145	2,013,615	296,099
336992	Military armored vehicle, tan	11,597	937,085	7,131	14,320	444,874	3,423,872	6,584,295	3,737,388	1,820,343	264,399
333131	Mining machinery and equip	15,764	891,096	10,865	19,503	455,537	2,875,788	4,751,837	1,801,698	1,626,024	81,947
332811	Metal heat treating	18,783	1,079,933	14,658	26,695	714,069	1,352,309	4,105,185	2,600,890	788,355	136,833
331512	Steel investment foundries	15,782	833,472	12,596	21,745	614,865	1,262,468	3,351,075	2,030,906	648,996	95,510
331513	Steel foundries (except inves	11,460	619,201	8,711	14,808	390,036	1,277,008	2,905,064	1,576,133	639,896	82,970
332117	Powder metallurgy part man	9,167	432,256	7,254	13,086	294,541	805,684	1,941,435	1,115,326	325,388	91,780

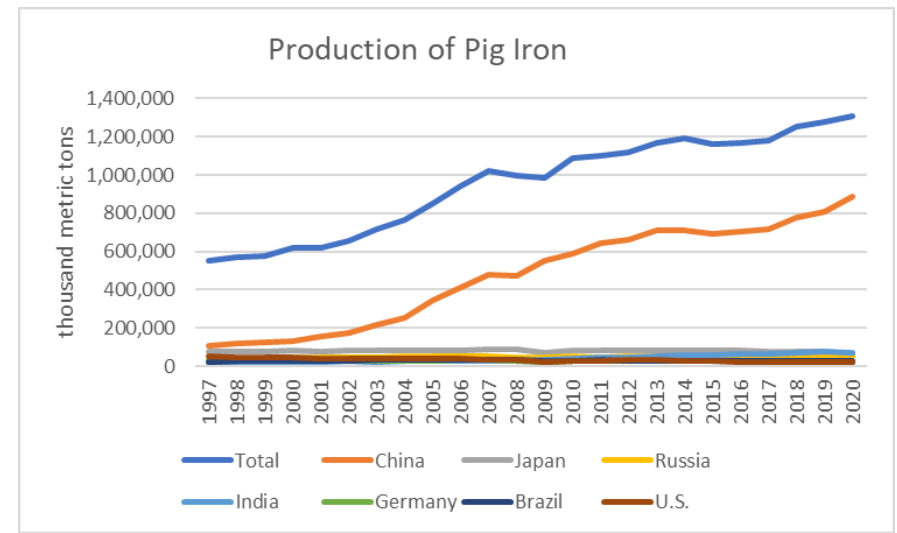


Resource Efficiency

	rmp/emp	rmp/prod	rmp/hr	rmp/pay	rmp/prod	rmp/cstm	val/emp	val/prod	val/hr	val/pay	val/prod pay	val/cstm
Manufacturing	459,924	644,748	344.50	7.532	13.040	1.843	209,385	293,528	156.84	3.429	5.937	0.839
Aerospace product	448,300	766,147	424.87	4.890	10.339	1.939	232,060	396,591	219.93	2.531	5.352	1.004
Iron and steel mills	923,165	1,132,590	565.07	11.542	14.790	1.507	294,813	361,692	180.45	3.686	4.723	0.481
Plate work and fabri	309,749	421,592	214.83	5.251	8.488	2.056	158,672	215,965	110.05	2.690	4.348	1.053
Ship and boat buildi	291,993	431,438	237.80	4.545	8.105	2.061	150,915	222,986	122.90	2.349	4.189	1.065
Machine shops	158,514	202,070	114.13	2.935	4.210	2.920	103,677	132,166	74.65	1.920	2.753	1.910
Construction machin	531,293	788,736	427.86	8.646	15.493	1.839	232,910	345,769	187.56	3.790	6.792	0.806
Metal valve manufa	364,861	514,116	280.72	5.790	10.477	2.354	206,980	291,650	159.25	3.285	5.943	1.335
Ship building and re	288,363	463,766	250.87	4.143	7.894	2.195	159,405	256,365	138.68	2.290	4.364	1.213
Forging and stampir	280,229	368,469	204.08	5.154	7.986	1.885	128,417	168,854	93.52	2.362	3.660	0.864
Pump and compress	461,228	785,436	453.01	6.334	14.134	2.116	237,434	404,333	233.20	3.261	7.276	1.089
Foundries	228,689	287,552	156.73	4.327	6.197	2.277	125,400	157,676	85.94	2.373	3.398	1.249
Heavy duty truck ma	726,957	914,706	571.78	13.163	18.002	1.398	206,409	259,718	162.35	3.737	5.111	0.397
Mining and oil and g	334,031	508,775	304.43	5.176	9.849	1.660	115,021	175,193	104.83	1.782	3.392	0.572
Ferrous metal found	250,644	314,254	166.57	4.545	6.482	2.203	134,321	168,410	89.26	2.436	3.474	1.180
Industrial valve man	373,830	544,827	279.02	5.542	10.420	2.553	224,231	326,799	167.36	3.324	6.250	1.531
Oil and gas field ma	350,925	548,668	342.47	5.110	9.611	1.664	115,399	180,424	112.62	1.680	3.160	0.547
Railroad rolling stoc	324,092	465,934	254.47	5.159	8.848	1.478	98,015	140,912	76.96	1.560	2.676	0.447
Iron foundries	268,534	331,205	163.38	4.736	6.683	2.045	135,952	167,680	82.72	2.398	3.384	1.035
Plate work manufac	201,852	259,859	133.23	3.725	5.443	2.276	112,891	145,333	74.51	2.083	3.044	1.273
Iron and steel forgin	334,985	447,412	279.05	5.746	9.094	1.734	132,450	176,903	110.33	2.272	3.596	0.686
Military armored ve	567,758	923,334	459.80	7.026	14.800	1.923	322,272	524,104	260.99	3.988	8.401	1.092
Mining machinery a	301,436	437,353	243.65	5.333	10.431	1.652	114,292	165,826	92.38	2.022	3.955	0.627
Metal heat treating	218,559	280,064	153.78	3.801	5.749	3.036	138,470	177,438	97.43	2.408	3.642	1.923
Steel investment fou	212,335	266,043	154.11	4.021	5.450	2.654	128,685	161,234	93.40	2.437	3.303	1.609
Steel foundries (exc	253,496	333,494	196.18	4.692	7.448	2.275	137,533	180,936	106.44	2.545	4.041	1.234
Powder metallurgy p	211,785	267,636	148.36	4.491	6.591	2.410	121,668	153,753	85.23	2.580	3.787	1.384



Pig Iron Production



	Production Pig Iron			thousand metric tons					U.S.
	Total	China	Japan	Russia	India	Germany	Brazil		
2020	1310000	887719	61600	51908	67783	22459	24628	18200	
2019	1280000	809365	74907	51184	74099	25490	26166	22300	
2018	1250000	779880	77328	51664	72641	27271	28655	24100	
2017	1180000	713620	78330	52127	66808	27816	28331	22400	
2016	1170000	702270	80186	51874	63714	27269	26129	22300	
2015	1160000	691413	81011	52573	58393	27842	27803	25400	
2014	1190000	711487	83872	51479	55166	27379	27016	29400	
2013	1170000	708970	83840	50111	51359	26678	26200	30300	
2012	1120000	663500	81405	50529	47987	26493	26900	32100	
2011	1100000	640510	81208	48117	43624	27563	33319	30200	
2010	1090000	590220	82283	48600	38685	28560	25200	26800	
2009	985000	552830	66943	43930	34000	20104	25135	19000	
2008	997000	470670	86171	48300	29000	29111	34871	33700	
2007	1020000	476520	86771	51523	28800	31149	35571	36300	
2006	939000	412450	84270	51683	28300	30360	32452	37900	
2005	851000	343750	83058	49175	25500	28854	34382	37200	
2004	764000	251850	82974	50427	25000	30018	34579	42300	
2003	715000	213660	82092	48368	24000	29481	32036	40600	
2002	653000	170850	80979	46060	24315	29427	29667	40200	
2001	616000	155540	78836	44980	21900	29184	27441	42100	
2000	616000	131010	81071	44618	21321	30846	27723	47900	
1999	578000	125390	74520	40854	20139	27931	25060	46300	
1998	572000	118600	74981	34827	20194	30162	25111	48200	
1997	549000	107225	74597	36061	19864	30012	23978	49400	

	US Imports thousand metric tons			
	Total	Brazil	Russia	Ukraine
2020	4500	813	1580	1870
2019	4920	1190	2150	1370
2018	6020	752	3190	1820
2017	5130	921	2780	1140
2016	3870	705	2220	685



Total World Production Ferroalloys

TABLE 9
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY OR LOCALITY AND ALLOY TYPE^{1,2}

(Metric tons, gross weight)

Country or locality	2014	2015	2016	2017	2018
Grand total ¹⁰	50,600,000 ^r	50,900,000 ^r	47,900,000 ^r	46,000,000 ^r	51,000,000
Of which:					
Ferroaluminum	4,600	3,010	4,140	4,340	4,340
Ferroboron	45	42	--	--	--
Ferrochromium	11,800,000	11,400,000	11,600,000	12,600,000	13,300,000
Ferromanganese	6,300,000 ^r	5,840,000 ^r	5,000,000 ^r	5,270,000 ^r	5,370,000
Ferromolybdenum	132,000	127,000	139,000	149,000	149,000
Ferronickel	3,880,000 ^r	3,700,000	3,930,000 ^r	4,160,000 ^r	4,490,000
Ferroniobium	89,100 ^r	88,600 ^r	77,500 ^r	101,000 ^r	103,000
Ferrophosphorus	1,500 ^e	1,500 ^e	1,500 ^e	1,540	1,500
Ferrosilicomagnesium	25,800	21,900	21,100	16,700	18,400
Ferrosilicon	8,020,000 ^r	7,420,000 ^r	6,820,000 ^r	6,030,000 ^r	6,270,000
Ferrosilicon-chromium	226,000	177,000	169,000	185,000	185,000
Ferrotitanium	8,260	10,200	11,000	10,600 ^r	9,130
Ferrovanadium	81,200 ^r	74,100 ^r	59,900 ^r	60,300 ^r	60,800
Silicomanganese	12,400,000 ^r	10,500,000 ^r	11,800,000 ^r	11,600,000 ^r	14,700,000
Other, unspecified	7,650,000 ^r	11,600,000 ^r	8,230,000 ^r	5,750,000 ^r	6,340,000



Major Suppliers

TABLE 9
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY OR LOCALITY AND ALLOY TYPE^{1,2}

(Metric tons, gross weight)

Country or locality	2014	2015	2016	2017	2018
China:					
Ferrochromium	4,120,000	3,940,000	4,230,000	4,940,000	5,250,000
Ferromanganese: ^e					
Blast furnace	457,000	446,000	340,000	220,000	270,000
Electric furnace	2,170,000	2,120,000	1,610,000	1,560,000	1,660,000
Ferromolybdenum	120,000	116,000	127,000	141,000	141,000
Ferronicel equivalent, n	2,400,000	1,900,000	1,900,000	2,100,000	2,400,000
Ferrosilicon	5,500,000	4,730,000	4,300,000	3,650,000	3,800,000
Ferrovandium	44,400 ^r	40,900 ^r	34,200 ^r	38,400 ^r	40,500
Silicomanganese	7,319,000	5,870,000	7,267,000	6,610,000	9,450,000
Other, unspecified	6,970,000	11,000,000 ^{r, e}	7,700,000 ^e	5,200,000 ^{r, e}	5,700,000
Total	29,100,400^r	30,162,900^r	27,508,200^r	24,459,400^r	28,711,500
South Africa:					
Ferrochromium ^s	3,719,010	3,684,598	3,596,000	3,600,000 ^e	3,900,000
Ferromanganese	787,000	512,000	335,000	257,100	235,600
Ferrosilicon	87,700	91,800	73,200	34,000 ^e	34,000
Ferrovandium ^e	19,000	15,000	7,000	7,000	6,800
Silicomanganese	228,100	210,200	144,000	160,400	164,200
Total	4,840,810	4,513,598	4,155,200	4,060,000^e	4,340,000
India:					
Ferroaluminum	4,596	3,010	4,140	4,337	4,337
Ferroboron	45	42	--	--	--
Ferrochromium	944,000	944,000	944,000	944,000	944,000
Ferromanganese	676,000 ^r	646,000 ^r	621,000 ^r	752,000 ^r	795,000
Ferromolybdenum	1,281	1,281	1,614	1,315	1,315
Ferrosilicomagnesium	25,788	21,887	21,140	16,724 ^r	18,436
Ferrosilicon	92,014	92,000	90,000	90,000	88,000
Ferrotitanium	760	204	231	393	125
Ferrovandium	1,031	879	1,266	1,318	1,150
Silicomanganese	1,920,000 ^r	1,832,000 ^r	1,768,000 ^r	2,038,000 ^r	2,098,000
Total	3,665,515^r	3,541,303^r	3,451,391^r	3,848,087^r	3,950,363



Russia

TABLE 9
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY OR LOCALITY AND ALLOY TYPE^{1, 2}

(Metric tons, gross weight)

Russia:					
Ferrochromium	439,600	363,286	268,439	436,280	400,000
Ferromanganese	178,600	155,700	124,200	253,000 ^f	281,000
Ferroniobium ^e	150 ^f	250 ^f	120 ^f	370 ^f	380
Ferrophosphorus	1,500 ^e	1,500 ^e	1,500 ^e	1,538	1,500
Ferrosilicon	1,026,190	1,057,909	935,912	840,765	841,000
Ferrosilicon-chromium	67,160	102,000 ^e	75,000 ^e	75,000 ^e	75,000
Ferrotitanium	7,500 ^e	9,961	10,741	10,200 ^f	9,000
Ferrovandium	11,400 ^e	12,277	12,392	12,593 ^f	11,383
Silicomanganese	179,910	188,895	203,216	44,917 ^f	43,334
Other, unspecified ^e	6,500	8,000	9,000	10,000	10,000
Total	1,918,510^f	1,899,778^f	1,640,520^f	1,684,663^f	1,670,000
Kazakhstan:					
Ferrochromium	1,351,803	1,414,476	1,525,221	1,640,300	1,600,000
Ferrosilicon	395	86,984	68,779	59,926	60,000
Ferrosilicon-chromium	158,825	74,609	94,468	110,497	110,000
Silicomanganese	200,379	164,189	135,885	123,977	132,000
Other, unspecified	3,735	1,662	1,987	--	46
Total	1,715,137	1,741,920	1,826,340	1,934,700	1,900,000
Ukraine:					
Ferromanganese	102,934	87,740	104,470	114,500	79,400
Ferronickel	114,222	95,209	79,900	72,500	79,537
Ferrosilicon	142,300	90,200	101,420	92,910	75,400
Silicomanganese	840,433	698,400	814,970	810,670	859,600
Other, unspecified	15,326	19,360	22,219 ^f	12,635 ^f	13,150
Total	1,215,215	990,909	1,122,979^f	1,103,215^f	1,107,087



Use of Ferroalloys in US

End use	FeCr	FeMn	SiMn	FeSi
2017:				
Steel:				
Carbon and high-strength low-alloy	6,970 ^r	271,000	102,000	34,100
Stainless and heat-resisting	371,000 ^r	9,820	15,600	44,300
Unspecified and other	35,900	57,200	20,700	90,300
Total steel	414,000 ^r	338,000	138,000	169,000 ³
Alloys and superalloys	9,680 ^r	(4)	--	(4)
Cast irons	(4)	6,530	255	70,200 ⁵
Miscellaneous and unspecified	5,700 ^r	542	2,690	272 ^{r, 3, 5}
Grand total	430,000 ^r	345,000	141,000	239,000
Consumer stocks, December 31	13,300 ^r	17,100 ^r	13,400 ^{r, 7}	11,200 ^r
2018:				
Steel:				
Carbon and high-strength low-alloy	7,740	W	90,100	32,100
Stainless and heat-resisting	366,000	9,820	15,600	42,600
Unspecified and other	34,900	W	30,100	41,100
Total steel	409,000	341,000	136,000	116,000 ³
Alloys and superalloys	9,570	(4)	--	(4)
Cast irons	(4)	6,720	289	80,100 ⁵
Miscellaneous and unspecified	5,580	498	2,810	370 ^{3, 5}
Grand total	424,000	348,000	139,000 ⁵	196,000



Mineral	aerospace	defense	energy	telecommunications and electronics	transportation	other	top producing country	top country supplier
aluminum (bauxite)	x	x	x	x	x	x	China	Canada
antimony		x	x	x		x	China	China
arsenic		x	x	x		x	China	China
barite			x	x		x	China	China
beryllium	x	x	x	x		x	U.S.	Kazakhstan
bismuth		x	x	x		x	China	China
cesium	x	x	x	x		x	Canada	Canada
chromium	x	x	x	x	x	x	South Africa	South Africa
cobalt	x	x	x	x	x	x	Congo	Norway
fluorspar			x	x		x	China	Mexico
gallium	x	x	x	x		x	China	China
germanium	x	x	x	x		x	China	China
graphite (natural)	x	x	x	x	x	x	China	China
hafnium	x	x	x	x		x	Australia	China
helium				x		x	U.S.	Qatar
indium	x	x	x	x		x	China	Canada
lithium	x	x	x	x	x	x	Australia	Chile
magnesium	x	x	x	x	x	x	China	China
manganese	x	x	x	x	x	x	China	South Africa
niobium	x	x	x	x		x	Brazil	Brazil
platinum group metals (PGM)*	x		x	x	x	x	South Africa	South Africa
potash			x	x		x	Canada	Canada
rare earth elements**	x	x	x	x	x	x	China	China
rhodium	x		x	x		x	Chile	Chile
rubidium	x	x	x	x		x	Canada	Canada
scandium	x	x	x	x		x	China	China
strontium	x	x	x	x	x	x	Spain	Mexico
tantalum	x	x	x	x		x	Rwanda	China
tellurium		x	x	x		x	China	Canada
tin		x		x		x	China	Peru
titanium	x	x	x	x		x	China	South Africa
tungsten	x	x	x	x		x	China	China
uranium	x	x	x			x	Kazakhstan	Canada
vanadium	x	x	x	x		x	China	South Africa
zirconium	x	x	x	x		x	Australia	China

