

Empirical Evaluation of Long Waves of Capitalist Development^{*}

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The Great Recession was followed by tepid recovery which has stretched into more than a decade of constricted growth. Long wave theory, which aims to elucidate patterns of capitalist development for timeframes beyond the business cycle, is relevant for contextualizing the ongoing extended period of constricted growth. Empirical data for the UK and US, typically spanning the 1800s to the present, are evaluated to ascertain long waves of capitalist development are demonstrable. Several indicators are assessed, including manufacturing and industrial production, GDP, investment, capital formation, exports and imports, unemployment rates, and profitability. Results indicate long waves date from the crisis of free competition capitalism and are most pronounced for periods throughout 1914–1991. Widespread capitalist restoration distinguishes 1992–2007 as an intervening period of qualified capitalist growth, during which China’s economy grew dramatically, post-Soviet states struggled, US growth moderately revived, and EU and OECD growth continued to decline. Impacts of the coinciding information and communications technology revolution are also appraised, focusing on the US. Selected indicators are assessed for capitalist-restoration economies and established capitalist aggregate economies in recent long waves. Results do not support the ‘long cycle’ interpretation of long wave theory, which claims extended periods of economic growth occur cyclically owing to endogenous factors. Instead the interpretation promoted by Ernest Mandel is borne out, which asserts transitions from long waves of robust growth to constricted growth are chiefly the result of endogenous factors while upturns depend upon adequate exogenous socio-political system shocks and technological revolutions. Prospects for future technological revolutions and system shocks are briefly considered.

Keywords: Long Wave Theory; Capitalism; Marxian Economics; Crisis; Ernest Mandel

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^{*} Geolocation information: UK, US, China, Russia, Europe.

The Great Recession inaugurated a period of constricted growth which, more than a decade later, continues to predominate. The extended downturn invites comparison with previous periods of capitalism characterized by prolonged lackluster growth and raises the question: is there a framework for understanding medium-term capitalist development which puts these periods into perspective?¹ An adequate theory of medium-term development must also account for extended periods of robust growth and explain transitions from constricted growth to robust growth, and vice versa. One candidate for such a framework, long wave theory, is evaluated in this article.

Long wave theory contends there is a dynamic to capitalist growth extending beyond the business cycle, with individual long waves of robust or constricted growth spanning approximately twenty to thirty years, or potentially longer.² The 'long cycle' interpretation asserts medium-term periods of robust growth and constricted growth alternate with cyclic regularity as the outcome of economic factors (such as the tendency for the rate of profit to fall until lengthy recessions re-establish a basis for expanding rates of profit and accumulation, oriented towards technological paradigm shifts). Alternatively, an interpretation advocated principally by Ernest Mandel asserts transitions from long waves of robust growth to constricted growth are fundamentally due to endogenous economic factors whereas technological revolution and exogenous system shocks (such as bourgeois revolutions, imperialist conquests, and wars) are necessary to jumpstart each long wave of robust growth.

To assess the relevance of long wave theory and its competing interpretations comprehensive historical data are presented for the UK and US as case studies and selected data are presented for a broader array of economies in the most recent long waves. The last long wave of robust growth, driven by capitalist restoration and, to a lesser extent, the information and communications technology (ICT) revolution, was fairly weak by historical standards and failed to rejuvenate the entire global capitalist economy. In contrast, the current long wave of constricted growth grips all major capitalist nations, although China maintains momentum. Prospects for the current long wave are discussed based on the history of former long waves of constricted growth.

Methodology: Selecting Economies, Timeframes, Indicators, and Statistics

Long waves are specific to the development of the capitalist mode of production and are anticipated to be most evident for the capitalist system as a whole or the largest economies, which are most developed and integrated into the world market. The uneven development of capitalism in the nineteenth century and scarcity of

¹ Medium-term refers here to timeframes on the order of decades, in distinction to years (short-term) and centuries (long-term).

² A different approach, not adopted in this article, classifies a period of robust growth and the subsequent constricted growth period as the upswing and downswing of a single long wave, lasting approximately 40–60 years.

comprehensive data hinder empirically evaluating long waves for the capitalist world economy as a whole during the era of free competition. Instead the UK and US, the first and second capitalist superpowers to emerge, serve as case studies through the present. The performance of aggregate capitalist economies and capitalist-restoration economies are evaluated to supplement the analysis of recent long waves. Differences in the start and end of long waves may vary from nation to nation depending on the timing of integration into the world market and historical circumstances. For instance, the US recovered from the Great Depression at the start of World War II while Western Europe generally recovered after the conclusion.

The timeframes are adapted from Mandel and broadly delineate historical periods in the development of the world market, diffusion and saturation of industrial and technological revolutions, and successive phases of capitalism.³ Long waves of robust growth conceivably date from the French Revolution (the rise of free competition capitalism, machinery driven by water power and handicraft-produced steam engines during the Industrial Revolution), the bourgeois revolutions of 1848 (technological revolution of industrially-produced steam engines and machine-produced machinery), the rise of classical imperialism (technological revolution of machinery powered by electricity and combustion engines), World War II (the rise of late capitalism and technological revolution in electronics and semi-automation), and the fall of the USSR (the ICT revolution). Long waves of constricted growth feasibly date from historic crises: the Panic of 1825, the Long Depression, World War I, the 1974–1975 recession (the rise of neoliberalism), and the Great Recession.

The principle modifications to Mandel's outline are designating 1973 as the end of the post-war boom rather than 1968 and updating the schema to include 1992–2007 and 2008–present as additional long waves. Economic indicators strongly point to the post-war boom ending years after 1968, despite an international monetary crisis that year and the US recession in 1969–1970. The dissolution of the Soviet bloc began in 1989 but capitalist restoration reached new dimensions with the fall of the USSR and the following decisive stage of restoration in China. This considerable expansion of the international market differentiates 1992–2007 from the long wave of constricted growth during 1974–1991, though the expansion was not global. Capitalist restoration was all but complete at the start of the Great Recession.

A long wave is positively identified by a marked reversal from the preceding and succeeding timeframes, considering relative and absolute changes of indicator values. Several indicators characterize long waves from a variety of angles. Commodity production is represented by manufacturing and industrial production indices, broader production of commodities and services by GDP, capital accumulation by investment and capital formation, market expansion and integration by exports and imports, and barriers to circulation by the rate of unemployment. The volume and rate of profit are central to determining the tempo of growth and synthesizing the

³ Ernest Mandel, *Late Capitalism* (New York: Verso, 1999), pp. 120–121; Ernest Mandel, *Long Waves of Capitalist Development: A Marxist Interpretation*, 2nd rev. ed. (New York: Verso, 1995), p. 82.

interactions of the basic indicators. Each factor influences the others while retaining a degree of independence. Analysis of additional indicators which express values per unit time, input, or person (such as productivity, capital-output ratio, GDP per capita, and myriad others) is largely beyond the scope of this work.

Each indicator has its limitations. Manufacturing and industrial production indices do not encompass all commodity-producing labor. GDP does not distinguish between productive and unproductive activity. Investment in terms of fixed capital formation leaves out circulating capital. Gross capital formation is only one side of net capital formation. Exports and imports may be affected by political circumstances apart from economic trends. The unemployment rate does not address underemployment or multiple jobholding. These critiques are by no means exhaustive.

Differences between bourgeois and Marxist conceptions (e.g. profit and capital) hinder evaluating Marxist economic factors with perfect fidelity using available statistics. The principal factors include the organic composition of capital, rate of surplus value, rate of profit, rate of capital accumulation, turnover-time, allocation of capital (fixed and circulating, constant and variable), and exchange relations between means of production and means of consumption. The rate of surplus value is approximated for US manufacturing and annual sales to end-of-quarter inventories ratios indirectly track turnover-time of commodity capital.

Aside from the unemployment rate, continuously compounded annual rates of growth are calculated for the remaining indicators to depict the cumulative nature of capitalist expansion and avoid discrepancies arising from averaging annual percentage change of cyclic series.⁴ Moving averages are generated for particularly volatile series. A significant limitation to the data summary in the tables is variations within each timeframe are not indicated.

Many data series have gaps in coverage, particularly affected by the world wars, and discontinue in distant timeframes. When practical, results are reported if data are incomplete but cover a significant portion of a given period. The indicators are frequently adjusted from one source to the next or over time within the same source, considering the relatively long timeframes evaluated. For the purposes of assessing medium-term economic development, these unavoidable modifications are relatively minor and mitigated by the diversity of multiple indicators.

Empirical Results: The Capitalist Superpowers

Results for the UK are presented in [Table 1](#). Three of five indicators improved in 1826–1847 over 1789–1825, but overall these periods performed comparably.⁵ Five of six

⁴ For instance, if an index changes from 100 to 90 in the first year and back to 100 in the second year the annual percentage changes are –10.0 per cent and 11.1 per cent respectively, averaging 0.6 per cent. The average continuously compounded rate of growth is 0.0 per cent. Calculating continuously compounded growth rates is also useful for series with gaps in coverage since only values for starting and ending years are required.

⁵ The alternatively proposed periods 1789–1815 and 1816–1847 also perform comparably. Empirical results are omitted for these periods for succinctness.

Table 1 Empirical Profile of Long Waves in the UK Economy

Indicator ^a	1789– 1825 (37 years)	1826– 1847 (22 years)	1848– 1873 (26 years)	1874– 1893 (20 years)	1894– 1913 (20 years)	1914– 1945 (32 years)	1946– 1973 (28 years)	1974– 1991 (18 years)	1992– 2007 (16 years)	2008– present ^b (> 12 years)
Manufacturing index			2.9 ^c	1.4	2.6	1.9 ^d	3.5 ^e	0.0	0.8	–0.6
Industrial production and construction index	2.4	2.8	3.2	1.4	2.6	1.8 ^d	3.2 ^e	1.0	0.9	–0.3
Real GDP	1.9	1.8	2.4	1.4	2.1	1.3	3.0	1.9	2.7	0.9
Real investment (i.e. real gross fixed capital formation) (five-year moving average)		5.2 ^f	2.4	1.1	1.8	0.5	9.5	2.2	1.5	0.2
Real exports index	3.2	4.2	5.1	1.8	3.3	–3.2	6.8	3.5	5.4	1.6
Real imports index	2.9	3.4	4.2	2.5	2.9	0.1	4.2	3.4	6.0	1.6
Unemployment rate	6.0	7.5	4.8	5.2	5.2	6.2	2.5	8.1	6.7	6.8

Sources: 'A14. Real output GDP(O), by Industry: o/w manufacturing; Total production and construction', 'A1. Headline Annual Series I086–2016: Index of real UK GDP at market prices cost-based on changing political boundaries; Real Investment; Export volumes; Import volumes; and Unemployment rate', 'A12. Gross fixed capital formation', A millennium of macroeconomic data, Bank of England.

^aValues depict continuously compounded annual rate of growth (per cent) for all indicators except the unemployment rate, reported as the average (per cent).
^bData are presented through 2016.

^c1856–1873.

^d1914–1946.

^e1947–1973.

^f1835–1847.

indicators improved in 1848–1873 over 1826–1847 but typically by a small margin. The downturn of 1874–1893 marks the first distinct long wave of constricted growth, with overall growth rates dropping approximately a third to half the level of the adjacent timeframes. The recovery of 1894–1913, ushering in imperialist monopoly capitalism, did not quite restore growth rates to the levels of free competition capitalism in its ascendant phase.

The 1914–1945 and 1946–1973 timeframes strongly contrast, with the disruption of World War II having a disparate effect on some indicators. Unemployment averaged 0.9 per cent in 1940–1945 compared to 7.5 per cent in 1914–1939. The drastic drop in investment and export activity during the war creates a low basis for comparison, which partly explains the particularly high values of post-war rates of growth, which are nevertheless 5.5 per cent and 4.1 per cent respectively during 1940–1973. The transition to a long wave of constricted growth by 1974 is clear-cut. Five of seven indicators improved in 1992–2007 over 1974–1991 but recovery was far from complete as indicated by stagnating industry and investment. The indicators are constricted from the Great Recession through the present.

Results for the US are presented in [Table 2](#) and [Figure 1](#). Historical factors explain the delayed emergence of long waves. Capitalist production relations were dominant throughout all territories only following the Civil War. Expansion into massive territorial acquisitions continued for decades to follow, aided by sustained immigration. Growth was generally strong for each period up to World War I. Five of eight indicators improved in 1895–1913 over 1874–1894 but differences were muted.

The downturn of 1914–1939 and upturn of 1940–1973 are both well-defined by all indicators. With the exception of exports, all indicators portray the downturn in 1974–1991. All indicators then improved in 1992–2007, although GDP and export growth rates did not change appreciably. Growth in imports and corporate profit increased most dramatically. Notably, the proportion of corporate profit originating outside the US increased markedly during periods of constricted growth, averaging 5.0 per cent, 13.7 per cent, 18.5 per cent, and 29.1 per cent of the total during 1940–1973, 1974–1991, 1992–2007, and 2008–2018 respectively.⁶ The period ushered in by the Great Recession depressed all indicators through the present, excepting the rate of profit (though growth in the mass of corporate profit is constricted).⁷

The manufacturing rate of profit trended downward throughout the post-war boom and subsequent long wave of constricted growth. It reversed course in the early 90s and stabilized at a high level in the years following the Great Recession. Alternative estimates for broader sections of the economy suggest the rate of profit stabilized in the mid-80s

⁶ Calculated from National Income and Product Accounts (NIPA), ‘Table 6.16A and 6.16B: Corporate Profits by Industry’, U.S. Bureau of Economic Analysis, 27 July 2018, <http://bea.gov>.

⁷ The developing coronavirus pandemic is widely anticipated to induce a globalized recession which will drag down profitability, along with the rest of the indicators.

Table 2 Empirical Profile of Long Waves in the US Economy

Indicator ^a	1789– 1825 (37 years)	1826– 1847 (22 years)	1848– 1873 (26 years)	1874– 1894 (21 years)	1895– 1913 (19 years)	1914– 1939 (26 years)	1940– 1973 (34 years)	1974– 1991 (18 years)	1992– 2007 (16 years)	2008– present ^b (> 12 years)
Manufacturing index				4.1	5.1	1.9 ^c	5.3	1.9	3.5	–0.3
Industrial production index	4.4 ^d	6.7	4.8	4.1	5.3	2.2 ^c	5.2	1.7	3.1	0.4
Real GDP	3.6 ^d	3.9	4.2	3.4	4.1	2.2	4.5	2.8	3.2	1.6
Real gross private domestic investment (five-year moving average) ^e				5.6 ^f	2.6	–0.4	5.7	3.3 [1.3]	4.8 [5.1]	1.8 [–0.8]
Real gross fixed capital formation ^g				5.3	2.9	–0.4 ^c	5.3 ^h /4.6 ⁱ	2.4	4.8	1.6
Real exports of goods index				2.3 ^j	4.0	1.4	5.5	5.6	5.8	3.0
Real imports of goods index				3.4 ^j	4.3	1.8	5.7	4.7	8.1	2.4
Unemployment rate				5.2	5.4	10.0	4.9	7.0	5.3	6.7

(Continued)

Table 2 Continued

Indicator ^a	1789– 1825 (37 years)	1826– 1847 (22 years)	1848– 1873 (26 years)	1874– 1894 (21 years)	1895– 1913 (19 years)	1914– 1939 (26 years)	1940– 1973 (34 years)	1974– 1991 (18 years)	1992– 2007 (16 years)	2008– present ^b (> 12 years)
Real corporate business profits before tax (five-year moving average) ^k							5.4	2.0	5.4	1.7

Sources: 'Index of Manufacturing Production for United States' (Series ID: A0107AUSA322NNBR) and 'Industrial Production: Manufacturing (SIC)' (Series ID: IPB00004NQ), Federal Reserve Economic Database (FRED), Federal Reserve Bank of St. Louis; J.H. Davis, 'Technical Data Appendix' to 'An Annual Index of U.S. Industrial Production, 1790–1915', *Quarterly Journal of Economics*, 119:4 (November 2004); 'Industrial Production Index' (Series ID: INDPRI), FRED, Federal Reserve Bank of St. Louis; Table Ca9: GDP—Millennial Edition series: Real', Historical Statistics of the United States: Millennial Edition Online, Cambridge University Press, <https://hsus.cambridge.org>; 'Real Gross Domestic Product' (Series ID: GDPCA), FRED, Federal Reserve Bank of St. Louis; 'A27: Gross private domestic investment', Long Term Economic Growth: 1860–1965, U.S. Census Bureau; 'Real Gross Private Domestic Investment' (Series ID: GPDICA) and 'Real net private domestic investment' (Series ID: A557RXI A020NBEA), FRED, Federal Reserve Bank of St. Louis; 'F 105. Private and public capital formation: Total: Gross', Historical Statistics of the United States, Colonial Times to 1970 (HSUS), U.S. Census Bureau; S. Kuznets and E. Jenks, 'Gross Capital Formation' in *Capital in the American Economy: Its Formation and Financing* (Princeton, Princeton University Press, 1961), p. 492; 'Gross Domestic Product by Expenditure in Constant Prices: Gross Fixed Capital Formation for the United States' (Series ID: NAEXKP04USA661S), FRED, Federal Reserve Bank of St. Louis; 'U 225.U.S. domestic exports: Total: Quantity', HSUS, U.S. Census Bureau; 'Real exports of goods' (Series ID: B253RA3A086NBEA), FRED, Federal Reserve Bank of St. Louis; 'U 237. U.S. general imports: Total: Quantity', HSUS, U.S. Census Bureau; 'Real imports of goods' (Series ID: B255RA3A086NBEA), FRED, Federal Reserve Bank of St. Louis; J.R. Vernon, 'Unemployment Rates in Postbellum America: 1869–1899', *Journal of Macroeconomics*, 16:4 (Fall 1994), p. 710; 'D 9. Unemployed: Percent of—Civilian labor force', HSUS, U.S. Census Bureau; 'Civilian Unemployment Rate' (Series ID: UNRATE), FRED, Federal Reserve Bank of St. Louis; 'Corporate profits with inventory valuation and capital consumption adjustments' (Series ID: A051RC1A027NBEA) and 'Gross domestic product (implicit price deflator)' (Series ID: A191RD3A086NBEA), FRED, Federal Reserve Bank of St. Louis.

^aValues depict continuously compounded annual rate of growth (per cent) for all indicators except the unemployment rate, reported as an average (per cent).

^bData are presented through 2018.

^c1920–1939.

^d1791–1825.

^eValues in brackets denote real net private domestic investment, five-year moving average.

^f1879–1894, in part using disaggregated decade averages.

^gValues generated using disaggregating five-year averages through 1913.

^h1940–1955.

ⁱ1961–1973.

^j1880–1894.

^kLacking chained-dollar series for profit volume in official sources, nominal profit is converted to real profit using the GDP implicit price deflator (selected as the broadest index available). The accuracy of this provisional series decreases with time from the base year of 2012.

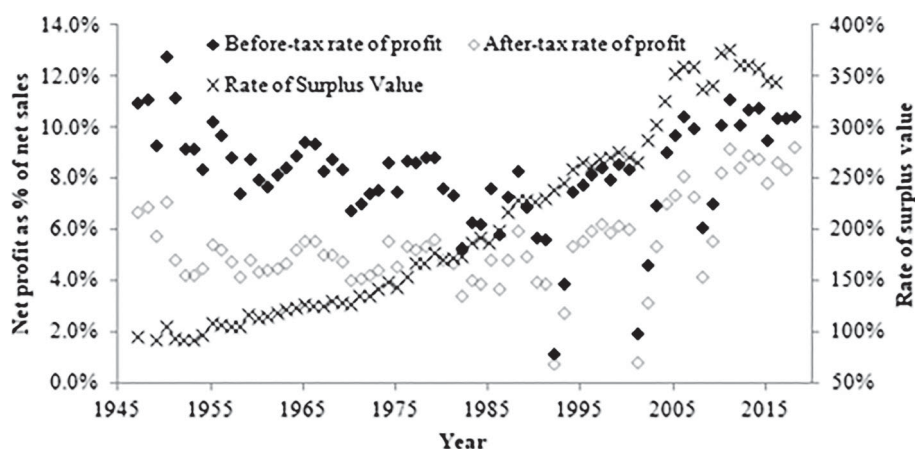


Figure 1 US Corporate Manufacturing Rates of Profit and Surplus Value. *Sources:* Rates of profit: 'P 93. Sales (net)', 'P 94. All manufacturing corporations: Net profits: Before Federal income taxes', and 'P 95. All manufacturing corporations: Net profits: After Federal income taxes', HSUS, U.S. Census Bureau; 'Net Sales, Receipts, and Operating Revenues & Income', 'Income (Loss) Before Income Taxes', and 'Income (Loss) After Income Taxes', Quarterly Financial Report for Manufacturing, Mining, Trade, and Selected Service Industries: All Manufacturing, U.S. Census Bureau, <https://www.census.gov/econ/currentdata>. Rate of surplus value: 'Payroll', 'Wages', 'Value added', and 'Total capital expenditures', Statistical Abstract of the United States: Manufactures and Annual Survey of Manufactures, U.S. Census Bureau, various years. Beginning in 1974 after-tax data include state taxes. Calculation of rate of surplus value is based on Ernest Mandel, *Late Capitalism*, London 1999, p. 174. Variable capital is defined as wages and half of salaries. Surplus value is defined as value added minus variable capital and total capital expenditures (used as a surrogate for depreciation due to lack of available data for the entire series).

through the present.⁸ The gap between the rates of profit before and after taxes has steadily diminished with the onslaught of neoliberalism. The rate of surplus value also increased at a faster pace under neoliberalism. It rose dramatically after 2001 and peaked in 2011. Finally, after increasing for several decades, in recent years it declined for the longest stretch of years on record but remains at a historically high level.

Context of the Contemporary Long Wave: A Brief Survey

Prior to the Great Recession, the recession in 1974–1975 heralded the last extended period of constricted growth which affected capitalism as a whole. The downturn

⁸ G. Duménil and D. Lévy, *The Historical Trends of Technology and Distribution in the U.S. Economy Since 1869* (Paris: CEPREMAP, September 2016), p. 22; G. Duménil and D. Lévy, *The Crisis of the Early 21st Century: Marxian Perspectives* (Paris: CEPREMAP, 2012), p. 19.

universally affected the major capitalist economies between 1974–1975 and 1991. While economic performance improved in the US during 1992–2007, this was offset by deepening stagnation in Western Europe, Japan, and other members of the Organisation for Economic Co-operation and Development (OECD). Results in Table 3 show the stagnation of 1974–1991 continued into 1992–2007 (and intensified thereafter) for the established capitalist economies in aggregate. The declining industrial growth is not simply attributable to a maturing international division of labor whereby capital reorients towards the service sector in the advanced economies.

The fall of the USSR and China's capitalist restoration dramatically expanded the world market, ultimately integrating approximately a quarter of the global population and a fifth of the world's land surface. This differentiates 1992–2007 as a relatively brief interlude of renewed growth, though fraught with crises. The Soviet collapse devolved into a difficult transition to capitalism, with years of economic depression followed by anemic growth. The ex-Soviet satellite states and Baltic states also faced challenges but recovered years earlier than Russia and other post-Soviet states. The Central Europe and Baltic states joined the EU beginning in 2004, in the largest expansion since Austria, Finland, and Sweden joined in 1995.

The 1993 level of industry for Russia was only surpassed in 2006.⁹ All of the weak growth, however, was capitalist growth and the privatization of a contracting economy is still a positive gain for capitalism. The privatization of the state-owned industries of the USSR constitutes one of the largest instances of accumulation by dispossession in capitalism's history. Between 1992 and 1997 the Russian private sector share in gross output rose from 14 per cent to 91 per cent for industry, 33 per cent to 50 per cent in agriculture, and 59 per cent to 92 per cent in retail trade.¹⁰ Economic hardship notwithstanding, Russia's GDP was the ninth largest in 1992, seventh largest in 2007, and sixth largest in 2018, accounting for 2–4 per cent of the world's GDP throughout this period.¹¹ During the same period the other post-Soviet bloc states collectively accounted for approximately 4 per cent of world GDP.

Capitalist restoration in China was more gradual and had a greater impact on the global economy. Market-oriented economic reforms dating from 1978 incrementally reduced the roles of state-owned enterprises and central planning, decollectivized agricultural production, compromised employment security, established special economic zones, recruited foreign direct investment (FDI), and opened stock exchanges. However, as Table 4 shows, the reforms principally shifted industry towards collective-owned enterprises until privatization took on new dimensions during the 90s.¹²

⁹ Federal Reserve Bank of St. Louis, 'Production of Total Industry in Russian Federation' (Series ID: RUSPROINDAISMEL), Federal Reserve Economic Data, <https://fred.stlouisfed.org>.

¹⁰ Vladimir Tikhomirov, *The Political Economy of Post-Soviet Russia* (New York: St. Martin's Press, 2000), p. 250.

¹¹ Calculated from World Bank, 'GDP, PPP (Current International \$)', <http://data.worldbank.org>.

¹² Note throughout this section that the reliability of official Chinese government economic data is open to doubt. See M. Owyang and H. Shell, 'China's Economic Data: An Accurate Reflection, or Just Smoke and Mirrors?', *The Regional Economist*, 25:2 (Second Quarter 2017); I. Koch-Weser, 'The Reliability of China's

Table 3 Recent Long Waves: Established Capitalist Economies and Capitalist-Restoration Economies^a

	OECD			European Economic Community/ European Union				Central Europe and the Baltics			Russia			China		
	IP	RGDP	UR	IP	RGDP	UR	IP ^b	RGDP	UR	IP	RGDP	UR	IP	RGDP	UR	UR
1974–1991	2.8 ^c	2.9	6.4	1.9 ^d	2.4	7.9										
1992–2007	2.5	2.6	6.9	1.6	2.3	9.5	3.5 ^e	3.6	11.1	0.8 ^f	0.7	8.8	12.1	10.1	3.6	
2008–Present ^g	0.7	1.3	7.1	0.2	0.9	9.0	1.8 ^h	2.3	8.0	1.3	1.2	6.0	8.0 ⁱ	7.8	4.5	

Sources: IP: ‘Industrial Production’, OECD Data, OECD; ‘Industry (including construction), value added (constant 2010 US\$): Central Europe and the Baltics’, World Bank Open Data, World Bank; ‘3–5. Indices of Gross Domestic Product: Industry’, *China Statistical Yearbook 2018*, <http://www.stats.gov.cn/tjsj/ndsj/2018/indexeh.htm>. RGDP: ‘GDP (constant 2010 US\$)’, World Bank Open Data, World Bank. UR: ‘Table 1.3.: Unemployment in the OECD area’ and ‘Table 2.7.: Unemployment and long-term unemployment’, in *Employment Outlook 1991*, OECD; ‘Unemployment, total (per cent of total labor force) (modeled ILO estimate)’, World Bank Open Data, World Bank. IP: industrial production, RGDP: real gross domestic product, and UR: unemployment rate.

^aValues represent continuously compounded annual rate of growth (per cent), except unemployment rate: average (per cent).

^bIP is in terms of real value added, lacking complete data for volume output.

^c1976–1991.

^d1977–1991.

^e1996–2007.

^f1994–2007.

^gData are presented through 2018.

^h2008–2016.

ⁱ2008–2017.

Table 4 Organization of China's Industry (Per cent of Total)^a

	State-owned enterprises	Collective-owned enterprises	Limited liability corporations	Share-holding enterprises	Private enterprises	Enterprises funded from Hong Kong, Macao, Taiwan	Foreign-funded enterprises
1965	90.1	9.9					
1970	87.6	12.4					
1975	81.1	18.9					
1980	76.0	23.5					
1985	64.9	32.1					
1990	54.6	35.6					
1995	34.0	36.6				11.7 ^b	
2000	23.5	13.9	12.8	11.8	6.1	12.3	15.0
2005 ^c	10.1	3.5	21.3	10.5	21.7	10.8	20.2
2010	8.2	1.5	22.4	9.1	30.5	9.4	17.8
2015	4.1	0.6	29.0	9.0	34.8	8.7	13.4

Source: National Bureau of Statistics of China, *China Statistical Yearbook*, various years, <http://www.stats.gov.cn/english>.

^aCalculations are based on gross industrial output for except 2015, based on revenue from principal business due to changes in reporting. Values do not total 100 per cent in all cases due to omitting assorted transient and/or secondary categories.

^bValue includes enterprises funded from Hong Kong, Macao, and Taiwan as well as foreign-funded enterprises.

^cDue to lack of data availability for 2005 values represent average for 2004 and 2006.

By 2000 the majority of industry was operating under capitalist forms of ownership. Privatization and integration into the global market continued full tilt after joining the World Trade Organization (WTO) in 2001, though China remains state-capitalist with the government owning about 30 per cent of wealth and 60 per cent of corporate equity in 2015 (the share of public ownership leveled off since the Great Recession).¹³

Industrial production in 2007 was nearly seven times the level in 1991 and has more than doubled since then.¹⁴ China surpassed the US as the world's largest exporter in 2009, manufacturer in 2010, and economy in 2013. It became the second largest importer in 2010. China's GDP was the fourth largest in 1992, second largest in 2007, and the largest in 2018, accounting for approximately 5 per cent, 12 per cent, and 19 per cent of the world's GDP respectively.¹⁵ China's rise almost entirely accounts for the OECD's declining share in world GDP from 61 per cent to 53 per cent and 44 per cent over the same years.

China's growth was predominantly driven by exports and FDI and these continue to play a significant role.¹⁶ After the Great Recession, however, domestic capital accumulation in the context of global stagnation has countervailed these trends. Exports fell from 36 per cent of GDP in 2006 to 20 per cent in 2018.¹⁷ The share of foreign-funded enterprises in total trade decreased from 59 per cent in 2006 to 43 per cent in 2018.¹⁸ 'Non-processing' exports, in which the component parts were not imported, rose from around 45 per cent in 2000 to over 65 per cent in 2016.¹⁹ The stock of inward FDI (excluding Hong Kong and Macao) was 569 per cent the level of outward FDI in 1995 and 84 per cent in 2018 (the respective values for Hong Kong are 289 per cent and 107 per cent).²⁰ Table 4 shows the share of foreign-funded enterprises in industry declined in the last decade.

China's growth remains strong in contrast to the rest of the leading economies but is winding down. Annual GDP growth is projected to fall to 3 per cent by 2030 and below 2 per cent by 2040.²¹ Industrial profitability (measured as total profit as a

Economic Data: An Analysis of National Output,' U.S.-China Economic and Security Review Commission, 28 January 2013. https://www.stlouisfed.org/~media/publications/regional-economist/2017/second_quarter_2017/re_q2_2017.pdf & <https://www.uscc.gov/sites/default/files/Research/TheReliabilityofChina'sEconomicData.pdf>.

¹³ T. Piketty, L. Yang and G. Zucman, 'Capital Accumulation, Private Property and Rising Inequality in China, 1978–2015', Working Paper 23368, NBER, June 2017, pp. 33–34.

¹⁴ Calculated from National Bureau of Statistics of China, *China Statistical Yearbook 2018*, Table 3–5, <http://www.stats.gov.cn/tjsj/ndsj/2018/indexeh.htm>.

¹⁵ Calculated from World Bank, 'GDP, PPP (Current International \$)', <http://data.worldbank.org>.

¹⁶ M. Hart-Landsberg and P. Burkett, 'China, Capitalist Accumulation, and Labor', *Monthly Review*, 59:1 (May 2007).

¹⁷ World Bank, 'Export of Goods and Services (% of GDP)', <http://data.worldbank.org>.

¹⁸ Calculated from National Bureau of Statistics of China, *National Data*, <http://data.stats.gov.cn/english/>.

¹⁹ S. Ahmed, 'China's Footprints on the Global Economy', IFDP Notes, Board of Governors of the Federal Reserve System, September 2017.

²⁰ Calculated from: United Nations Conference on Trade and Development, 'Country Fact Sheet: China,' 'Country Fact Sheet: Hong Kong, China', in *World Investment Report, 2019* (Geneva: United Nations, 2019).

²¹ W.M. Morrison, *China's Economic Rise: History, Trends, Challenges, and Implication for the United States* (Washington, DC: Congressional Research Service, 25 June 2019), p. 9, <https://crsreports.congress.gov>.

percentage of total assets) rose from 1.3 per cent in 1998 to 9.1 per cent in 2011 but has steadily fallen to 6.7 per cent in 2017.²² Industrial turnover-time gains have slowed and fallen for the first time in recent years, as shown in Figure 2. China's external market development is constrained by the global slowdown, while domestic growth is constrained by the trade-off between surplus value generation and realization amid prevalent low-wages.

China's manufacturing, while remaining centered on labor-intensive export production, expanded into high-technology markets. The ICT revolution bolstered China's integration into the world market and shaped trade relations with the US.²³ ICT goods exports accounted for approximately a fifth of China's total by 2001, over 30 per cent by 2005, and more than 25 per cent since then.²⁴ By 2006 computers and telecommunications equipment yielded China's strongest comparative advantages.²⁵ Trade with the US grew dramatically over this time, particularly after joining the WTO. In 2007 China surpassed Canada as the largest exporter of goods to the US and overtook Japan to become the third largest importer of US goods.²⁶

In the advanced economies the ICT revolution launched in the 90s primarily increased productivity and rationalization of existing industries. Aside from the ICT sector, overall industrial growth was modest- digital technologies extend the reach of established industries and only to a lesser extent spark altogether new lines of production. Uneven effects of ICT dissemination boosted US economic performance relative to the EU, accounting for perhaps a quarter of the widening productivity gap between the two during 1995–2005.²⁷ The US consistently designated a higher proportion of fixed capital investment into ICT, roughly one and a half to over two times the levels in Japan, Germany, France, and Italy (and to a lesser extent for the UK).²⁸ Analysis of the ICT revolution will focus on the US economy as the best-case scenario.

Investment in ICT grew rapidly in the decades preceding the 90s. Between 1974 and 1991 the share of information processing equipment (including computers) and software in total private fixed investment rose from 10 per cent to 19 per cent.²⁹ It only increased by a few percentage points in the next decade, fell with the dot-com crash, reached a new maximum of 25 per cent in 2010, and decreased somewhat

²² Calculated from National Bureau of Statistics of China, *China Statistical Yearbook*, various years, <http://www.stats.gov.cn/english>.

²³ M. Hart-Landsberg, 'The U.S. Economy and China: Capitalism, Class, and Crisis', *Monthly Review*, 61:9 (February 2010).

²⁴ World Bank, 'ICT Goods Exports (% of Total Goods Exports)', <http://data.worldbank.org>.

²⁵ I. Bensidoun, F. Lemoine and D. Ünal, 'The Integration of China and India Into the World Economy: A Comparison', *The European Journal of Comparative Economics*, 6:1 (June 2009), pp. 140–142.

²⁶ U.S. Census Bureau, 'Top Trading Partners – December 2007', <http://census.gov>.

²⁷ N. Bloom et al., 'The Economic Impact of ICT', SMART N. 2007/0020, London School of Economics, January 2010, pp. 8–9.

²⁸ OECD, 'ICT Investment', <http://data.oecd.org>.

²⁹ Calculated from NIPA, 'Table 5.3.5.: Private Fixed Investment by Type', U.S. Bureau of Economic Analysis, 26 July 2019, <http://bea.gov>.

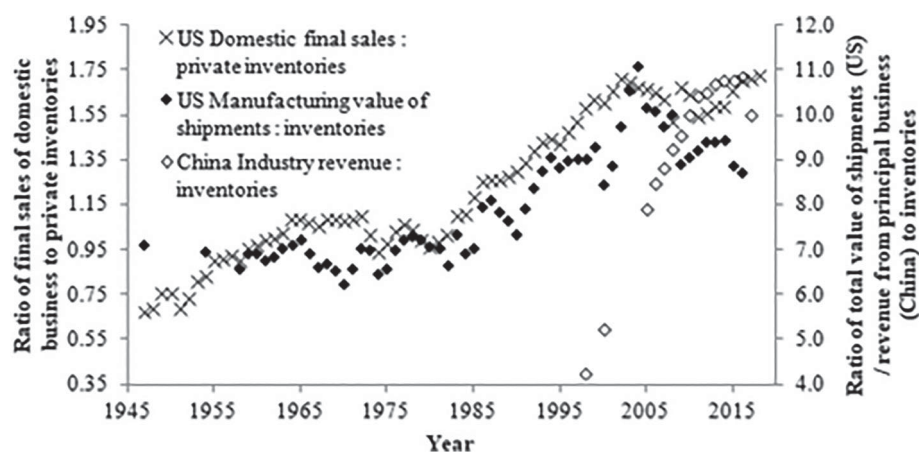


Figure 2 Annual Sales to End-of-Quarter Inventories Ratios, US and China. *Sources:* ‘Table 5.8.5A: Private Inventories and Domestic Final Sales of Business by Industry’ and ‘Table 5.8.5B: Private Inventories and Domestic Final Sales by Industry’, NIPA, U.S. Bureau of Economic Analysis, 27 July 2019, <http://bea.gov>; ‘Inventories’ and ‘Total Value of Shipments’, Statistical Abstract of the United States: Manufactures, HSUS, and Annual Survey of Manufactures, U.S. Census Bureau, various years; National Bureau of Statistics of China, *China Statistical Yearbook*, various years, <http://www.stats.gov.cn/english>.

since then. The expanding role of ICT in the 90s is a case of quantitative growth (exponential advances in computational power, rapidly falling costs, and the commercialization of the internet) yielding qualitative change (enhanced innovative capacity, improved network effects, and transformed consumer and workplace cultures).

Growth of ICT-producing industries was impressive but has slowed since the Great Recession. The continuously compounded annual rate of growth for computer and electronic product manufacturing was 11.0 per cent from 1992 to 2007 and –1.5 per cent from 2008 to 2018.³⁰ The continuously compounded annual rate of growth for ICT sector real output was 7.6 per cent from 1998 to 2007 and 4.6 per cent from 2008 to 2017.³¹ Between 1997 and 2017 the digital economy ranged from 5.6 per cent to 6.9 per cent of GDP (to put this in perspective, it is currently larger than the wholesale trade sector).³²

The improved quality and quantity of ICT supply reciprocated the demand of evolving business needs. As the post-war boom wore on monopoly capital struggled to

³⁰ Calculated from U.S. Bureau of Labor Statistics, ‘Annual Index of Output (2007 = 100) for NAICS 334, Computer and Electronic Product Manufacturing’, Databases, Tables & Calculators by Subject, <https://www.bls.gov>.

³¹ Calculated from U.S. Bureau of Economic Analysis, ‘Table 4: Real Gross Output by Commodity’, *Defining and Measuring the Digital Economy*, April 2019, <http://bea.gov>.

³² U.S. Bureau of Economic Analysis, ‘Research Spotlight: Measuring the Digital Economy’, *Survey of Current Business*, 99:5 (April 2019), pp. 7–9.

reinvest accumulated profits productively. Besides massive financialization and neocolonialism, capital increasingly permeated the services sector, which circuitously increases the mass of surplus value by developing the division of labor, speeding up turnover-time, and reducing indirect costs of industrial capital, as well as progressively commodifying services themselves.³³ Economizing the labor-intensive services sector, which grew from 22 per cent to 40 per cent of GDP from 1945 to 1991 (and 48 per cent in 2018), was a top neoliberal priority.³⁴ The high stakes and growing complexity of globalization compelled businesses to leverage ICT to remain competitive.

The nonfarm business sector productivity continuously compounded annual rate of growth was 2.8 per cent in 1948–1973, fell to 1.4 per cent during 1974–1991, rose to 2.4 per cent in 1992–2007, and fell to 1.3 per cent during 2008–2018.³⁵ The share of private sector labor productivity growth attributable to information technology increased from 11 per cent during 1959–1973 to 43 per cent during 1973–1995. It rose to 59 per cent during 1995–2000 and subsided to 38 per cent during 2000–2006.³⁶ ICT-producing industries were chiefly responsible for the ICT contribution to productivity growth until the dot-com crash, after which productivity gains stemmed from industries intensively using ICT, including trade and services.³⁷

ICT empowers just-in-time production and fosters widespread opportunities for automation, reducing stocks of inventories and freeing a portion commodity capital to circulate in other channels. E-commerce facilitates distribution, with the internet providing a 24-hour global marketplace. In 1999 E-commerce accounted for 18.1 per cent of total manufacturing shipments, but only 5.3 per cent of wholesale trade sales and 0.5 per cent of retail trade sales. In 2007 these values rose to 35.2 per cent, 16.6 per cent, and 3.4 per cent respectively. In 2016 they rose to 64.8 per cent, 27.2 per cent, and 8.0 per cent.³⁸ Figure 2 shows that turnover-time of circulating capital improved significantly through the 90s and reached an impasse in the mid-00s which continues through the present.

Given the relative weakness of the US labor movement, increasing labor productivity and decreasing turnover-time chiefly increased the mass and rates of surplus value and profit during 1992–2007, as reflected in Figure 1 and Table 2. One mainstream estimate attributes four-fifths of the declining US labor share of

³³ Ernest Mandel, *Late Capitalism* (New York: Verso, 1999), p. 388.

³⁴ Calculated from Federal Reserve Bank of St. Louis, 'Gross Domestic Product' (Series ID: GDPA), 'Personal Consumption Expenditures: Service' (Series ID: PCESVA), 'Current Receipts from the Rest of the World: Exports of Services' (Series ID: A646RC1A027NBEA), and 'Current Payments to the Rest of the World: Imports of Services' (Series ID: B656RC1A027NBEA), Federal Reserve Economic Data, <https://fred.stlouisfed.org>.

³⁵ Calculated from Federal Reserve Bank of St. Louis, 'Nonfarm Business Sector: Real Output Per Hour of All Persons' (Series ID: OPHNFB), Federal Reserve Economic Data, <https://fred.stlouisfed.org>.

³⁶ D.W. Jorgenson, M.S. Ho and K.J. Stiroh, 'A Retrospective Look at the U.S. Productivity Growth Resurgence', *Journal of Economic Perspectives*, 22:1 (Winter 2008), p. 13.

³⁷ D.W. Jorgenson, 'Innovation and Productivity Growth', *American Journal of Agricultural Economics*, 93:2 (April 2011), p. 283.

³⁸ Calculated from U.S. Census Bureau, 'E-Commerce Statistics: E-Stats Tables', various years, <http://census.gov>.

income from the 80s to the Great Recession to computerization.³⁹ Another attributes half of the global labor share decline in the same period to cheapening of investment goods engendered by ICT.⁴⁰ Increasing imports of cheap consumer goods from Mexico after NAFTA and other low-wage nations with the formation of the WTO, distributed through burgeoning retail corporations such as Walmart and Amazon, also held down the costs of reproducing labor-power. Increased trade competition with underdeveloped nations in turn promoted ICT innovation and diffusion.

Conclusions

The empirical results presented shed light on three points of contention in long wave theory: in which timeframes are long waves empirically evident, are long waves cyclic, and are the transitions from long waves of constricted growth to robust growth endogenous? Greater confidence in answering these questions improves the reliability of anticipating future developments of capitalist growth in the medium-term.

Results for the UK suggest long waves are empirically demonstrable starting with the crisis of free competition capitalism. The 1848–1873 period displayed robust growth, however not all indicators sufficiently contrast with the preceding decades to unambiguously represent a distinct long wave of robust growth. Results for the other leading Western European nations must be evaluated to settle the question of when long waves first emerged internationally, yet the importance of the UK in the first half of the nineteenth century certainly weighs against dating long wave activity any earlier than 1848. The existence of long waves dating from the Industrial Revolution and French Revolution is questionable considering the more tangible business cycle did not manifest until the Panic of 1825.

Long wave activity is most conspicuous for the timeframes spanning 1914–1991 for both the UK and US. The period of crisis punctuated by world wars, the post-war boom, and the transition to a period of constricted growth in the mid-1970s affected the leading capitalist nations universally. The less coherent 1992–2007 period presents an opportunity for assessing competing interpretations of long wave theory.

The long cycle interpretation suggests that twenty to thirty years after the end of the post-war boom a new long wave of growth would unfold. Considering the post-war boom ended by 1974, this situates the proposed upturn around 1994–2004. Instead, more than four consecutive decades of constricted growth for the OECD (despite the ICT revolution) and continuing poor prospects for robust growth indicate there are no endogenous mechanisms cycling long waves of constricted growth into long waves of robust growth. The 1992–2007 period can only be considered distinct due to widespread

³⁹ S. Aum, S.Y. Lee and Y. Shin, 'Computerizing Industries and Routinizing Jobs: Explaining Trends in Aggregate Productivity', Working Paper 24357, NBER, February 2018, p. 6.

⁴⁰ L. Karabarbounis and B. Neiman, 'The Global Decline of the Labor Share', Working Paper 19136, NBER, June 2013, pp. 31–32.

capitalist restoration (and the post-capitalist economies of the 1970s–1980s can hardly figure in any supposed mechanisms underlying long cycles of capitalist growth).

To the limited extent that 1992–2007 is characterized by growth, the expansion was exogenous. Faced with bureaucratic degeneration crippling intensive economic development, the post-capitalist societies reached a crossroads: move forward to democratic socialism or backward to capitalism. The absence of independent and experienced workers' unions and political parties, the devastating legacy of Stalinism and its variants, world market and Cold War pressure, and the weakness of revolutionary movements internationally all tipped the scales in capitalism's favor. Yet capitalist restoration was not a foregone conclusion, much less the endogenous result of purely economic factors- it was a matter of historical struggle.

The fall of the USSR and capitalist restoration in China was a gratuitous system shock, expanding the world market decades into a long wave of constricted growth. The timing of the market expansion broadly coincided with the ICT revolution and there was some interaction between the diffusion of ICT, the trajectory of China's industry, and the qualified resurgence of the US economy. Capitalist restoration and the ICT revolution failed to spark a long wave of robust growth for capitalism globally. The financial crisis, bursting real-estate bubble, and other endogenous factors in the US economy sparked the Great Recession at the start of the contemporary long wave of constricted growth.⁴¹

There is no more opportunity for extensive geographic market expansion, with capitalism dominant in all but a few regions. Intensive expansion in underdeveloped nations is held in check by competition with the leading capitalist nations and global divisions of labor prevailing under neoliberalism, amongst a host of other factors. A transition to a new long wave of robust growth therefore depends on technological revolutions and system shocks.⁴²

Candidates for the next technological revolution include artificial intelligence and advanced robotics (substantially increasing automation), as well as green technology and renewable energy. With an estimated 25 per cent of jobs at high risk and 36 per cent at medium risk of automation in the next decades, growth from artificial intelligence and robotics will likely be checked by unemployment and overaccumulation.⁴³ Development of green technology is stunted by capital's need to valorize immense investments in entrenched fossil fuel industries and unplanned profit-driven production is prone to perpetuate environmental market failures (e.g. global climate change and mass extinction). These technological revolutions, unaccompanied by

⁴¹ A detailed account of endogenous factors leading to the Great Recession, a topic addressed extensively in socialist literature, is beyond the scope of this article.

⁴² 'Here we are faced with a basic contradiction of the capitalist growth process: namely, that both a sharp increase in the rate of profit and a huge widening of the market are necessary to bring about a long expansion. Normally, the capitalist way of securing the first condition conflicts with the capitalist way of assuring the second.' Ernest Mandel, *Long Waves of Capitalist Development: A Marxist Interpretation*, 2nd rev. ed. (New York: Verso, 1995), p. 113.

⁴³ M. Muro, R. Maxim and J. Whiton, 'Automation and Artificial Intelligence', *Metropolitan Policy Program at Brookings*, January 2019, p. 5.

massive market expansion or a system shock, are unlikely to initiate a long wave of robust growth but will contribute to incremental growth.

Though timing is indeterminate, mobilization to address catastrophic effects of climate change is a potential system shock. Climate change tipping points, such as dramatic sea level rise, could prompt massive investments to rebuild cities and infrastructure further inland and deploy technologies to curb climate change. However, climate change is expected to constrict long-term economic growth, particularly impacting underdeveloped nations which are least equipped to economically adapt.⁴⁴ Global deployment of technology to mitigate or reverse climate change, commonly unprofitable in itself, could stimulate Keynesian economics (with all the contradictions this entails) but would face resistance from prevailing neoliberal institutions.

War is the perennial fallback for capitalism in crisis. Since 1974 there has been no shortage of wars, yet none were substantial enough to constitute a system shock leading to a period of robust growth. The mechanization of contemporary warfare, not to mention nuclear capabilities, limits the economic uplift which could result, if at all, from large-scale war. Rather than direct military conflict, proxy wars between regional powers for geopolitical hegemony are more probable in upcoming decades. The widening divergence between US economic and military standing in the world, China's growing influence beyond Asia as a burgeoning world power, Russia's military posturing, and climate change increasing tensions over resources point in this direction.

There are no cyclically occurring extended periods of growth for capitalism and market expansions and technological revolutions capable of ending the contemporary long wave of constricted growth are not forthcoming. This suggests that the unsettling prospect of system shocks will continue as long as capitalism remains stuck in a long wave of constricted growth, with all the dangers and opportunities these uncertain periods of escalating class struggle entail. Further research into long wave theory may provide an adequate framework for comprehending and anticipating medium-term patterns of capitalist development, thereby enabling socialists to more effectively advance the struggle for a classless society.

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⁴⁴ Annual global GDP losses may amount to 1.0–3.3 per cent by 2060 (based on global average temperature increasing 1.6°C–2.6°C) and 2–10 per cent by 2100 (based on an increase of 2.5°C–5.5°C). Even with determined action to mitigate climate change, GDP losses may still range 1–3 per cent by 2100. Inaction, of course, will only increase the ultimate damage. 'The Economic Consequences of Climate Change: Policy Highlights', OECD, 2015, p. 1, https://issuu.com/oecd.publishing/docs/economic_consequences_of_climate_ch_21bcb6d97fe6a8/1?ff&e=3055080/31101482.