Transport Costs, Trade Policy, and Industrial Development: Iron and Steel in a Small Open Economy, 1870-1913

Data Appendix

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Note: All data described in this appendix is available in file "irondata.xls/fulldata".

"Urquhart" refers to M. C. Urquhart (1993), Gross National Product, Canada, 1870-1926: The Derivation of the Estimates, McGill-Queen's Press.

"HS1" refers to K.A.H. Buckley and M.C. Urquhart (Eds.) (1964), Historical Statistics of Canada, 1st Edition, Macmillan Press.

"HS2" refers to F.H. Leacy (Ed.) (1983), Historical Statistics of Canada, 2nd Edition, Statistics Canada.

"USHS" refers to Susan Carter, Scott Gartner, Michael Haines, Alan Olmstead, Richard Sutch and Gavin Wright (Eds.) (2006), Historical Statistics of the United States: Millennial Edition, Cambridge University Press.

"USStatAb" refers to United States, Bureau of the Census, Statistical Abstract of the United States.

All other bibliographic references are provided in the paper, or may be provided by the authors.

Industry Stats

Pig Iron Production, By Province (Net Tons):

1870-1886 Inwood (1986), Pg. 105-6, Halifax Herald (1890), January 16.
1887-1913 Geological Survey of Canada, Mining and Mineral Industry Returns, 1887-1920, Blast Furnaces, National Archives of Canada (NAC), Record Group (RG) 87, Volume 18-19.

Pig Iron Production, By Blast Furnace (Net Tons):

1870-1886 Inwood (1984), Table 4.1, Halifax Herald (1890), January 16.
1887-1913 Geological Survey of Canada, Mining and Mineral Industry Returns, 1887-1920, Blast Furnaces, National Archives of Canada (NAC), Record Group (RG) 87, Volume 18.

Steel Ingot Production, By Province (Net Tons):

1887-1890 NAC, RG 87, Volume 18-19.
1891-1893 Linear interpolation between 1890 and 1894.
1894-1900 Geological Survey of Canada, Report of Progress, Statistical Section.
1901-1904 NAC, RG 87, Volume 18-19.
1905-1906 Dominion Iron and Steel Corporation, Annual Report (1905), Lake Superior Corporation, Annual Report (1906), Public Archives of Nova Scotia, Manuscript Group 3, Volume 1873, Number 52.
1907-1913 NAC, RG 87, Volume 18-19.

Total Employment, By Blast Furnace (Number Employees):

1870-1886 Various Years and Furnaces, Robert Bell, Papers and Correspondence, NAC, R7346-11-9-E (formerly MG 29-B15), Hamelin and Roby (1969), Pg. 250, Hardy (1995), Pg. 102-5, Harrington (1874) and (1883), Massey (1976), Montreal Gazette (1881), May 31.

1887-1913 Geological Survey of Canada, Mining and Mineral Industry Returns, 1887-1920, Blast Furnaces, National Archives of Canada (NAC), Record Group (RG) 87, Volume 18-19.

Total Employment, By Blast Furnace (Person-Days):

1870-1904 Total Production ÷ Production Per Day, Various Years, Robert Bell, Papers and Correspondence, NAC, R7346-11-9-E (formerly MG 29-B15), Canada Iron Furnace Company: Radnor Forges (1893), Harrington (1874), Pg. 58-60, Journal of the United States Association of Charcoal Iron Workers (1883), Pg. 58, London Mining Journal (1881), April 28, MacDonald (1909), Pg. 240-3, Milot (1983), Montreal Herald (1879), December 21, Montreal Gazette (1881), May 31.

1905-1913 Days in Blast, Geological Survey of Canada, Mining and Mineral Industry Returns, 1887-1920, Blast Furnaces, National Archives of Canada (NAC), Record Group (RG) 87, Volume 19.

Labour Remuneration (CAD/Person Day):

1870-1913 Wages and Salaries in Primary Iron and Steel, Urquhart, Table 4.6 ÷ Total Employment.

US Pig Iron Production, Aggregate (Gross Tons):

1870-1913 USHS, Series Db74.

Macro Stats

Federal Election Years:

1870-1913 HS1, Series W46.

Party in Power:

1870-1913 Political party of Prime Minister, HS1, Series W6.

Population (000s):

1870-1913 HS1, Series A1.

Population of Western Provinces (000s):

1871, 1881, 1891, 1901, 1911 HS1 Series A9-12.

1870-1913 OLS Regression: Western Population=f(constant, total population, urban population, net migration, net wheat exports).

Gross National Product (000 CAD):
1870-1913 Urquhart, Table 1.1.

GNP Deflator (1900=100):
1870-1913 Urquhart, Table 1.6.

Wholesale Price Index (1900=100):
1868-1913 All commodities, HS1 Series J1.

Manufacturing Value Added (000 CAD):
1870-1913 Urquhart, Table 1.1.

Other Manufacturing Value Added (000 CAD):
1870-1913 Manufacturing Value Added - Primary Iron and Steel Value Added, Urquhart, Table 4.5.

Manufacturing Wages and Salaries (CAD):
1870-1913 Urquhart (1993), Table 4.6.

Manufacturing Total Employment (000s):
1871, 1881, 1891 HS2, Series R21.
1900-1913 Keay (2010), Canadian Natural Resource Industries Data Appendix.
1870-1913 OLS Regression: Total L = f(constant, urban population, manufacturing output, year, year squared).

Share Urban Population:
1871, 1881, 1891, 1901, 1911 HS2, Series A68.
1870-1913 OLS Regression: Share Urban=f(constant, manufacturing share, population, net migration).

Miles of 1st Main RR Track in Operation (000s):
1867-1913 HS1, Series S28.

Net Migration (000s):
1870-1913 Green and Urquhart (1987), Table 4.

Net Wheat Exports (000s Bushels):
1870-1913 Green and Urquhart (1987), Table 4.

Wheat Price Index:
1870-1913 Wholesale Prices, Grains and Flour, HS1, Series J3.

Gross Fixed Capital Formation (000 CAD):
1870-1913 Green and Urquhart (1987), Table 3.

Foreign Capital Inflows (000 CAD):
1870-1913 Current Account Balance, Green and Urquhart (1987), Table 3.

Domestic Savings (000 CAD):
1870-1913 Residual (Gross Fixed Capital Formation-Foreign Capital Inflows), Green and Urquhart (1987), Table 3.

US Gross Private Saving Rate:
1870-1909 USHS, derived from sources for Figure Ce-E.
1910-1913 Interpolation from McLean (2007), Figure 1.

UK Gross Private Saving Rate:
1870-1913 Edelstein (1982), Table 8.6.

US Real Wage Index:
1870-1913 US Unskilled Nominal Wage Index, David and Solar (1977), Table B1 ÷ US CPI, David and Solar Base, USHS, Series Cc2.

UK Real Wage Index:
1870-1913 UK Real Wage Index, Not Allowing for Unemployment, Mitchell and Deane (1962), Pg. 343.

US Immigration (000s):
1870-1913 USHS, Series Ad1.

US Total Population (000s):
1870-1913 USHS, Series Aa7.

UK Emigration (000s):
1870-1913 Outbound Passengers from British Ports, Mitchell and Deane (1962), Pg. 49.

UK Total Population (000s):
1870-1913 Mitchell and Deane (1962), Pg. 10.

US Interest Rate:
1870-1913 Long Term Railway Bond Yields, USHS, Series Cj1195.

UK Interest Rate:
1870-1913 Open Market Discount Rate, NBER Macro-History Data Set, Series M13016.

UK GDP (M£):
1870-1913 Feinstein (1972), Table 1.

UK Net Foreign Investment (M£):

1870-1913 Feinstein (1972), Table 15.

Trade Stats

Gross Exports, Pig Iron (000 CAD):
1870-1913 Donald (1915), Table G1.

Gross Imports, Pig Iron (000 CAD):
1867-1880 Trade and Navigation Reports, Canada Sessional Papers.
1880-1913 Donald (1915), Table G3.

Dutiable Imports, Pig Iron, UK and US (Tons):
1868-1913 Trade and Navigation Reports, Canada Sessional Papers.
1868 Index using Pig Iron, Copper, Lead (Dominion).
1869-1875 Index using Pig, Scrap, Galvanized, Booms, Billets, Slabs (ON, NS, NB).
1875-1879 Pig Iron (Cwt).
1880 Linear Interpolation.
1881-1883 Pig Iron + Pig Iron from Charcoal.
1884-1893 Pig Iron, Kentledge, Cast Scrap.
1894-1913 Pig Iron + Pig Iron from Charcoal .

Output Prices

Price, Imported Pig Iron, Toronto (CAD/Net Ton):
1868-1889 Taylor and Mitchell (1931), Pg. 79, Annual Average.

Price, Summerlee No. 2 Pig Iron, Montreal (CAD/Net Ton):
1890-1913 Department of Labour (1914), Pg. 165 and 203, Annual Average.

Price, Cleveland No. 3 Pig Iron, UK (Sterling/Net Ton):
1867-1913 Mitchell and Deane (1962), Pg. 493.

Price, No. 1 Foundry Pig Iron, Philadelphia (USD/Ton):
1867-1913 USStatAb (1900), Pg. 429, (1914), Pg. 676.

CAD-USD Official Exchange Rate:
1867-1913 USHS, Series EE618 (derived from USD-Sterling).

CAD-Sterling Official Exchange Rate:
1867-1913 USHS, Series EE618 (derived from USD-Sterling, post-1880 = 4.835:1).

UK-Hamilton Transport Costs: Ocean

Ocean Freight Rates, Pig Iron, Westbound, Liverpool-Montreal (CAD/Net Ton):

1868-1871	Index using UK-New York City freight rates, reported by Bell (1884), Pg. 304-7.
1872-1873	Angier (1920), and Fairplay, (1872) February 10 and July 20, (1873) January 25, Feb. 22, March 22.
1874	Index using UK-New York City freight rates reported in Iron Age, annual averages using the earliest available quotation for each month - generally the first Monday.
1875-1878	Iron Age (1875) March 25, September 2, October 14, (1876) July 20, December 14, (1877) March 8, August 2, August 16, (1878), May 9.
1879-1881	Canada, House of Commons (1882), Debates, Pg. 1212.
1884-1903	British Board of Trade (1905), Report: British Trade Representative in Canada, Parliamentary Papers, CD. 2337, LXXXIV, Pg. 262.
1904-1905, 1908-1909, 1911-1912	Index using Outbound Freight Rates, UK-Montreal, British Dominions Royal Commission (1914), Report, Parliamentary Papers, CD. 7173, Pg. 109.
1906	British Board of Trade (1908), Report: British Trade Representative in Canada, Parliamentary Papers, CD. 3868, Pg. 42.
1907, 1910, 1913	British Board of Trade (1913), Report: British Trade Representative in Canada, Parliamentary Papers, CD. 6870, Pg. 26.

UK Rail and Port Costs, Pig Iron (CAD/Net Ton):

1880	Rail cost to UK port + loading charge, Iron Age (1880), July 5, Pg. 20.
1868-1913	Index 1880 value using UK rail revenue/ton-mile.

UK Rail Revenue/Ton-Mile (CAD/Ton/Mile):

1871, 1880, 1890, 1900, 1911	Cain (1980), Table 5.
1868-1913	Linear interpolation.

UK Insurance on Westbound Freight, Pig Iron (% UK Price):

1868, 1889	Iron Age (1878) May 9, (1888) August 23, (1889) July 4.
1868-1913	Interpolation using exponential decay from 10% in 1868 to 3% in 1897.

Montreal Port Charges, Pig Iron (CAD/Net Ton):

1880	Wharfage, Montreal Dock, Montreal Times (1880) Pg. 1201, (1881) Pg. 1178, and Public Archives of Nova Scotia (1907), MG3, Volume 1877, Number 44, December 27.
1868-1913	1880 % x Freight Cost to Montreal Dock.

Montreal Brokerage Fees, Pig Iron (CAD/Net Ton):

1884	Iron Age (1884), July 31, Pg. 25.
1868-1913	1884 % x Freight Cost to Montreal Dock.

Total Westbound Ocean Transport Cost, Pig Iron (CAD/Net Ton):

1868-1913 Liverpool UK - Montreal, UK Rail and Port Cost + Ocean Freight Rate + Insurance + Montreal Post Charges + Montreal Brokerage.

UK-Hamilton Transport Costs: Rail

Pennsylvania Rail Revenue/Ton-Mile (CAD/Ton/Mile):

1868-1913 Revenue from freight/ton-mile from Pennsylvania Railroad System, Poor's Manual of Railroads.

Grand Trunk Rail Revenue/Ton-Mile (CAD/Ton/Mile):

1868-1872	Index using PA revenue/ton-mile.
1872-1875	NAC, RB 30, Volume 10394, "Grand Trunk Railway Statistics".
1876-1878	NAC, RG 2, Series 3, Volume 46, Pg. 91, "Transcript of Hearings before the Royal Commission on Railways", Montreal, December 9, 1887.
1879-1895	NAC, RB 30, Volume 10394, "Grand Trunk Railway Statistics".
1896-1897	The Grand Trunk Railway System (1901), Canadian National Railway Archives, Montreal.
1897, 1900	Cruikshank (1987), Table 2.
1898-1899, 1901-1913	Index using CPR revenue/ton-mile.

CPR Rail Revenue/Ton-Mile (CAD/Ton/Mile):

1885-1913 HS1, Series S146.

Railway Insurance and Miscellaneous Costs, Pig Iron (% Railway Transport Cost):

1887 Assumed 10%.

1868-1913 Index using UK insurance on westbound freight.

Montreal - Hamilton, Railway Transport Cost, Pig Iron (CAD/Net Ton):

1887 Insurance + full car load rate, NAC, RG 19, Volume 2720-21, File 1, Montreal Rolling Mills, May 28, 1887, and NAC, RG 19, Volume 3727a, File 27, March 22, 1886.

1868-1913 Index using GTR revenue/ton-mile.

Pittsburgh-Hamilton Transport Costs

Pittsburgh - Buffalo, Railway Transport Cost, Pig Iron (CAD/Net Ton):

1889 Insurance + $/gross ton, Iron Age (1889), November 9, Pg. 745.

1868-1913 Index using PA revenue/ton-mile.

Buffalo - Hamilton, Railway Transport Cost, Pig Iron (CAD/Net Ton):

1888 Insurance + $/gross ton, Interstate Commerce Commission, Report, Volume 3 (1888), Pg. 496-504, and NAC, RG 2, Series 3, Volume 46, Pg. 54.

1868-1913 Index using GTR revenue/ton-mile.

Input Transport Costs: Iron Ore

Railway Transport Costs, Iron Ore Mine - Upper Lake Port (CAD/Ton):

1867-1913 Insurance + Marquette Mine - Marquette MI, includes dock handling charges, Lake Carriers' Association (1923), The Iron Ores of Lake Superior, Pg. 70.

Great Lakes Insurance (% US Iron Ore Price):

1867-1913 UK ocean freight insurance x (distance Marquette - Buffalo (751 nm) / distance Liverpool - Montreal (2812 nm)).

Great Lake Freight Rates, Iron Ore (CAD/Ton):

1867-1913 Insurance + Marquette MI - Buffalo NY, includes unloading charges, Lake Carriers' Association (1923), The Iron Ores of Lake Superior, Pg. 77-78.

Total Transport Costs, Iron Ore Mine - Hamilton (CAD/Ton Iron):

1870-1913 (Rail costs, mine - upper lake port + Great Lake freight charges, upper lake port - Buffalo + pig iron rail costs, Buffalo - Hamilton) x (average ton iron ore/ton pig iron, US Census of Manufacturing, Blast Furnaces, Materials Used).

Input Transport Costs: Coke

Railway Transport Costs, Connelsville PA Coke Ovens - Pittsburgh (CAD/Ton):

1887 Insurance + $/gross ton, American Iron and Steel Association (1913), Pg. 100.

1870-1913 Index using PA revenue/ton-mile.

Total Transport Costs, Connelsville PA Coke Ovens - Hamilton (CAD/Ton Iron):

1870-1913 (Rail costs, furnace - Pittsburgh + pig iron rail costs, Pittsburgh - Hamilton) x (average ton coke/ton pig iron, US Census of Manufacturing, Blast Furnaces, Materials Used).

Input Prices: Iron Ore

Price, Marquette Iron Ore, Bessemer (CAD/Ton):

1867-1910 At lower Lake ports, Lake Carriers' Association (1911), The Iron Ores of Lake Superior, Pg. 42.

Price, Marquette Iron Ore, Non-Bessemer (CAD/Ton):
1867-1910 At lower Lake ports, Lake Carriers' Association (1911), The Iron Ores of Lake Superior, Pg. 42.

Input Transport Costs: Coke

Price, Bituminous Coal at Baltimore (CAD/Short Ton):
1867-1913 USStatAb (1920), Table 305.

Price, Connelsville Coke, FOB at Ovens (CAD/Short Ton):
1868-1890 Index using (Bituminous Coal at Baltimore - Rail transport costs, Connelsville - Pittsburgh).
1890-1913 NBER Macro Dataset, Series M04138.

Trade Policy

Bounty, Pig Iron (CAD/Net Ton):
1870-1913 Domestic ore, usual process, Donald (1915), Table D.

Tariff, Pig Iron (CAD/Net Ton):
1870-1906 Donald (1915), Table F.
1907-1913 "Preferential Tariff" on UK imports, "General Tariff" on US imports.

Tariff, Coke (CAD/Ton):
1870-1913 Donald (1915), Table F.

US Tariff, Pig Iron (USD/Gross Ton):
1870-1913 Naknoi (2010), Figure 2.

Effective Protection

Effective Transport Protection, Pig Iron (CAD/Net Ton Pig Iron):
1870-1913 Weighted average transport cost (UK-Montreal + Montreal-Hamilton) and (Pittsburgh-Buffalo + Buffalo-Hamilton), using share UK and US dutiable imports as weights - (transport cost ore + coke / ton pig iron).

Effective Tariff Protection, Pig Iron (CAD/Net Ton Pig Iron):
1870-1906 Bounty on pig iron + tariff on pig iron - (tariff on coke x average ton coke/ton pig iron, US Census of Manufacturing, Blast Furnaces, Materials Used).
1907-1913 Bounty on pig iron + weighted average tariff on pig iron (using share UK and US dutiable imports as weights) - (tariff on coke x average ton

coke/ton pig iron, US Census of Manufacturing, Blast Furnaces, Materials Used).

Effective Protection, Pig Iron (CAD/Net Ton Pig Iron):

1870-1913 Effective tariff protection + effective transport protection.

Table 1: Transport Costs and Tariff Protection (CAD / Net Ton Pig Iron)

Year	Transport Costs				Tariffs+Bounties		
	Pig Iron		Coke	Ore	Pig Iron		Coke
	Liverpool-Hamilton	Pittsburgh-Hamilton	Connelsville-Hamilton	Marquette-Hamilton	UK	US	US
1870	10.70	3.48	7.43	9.32	0.00	0.00	0.00
1871	10.48	3.48	7.62	10.41	0.00	0.00	0.00
1872	10.87	3.57	7.53	8.67	0.00	0.00	0.00
1873	11.62	3.58	6.60	10.30	0.00	0.00	0.00
1874	9.38	3.07	5.47	7.81	0.00	0.00	0.00
1875	8.24	2.56	4.70	6.94	0.00	0.00	0.00
1876	5.75	2.19	5.17	5.35	0.00	0.00	0.00
1877	6.48	2.34	4.91	5.05	0.00	0.00	0.00
1878	7.53	2.20	4.35	5.53	0.00	0.00	0.00
1879	5.83	1.95	4.71	7.21	2.00	2.00	0.50
1880	8.36	2.09	4.29	6.66	2.00	2.00	0.50
1881	5.91	1.92	4.44	5.45	2.00	2.00	0.50
1882	7.29	2.01	4.52	5.14	2.00	2.00	0.50
1883	6.77	2.08	4.08	4.50	2.00	2.00	0.50
1884	7.17	1.88	3.51	4.10	3.50	3.50	0.50
1885	6.23	1.64	3.85	4.98	3.50	3.50	0.50
1886	6.60	1.79	3.58	5.69	3.50	3.50	0.50
1887	6.17	1.74	3.57	4.56	5.50	5.50	0.50
1888	6.78	1.70	3.57	4.42	5.50	5.50	0.50
1889	6.48	1.70	3.40	4.39	5.50	5.50	0.50
1890	6.39	1.62	3.41	3.98	5.00	5.00	0.50
1891	4.90	1.62	3.17	4.12	5.00	5.00	0.50
1892	4.72	1.50	3.11	3.82	5.00	5.00	0.50
1893	4.63	1.48	2.95	3.31	6.00	6.00	0.50
1894	4.65	1.43	2.85	3.20	6.00	6.00	0.00
1895	4.60	1.39	2.87	3.54	6.00	6.00	0.00
1896	4.58	1.38	2.76	3.01	4.50	4.50	0.00
1897	4.61	1.35	2.63	2.88	4.50	4.50	0.00
1898	4.55	1.29	2.90	2.71	5.50	5.50	0.00
1899	4.56	1.37	3.14	3.66	5.50	5.50	0.00
1900	4.73	1.47	3.09	2.88	5.50	5.50	0.00
1901	4.48	1.44	3.21	2.88	5.50	5.50	0.00
1902	4.59	1.47	3.22	2.95	5.50	5.50	0.00
1903	5.09	1.47	3.13	2.71	5.20	5.20	0.00
1904	4.80	1.45	3.15	3.01	5.20	5.20	0.00
1905	5.21	1.46	3.11	2.97	4.75	4.75	0.00
1906	4.65	1.43	3.13	3.03	4.15	4.15	0.00
1907	5.14	1.46	3.13	2.80	3.60	4.60	0.00
1908	4.87	1.44	3.09	2.81	3.60	4.60	0.00
1909	5.07	1.43	3.06	2.92	3.20	4.20	0.00
1910	5.40	1.43	3.10	2.80	2.40	3.40	0.00
1911	6.12	1.47	3.04	2.51	1.50	2.50	0.00
1912	7.04	1.42	3.04	2.52	1.50	2.50	0.00
1913	5.73	1.43	7.43	9.32	1.50	2.50	0.00

Table 2: Canadian Pig Iron Production and Employment (Net Tons and Person-Days)

	Production		Employment
Year	13 Furnace Total	Aggregate Industry	13 Furnace Total
1870	6776	9397	47513.35
1871	7980	9207	58244.04
1872	6393.333	8299	49326.88
1873	6542.667	9106	48088.62
1874	5040	5287	33257.04
1875	6441.12	7504	43604.93
1876	3808	4704	29562.5
1877	5600	15602	40985.29
1878	17024	16957	26027.78
1879	15904	15859	14552.63
1880	25240	24640	39275.89
1881	20944	20843	44983.33
1882	27664	27742	63178.53
1883	36736	36042	53986.54
1884	30240	29770	42828.58
1885	25872	25323	43823.29
1886	24892	32222	39825.11
1887	24827	29941	48985.22
1888	21799	27859	36327.07
1889	25922	39047	43442.36
1890	21772	38432	29563.2
1891	23891	43578	28337.86
1892	42442	65156	64042.49
1893	55953	81687	83947.42
1894	49967	78734	75525.34
1895	42455	61494	61548.95
1896	53527	85188	70856.62
1897	58007	78615	88158.56
1898	77017	101139	122321.1
1899	102942.9	127582	123863.6
1900	98635.4	122980	122726.5
1901	275717	316325	281141.1
1902	357901	555967	280128.4
1903	297884	494562	275516.3
1904	303454	463286	327771.9
1905	521471	906062	462549.4
1906	598411	1177681	455610
1907	651960	1337194	584250
1908	630835	1219552	389490
1909	757222	1505864	475487.5
1910	800796.8	1604397	456582
1911	917533	1779029	582981.5
1912	1014587	1940464	420299.1
1913	1118224	2264905	513889

Note: Furnaces include: St. Maurice, Drummondville, St. Francis, L'Islet and Radnor in QC; Sydney, Pictou and Londonderry in NS; and Deseronto, Hamilton, Algoma, Port Arthur/Port Colborne and Midland in Ontario.