

10

Key Economic Sectors and Services Supplementary Material

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SM10.1. Industrial Classification

International Standard Industrial Classification (ISIC) of All Economic Activities, Rev.4, the outline of Chapter 10, and nil returns in a literature search on Scopus.

A - Agriculture, forestry, and fishing (10.5)

- 01 -Crop and animal production, hunting, and related service activities
- 02 -Forestry and logging
- 03 -Fishing and aquaculture

B - Mining and quarrying (10.5)

- 05 -Mining of coal and lignite
- 06 -Extraction of crude petroleum and natural gas
- 07 -Mining of metal ores
- 08 -Other mining and quarrying
 - Climate change impact & quarrying: No results*
- 09 -Mining support service activities

C - Manufacturing (10.5, except C19)

- 10 -Manufacture of food products
 - Climate change impact & food products: No results*
 - Climate change impact & food processing: No results*
- 11 -Manufacture of beverages
 - Climate change impact & beverages: No results*
- 12 - Manufacture of tobacco products
 - Climate change impact & tobacco: No results*
- 13 -Manufacture of textiles
 - Climate change impact & textiles: No results*
- 14 -Manufacture of wearing apparel
 - Climate change impact & apparel: No results*
- 15 -Manufacture of leather and related products
 - Climate change impact & leather: No results*
- 16 -Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
 - Climate change impact & wood: No results*
- 17 -Manufacture of paper and paper products
 - Climate change impact & pulp paper: No results*
- 18 -Printing and reproduction of recorded media
 - Climate change impact & printing: No results*
 - Climate change impact & recorded media: No results*
- 19 -Manufacture of coke and refined petroleum products (10.2)
- 20 -Manufacture of chemicals and chemical products
 - Climate change impact & chemical production: No results*
- 21 -Manufacture of basic pharmaceutical products and pharmaceutical preparations
 - Climate change impact & pharmaceutical: No results*
- 22 -Manufacture of rubber and plastics products
 - Climate change impact & rubber: No results*
 - Climate change impact & plastic: No results*
- 23 -Manufacture of other non-metallic mineral products
 - Climate change impact & cement: No results*
 - Climate change impact & glass: No results*
- 24 -Manufacture of basic metals
 - Climate change impact & steel: No results*
 - Climate change impact & iron: No results*
 - Climate change impact & alumina: No results*
 - Climate change impact & aluminum: No results*

25 -Manufacture of fabricated metal products, except machinery and equipment

- Climate change impact & metal: No results*

26 -Manufacture of computer, electronic and optical products

- Climate change impact & equipment: No results*

27 -Manufacture of electrical equipment

- Climate change impact & equipment: No results*

28 -Manufacture of machinery and equipment n.e.c.

- Climate change impact & equipment: No results*

- Climate change impact & machinery: No results*

29 -Manufacture of motor vehicles, trailers and semi-trailers

- Climate change impact & vehicle: No results*

30 -Manufacture of other transport equipment

- Climate change impact & equipment: No results*

31 -Manufacture of furniture

- Climate change impact & furniture: No results*

32 -Other manufacturing

33 -Repair and installation of machinery and equipment

- Climate change impact & equipment: No results*

- Climate change impact & machinery: No results*

D - Electricity, gas, steam, and air conditioning supply (10.2)

35 -Electricity, gas, steam and air conditioning supply

E - Water supply; sewerage, waste management, and remediation activities

36 -Water collection, treatment, and supply (10.3)

37 -Sewerage (10.3)

38 -Waste collection, treatment, and disposal activities; materials recovery (10.8)

39 -Remediation activities and other waste management services (10.8)

F - Construction (10.5)

41 -Construction of buildings

42 -Civil engineering

43 -Specialized construction activities

G - Wholesale and retail trade; repair of motor vehicles and motorcycles (10.8)

45 -Wholesale and retail trade and repair of motor vehicles and motorcycles

46 -Wholesale trade, except of motor vehicles and motorcycles

47 -Retail trade, except of motor vehicles and motorcycles

H - Transportation and storage (10.4)

49 -Land transport and transport via pipelines

50 -Water transport

51 -Air transport

52 -Warehousing and support activities for transportation

53 -Postal and courier activities

I - Accommodation and food service activities (10.6)

55 -Accommodation

56 -Food and beverage service activities

J - Information and communication (10.8)

58 -Publishing activities

59 -Motion picture, video and television program production, sound recording and music publishing activities

60 -Programming and broadcasting activities

61 -Telecommunications

62 -Computer programming, consultancy, and related activities

63 -Information service activities

- K - Financial and insurance activities (10.7)
 - 64 -Financial service activities, except insurance and pension funding
 - 65 -Insurance, reinsurance, and pension funding, except compulsory social security
 - 66 -Activities auxiliary to financial service and insurance activities
- L - Real estate activities (10.8)
 - 68 -Real estate activities
- M - Professional, scientific, and technical activities (10.8)
 - 69 -Legal and accounting activities
 - 70 -Activities of head offices; management consultancy activities
 - 71 -Architectural and engineering activities; technical testing and analysis
 - 72 -Scientific research and development
 - 73 -Advertising and market research
 - 74 -Other professional, scientific, and technical activities
 - 75 -Veterinary activities
- N - Administrative and support service activities (10.8 except N79)
 - 77 -Rental and leasing activities
 - 78 -Employment activities
 - 79 -Travel agency, tour operator, reservation service, and related activities (10.6)
 - 80 -Security and investigation activities
 - 81 -Services to buildings and landscape activities
 - 82 -Office administrative, office support, and other business support activities
- O - Public administration and defense; compulsory social security (10.8)
 - 84 -Public administration and defense; compulsory social security
- P - Education (10.8)
 - 85 -Education
- Q - Human health and social work activities (10.8)
 - 86 -Human health activities
 - 87 -Residential care activities
 - 88 -Social work activities without accommodation
- R - Arts, entertainment, and recreation (10.6)
 - 90 -Creative, arts, and entertainment activities
 - 91 -Libraries, archives, museums, and other cultural activities
 - 92 -Gambling and betting activities
 - 93 -Sports activities, and amusement and recreation activities
- S - Other service activities (10.8)
 - 94 -Activities of membership organizations
 - 95 -Repair of computers and personal and household goods
 - 96 -Other personal service activities
- T - Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use (10.8)
 - 97 -Activities of households as employers of domestic personnel
 - 98 -Undifferentiated goods- and services-producing activities of private households for own use
- U - Activities of extraterritorial organizations and bodies (10.8)
 - 99 -Activities of extraterritorial organizations and bodies

*No results = no results for the impact of climate change on this particular economic activity. There may be results for the impact of climate change on a related activity, or for the impact of the activity on climate change.

SM10.2. Estimates of the Total and Marginal Economic Impact of Climate Change

Table SM10-1 | Estimates of the welfare impact of climate change (expressed as an equivalent change in income, calculated as a percent of global aggregate GDP); estimates of the uncertainty are given in brackets as standard deviations or ranges. Table entries based on regional results are simple sums of impacts on regional economic output; other weightings yield different estimates.

Study	Warming (°C)	Impact ^a (%GDP)	Method	Coverage
Nordhaus (1994b)	3.0	-1.3	Enumeration	Agriculture, energy demand, sea level rise
Nordhaus (1994a)	3.0	-1.9 (median) -3.6 (mean) [-21 to 0.0]	Expert elicitation ^b	Total welfare
Fankhauser (1995) [†]	2.5	-1.4	Enumeration	Sea level rise, biodiversity, agriculture, forestry, fisheries, electricity demand, water resources, amenity, human health, air pollution, natural disasters
Tol (1995) [†]	2.5	-1.9	Enumeration	Agriculture, biodiversity, sea level rise, human health, energy demand, water resources, natural disasters, amenity
Nordhaus and Yang (1996) ^{††}	2.5	-1.7	Enumeration	Agriculture, energy demand, sea level rise
Plambeck and Hope (1996) ^{††}	2.5	-2.5 [-11.4 to -0.5]	Enumeration	Sea level rise, biodiversity, agriculture, forestry, fisheries, electricity demand, water resources, amenity, human health, air pollution, natural disasters
Mendelsohn et al. (2000) [†]	2.2	0.0	Enumeration	Agriculture, forestry, sea level rise, energy demand, water resources
Mendelsohn et al. (2000) [†]	2.2	0.1	Statistical	Agriculture, forestry, energy demand
Nordhaus and Boyer (2000) [†]	2.5	-1.5	Enumeration ^d	Agriculture, sea level rise, other market impacts, human health, amenity, biodiversity, catastrophic impacts
Tol (2002)	1.0	2.3 [1.0]	Enumeration	Agriculture, forestry, biodiversity, sea level rise, human health, energy demand, water resources
Maddison (2003) ^{††}	2.5 ^e	-0.1	Statistical	Household consumption
Rehdanz and Maddison (2005) ^c	1.0 ^e	-0.4	Statistical	Self-reported happiness
Hope (2006a) ^{††}	2.5	-0.9 [-2.7 to 0.0]	Enumeration	Sea level rise, biodiversity, agriculture, forestry, fisheries, energy demand, water resources, amenity, human health, air pollution, natural disasters
Nordhaus (2006)	3.0	-0.9 [0.1] -1.1 [0.1]	Statistical ^d	Economic output
Nordhaus (2008)	3.0	-2.6	Enumeration	Agriculture, sea level rise, other market impacts, human health, amenity, biodiversity, catastrophic impacts
Maddison and Rehdanz (2011) ^c	3.2 ^e	-12.4	Statistical	Self-reported happiness
Bosello et al. (2012)	1.9	-0.5	CGE	Energy demand; tourism; sea level rise; river floods; agriculture; forestry; human health
Roson and van der Mensbrugge (2012)	2.9 5.4	-2.1 -6.1	CGE	Agriculture, sea level rise, water resources, tourism, energy demand, human health, labor productivity

^a Central estimates of welfare impact of climate change; some of these estimates are the expected impacts from a regression analysis, some are the average impacts from a Monte Carlo experiment with a model, some are the expected impacts from a meta-analysis, and some are best guesses. The estimates of the uncertainty about the central estimates have similarly diverse interpretations. Therefore, the spread between estimates indicates the range of results but does not constitute a confidence interval. For example, the standard deviation of the estimates for a ~2.5°C warming relative to pre-industrial (estimates labeled with a †) is 0.9% of GDP with an average of -1.1% (i.e., -0.2 to -2.0% GDP). The distribution of the uncertainty is asymmetric such that losses are more likely than not to be greater, rather than smaller, than this range.

^b Nordhaus (1994a) reported results for additional scenarios at greater or more rapid warming. Knowledge of climate impacts at that time was limited and the uncertainty of those scenarios, based on expert elicitation, is therefore very large. See original study for more details.

^c Results aggregated by Tol (2013). For details on aggregations, see accompanying spreadsheet: TableSM10-1_SupplementarySpreadsheet.xls.

^d The table entries are output weighted. Nordhaus and Boyer (2000) also report a population weighted output of -1.9%. Nordhaus (2006) reports values with and without midcontinental drying, and with weighting by output, area or population. Population weights would increase the estimated impacts of the CC1 and CC2 scenarios to -1.7% and -3.0%, respectively.

^e The temperature increase is calculated relative to a variety of country-specific historical baselines.

The database on the marginal damage costs of CO₂ emissions and its growth rate can be found in the spreadsheet <marginaldamagecost.xls>.

The following papers are included in the database on the marginal damage costs of CO₂ emissions: Ackerman and Munitz, 2012; Ackerman and Stanton, 2012; Anthoff et al., 2009a,b,c, 2011a,b; Anthoff and Tol, 2010, 2011, 2013; Ayres and Walter, 1991; Azar, 1994; Azar and Sterner, 1996; Cai et al., 2012; Ceronsky et al., 2006, 2011; Clarkson and Deyes, 2002; Cline, 1992, 1997, 2004; Downing et al., 1996, 2005; EPA and NHTSA, 2009; Eyre et al., 1999; Fankhauser, 1994; Guo et al., 2006; Haraden, 1992, 1993; Hohmeyer and Gaertner, 1992; Hohmeyer, 1996, 2004; Hope, 2005a,b, 2006a,b, 2008a,b, 2011, 2013; Hope and Hope, 2013; Hope and Maul, 1996; Interagency Working Group on the Social Cost of Carbon, 2013; Kemfert and Schill, 2010; Link and Tol, 2004; Maddison, 1995; Manne, 2004; Marten, 2011; Mendelsohn, 2004; Narita et al., 2009, 2010; Newell and Pizer, 2003; Nordhaus, 1982, 1991, 1993, 1994a,b, 2008, 2010; Nordhaus and Boyer, 2000; Nordhaus and Popp, 1997; Nordhaus and Yang, 1996; Parry, 1993; Pearce, 2003; Peck and Teisberg, 1993; Penner et al., 1992; Perrissin Fabert et al., 2012; Plambeck and Hope, 1996; Reilly and Richards, 1993; Roughgarden and Schneider, 1999; Schauer, 1995; Sohngen, 2010; Stern et al., 2006; Stern and Taylor, 2007; Tol, 1999, 2005, 2010, 2012; Uzawa, 2003; Wahba and Hope, 2006; Waldhoff et al., 2011.

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