

## Online Appendix

# IS WATER A SOURCE OF COMPARATIVE ADVANTAGE?

Peter Debaere\*

### Abstract

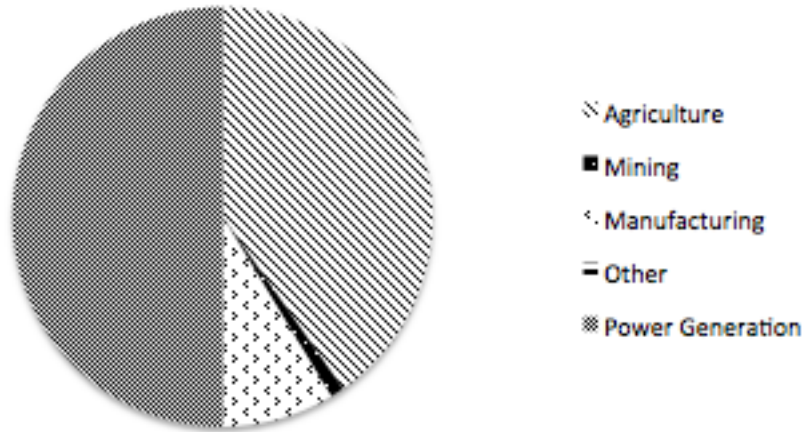
With newly available data, I investigate to what extent countries' international trade exploits the very uneven water resources on a global scale. I find that water is a source of comparative advantage and that relatively water abundant countries export more water-intensive products. Additionally, water contributes significantly less to the pattern of exports than the traditional production factors labor and physical capital. This suggests relatively moderate disruptions to overall trade on a global scale due to changing precipitation in the wake of climate change.

Figure A1: Direct and Total (Direct plus Indirect) Water Use by Sector

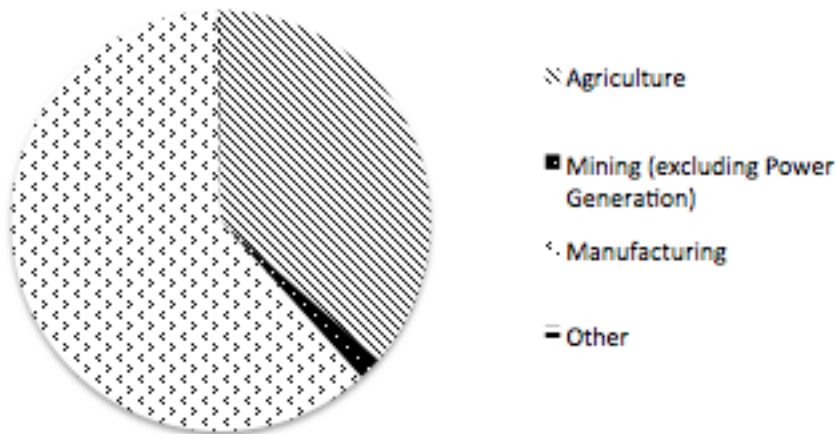
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\* Peter Debaere, Darden Business School, University Boulevard 1, Charlottesville Virginia, [debaerep@darden.virginia.edu](mailto:debaerep@darden.virginia.edu). Nan Zhang and especially Amanda Kurzendoerfer provided excellent research assistance. This project benefitted from funding by the Darden Foundation. I thank Nathan Nunn for making his data available, as well as Arjen Hoekstra and Chris Hendrickson. This paper was written in part while visiting the Haas Business School at Berkeley. I received helpful suggestions from Gordon Hanson, James Harrigan, David Levine, Arik Levinson, John McLaren, Brian Richter, Andres Rodriguez-Clare, John Romalis, and Bob Stern and I benefitted from presentations at UC San Diego, University of Michigan and the University of Virginia, Econ. Dept. and Darden. All remaining errors are mine.

## Direct Water Use

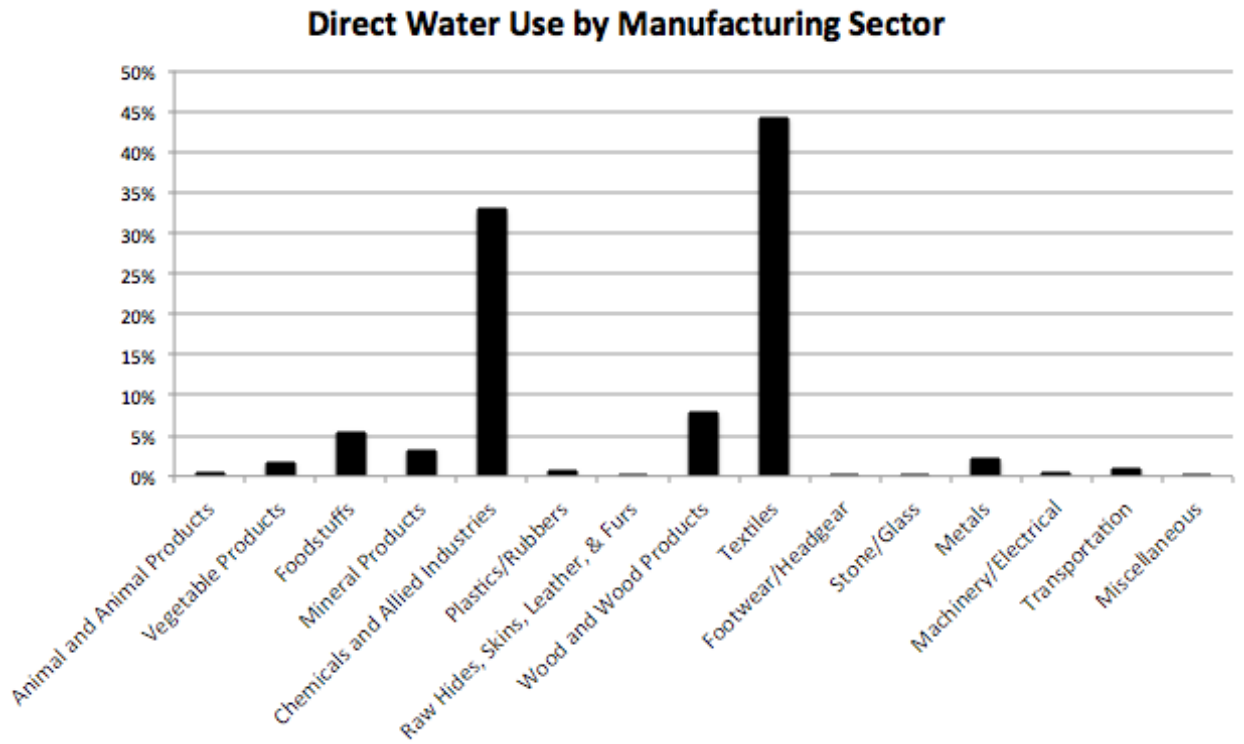


## Direct and Indirect Water Use

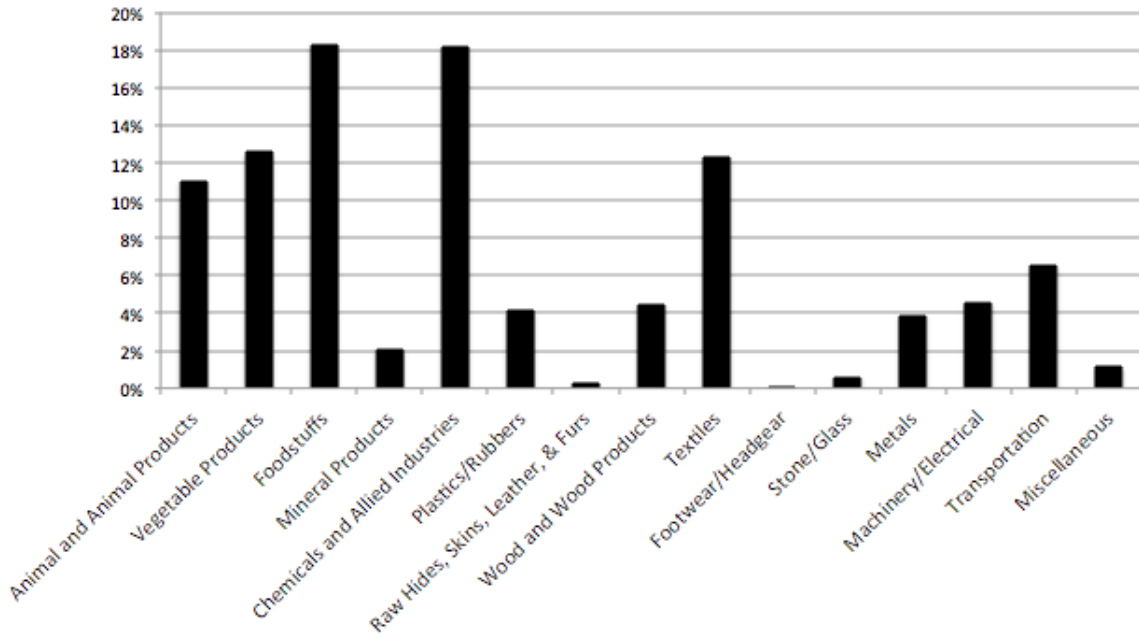


*Notes:* Direct water use consists of water withdrawals by the sector itself, and indirect water use takes place through the use of intermediates from other sectors. *Source:* Using BHV (2010) data.

Figure A2: Direct and Indirect Water Use within the Manufacturing Sector

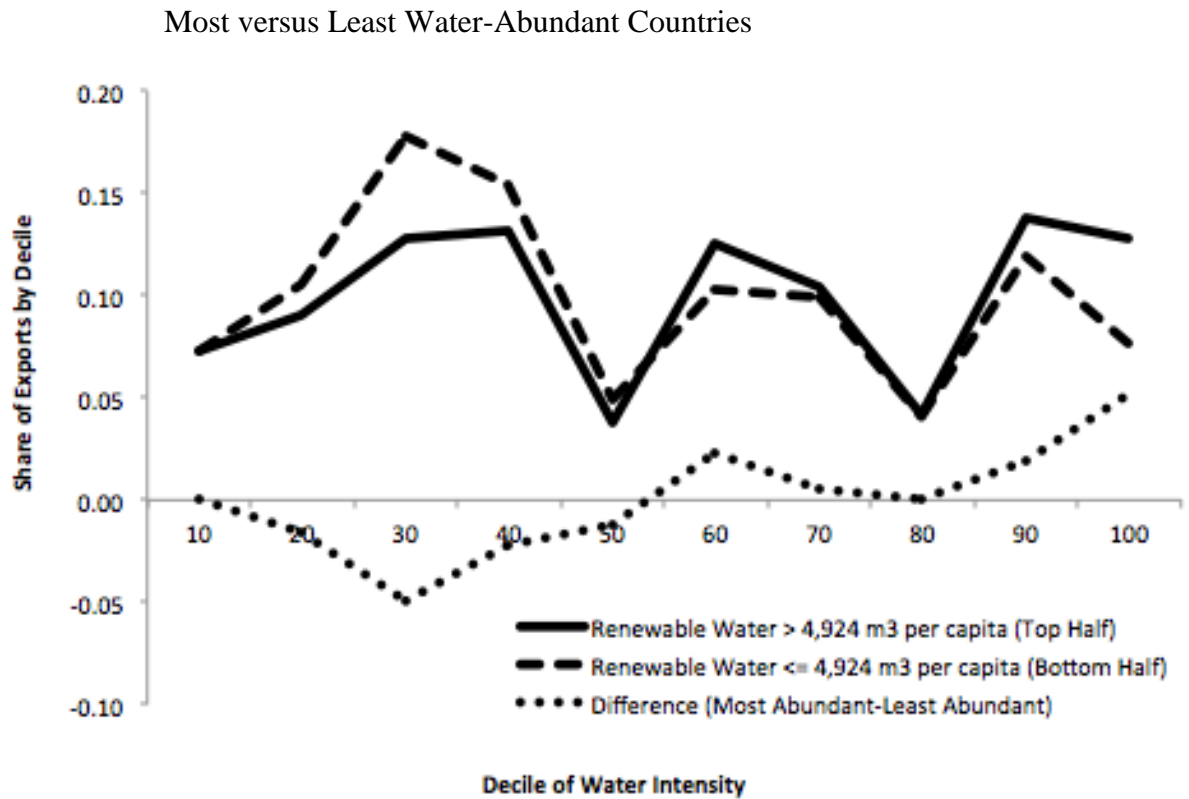


### Direct and Indirect Water Use by Manufacturing Sector



*Notes:* Direct water use consists of water withdrawals by the sector itself, and indirect water use takes place through the use of intermediates from other sectors. Each bar represents the percentage of total manufacturing water use by a sector. *Source:* Using BHV (2010) data.

Figure A3: Average Share of Individual Countries' Exports by Decile of Water Intensity



*Notes:* Products are split into deciles of green and blue water intensity. The share of exports is calculated as the total amount of exports in each decile divided by the total amount of exports for the most and least water-abundant countries (half the countries in the sample have more than 4,924m<sup>3</sup> per capita renewable water resources). *Data source:* BHV (2010).

Table A1: The fifteen most and least water intensive sectors

15 Most Water Intensive (Blue Water Only)			15 Most Water Intensive (Green and Blue Water)		
Industry Code	Industry Description	Water Intensity	Industry Code	Industry Description	Water Intensity
111920	Cotton farming	0.85351	1111B0	Grain farming	0.95606
1111B0	Grain farming	0.81751	111920	Cotton farming	0.93700
1119A0	Sugarcane & sugar beet farming	0.77959	1119A0	Sugarcane & sugar beet farming	0.92658
111335	Tree nut farming	0.65498	1113A0	Fruit farming	0.87206
1113A0	Fruit farming	0.65127	111335	Tree nut farming	0.74148
1119B0	Oth. crop farming	0.57134	111200	Vegetable & melon farming	0.73170
111200	Vegetable & melon farming	0.52943	111910	Tobacco farming	0.58083
1111A0	Oilseed farming	0.41767	1119B0	Oth. crop farming	0.55042
212320	S&, gravel, clay, & refractory mining	0.26816	1111A0	Oilseed farming	0.35753
212310	Stone mining & quarrying	0.23560	212320	S&, gravel, clay, & refractory mining	0.26816
2122A0	Gold, silver, & oth. metal ore mining	0.22406	212310	Stone mining & quarrying	0.23560
212230	Copper, nickel, lead, & zinc mining	0.16955	2122A0	Gold, silver, & oth. metal ore mining	0.22406
111910	Tobacco farming	0.16346	111400	Greenhouse & nursery production	0.21876
111400	Greenhouse & nursery production	0.14920	212230	Copper, nickel, lead, & zinc mining	0.16955
212210	Iron ore mining	0.13997	212210	Iron ore mining	0.13997
15 Least Water Intensive (Blue Water Only)			15 Most Least Intensive (Green and Blue Water)		
Industry Code	Industry Description	Water Intensity	Industry Code	Industry Description	Water Intensity
114100	Fishing	0.00000	114100	Fishing	0.00000
312229	Oth. tobacco product man.	0.00000	312229	Oth. tobacco product man.	0.00000
334517	Irradiation apparatus man.	0.00000	334517	Irradiation apparatus man.	0.00000
334515	Electricity & signal testing instruments	0.00000	334515	Electricity & signal testing instruments	0.00000
312221	Cigarette man.	0.00000	312221	Cigarette man.	0.00000
334510	Electromedical apparatus man.	0.00001	334510	Electromedical apparatus man.	0.00001
334210	Telephone apparatus man.	0.00001	334210	Telephone apparatus man.	0.00001
339115	Ophthalmic goods man.	0.00001	339115	Ophthalmic goods man.	0.00001
333315	Photographic & photocopying equip. man.	0.00001	333315	Photographic & photocopying equip. man.	0.00001
33451A	Watch, clock, & oth. measuring & controlling	0.00001	33451A	Watch, clock, & oth. measuring & controlling	0.00001
339994	Broom, brush, & mop man.	0.00001	339994	Broom, brush, & mop man.	0.00001
333993	Packaging mach. man.	0.00001	333993	Packaging mach. man.	0.00001
316900	Oth. leather product man.	0.00001	316900	Oth. leather product man.	0.00001
334220	Broadcast & wireless comm. equip.	0.00001	334220	Broadcast & wireless comm. equip.	0.00001
339113	Surgical appliance & supplies man.	0.00001	339113	Surgical appliance & supplies man.	0.00001

Notes: Water intensity is the ratio of the cost of water use to value added plus cost of water for each industry. Blue water includes fresh surface and ground water, and green water is rainwater absorbed through the soil.

Table A2: Determinants of Comparative Advantage

Explanatory variables	Dependent variable: log of exports per country and industry							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Water interaction, direct, blue	0.033** (0.015)				0.039* (0.023)			
Water interaction, direct and indirect, blue		0.041** (0.017)				0.047* (0.027)		
Water interaction, direct, green and blue			0.031* (0.016)				0.037 (0.024)	
Water interaction, direct and indirect, green and blue				0.044** (0.018)				0.042 (0.026)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.72	0.73	0.72	0.73	0.72	0.72	0.72	0.72
Number of observations	19,719	19,719	19,719	19,719	11,661	11,661	11,661	11,661

*Notes:* Water interaction stands for the interaction between water abundance and water intensity. Direct and indirect refer to direct and indirect water use. Blue focuses only on blue water used. Blue and green refers to both blue and green water used. Standard errors clustered by country and industry. \*, \*\*, and \*\*\* indicate significance at the 10 percent, 5 percent, and 1 percent levels.

(1)-(4) Entire sample

(5)-(8) Subgroup of countries for which capital and skill data are available

Table A3: Robustness Checks

Explanatory variables	Dependent variable: log of exports per country and industry							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Water interaction, direct and indirect, blue	0.047** (0.022)		0.057** (0.025)		0.046* (0.025)		0.058** (0.024)	
Water interaction, direct and indirect, green and blue		0.042* (0.022)		0.053** (0.024)		0.042* (0.024)		0.054** (0.023)
Capital interaction	0.11* (0.064)	0.11* (0.064)	0.11* (0.064)	0.11* (0.064)	0.11* (0.067)	0.11* (0.067)	0.11* (0.063)	0.11* (0.063)
Skilled labor interaction	0.25*** (0.042)	0.25*** (0.042)	0.25*** (0.046)	0.25*** (0.046)	0.23*** (0.045)	0.23*** (0.045)	0.22*** (0.044)	0.22*** (0.044)
Land interaction	0.27** (0.136)	0.27** -0.1380	0.24* (0.134)	0.24* (0.134)	0.17 (0.14)	0.17 (0.141)	0.04 (0.24)	0.04 (0.24)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.72	0.72	0.71	0.71	0.69	0.69	0.71	0.71
Number of observations	10,792	10,792	10,492	10,492	10,483	10,483	10,491	10,491

Notes: Water interaction stands for the interaction between water abundance and water intensity. Direct and indirect refer to direct and indirect water use. Blue focuses only on blue water used. Blue and green refers to both blue and green water used. Standard errors clustered by country and industry. \*, \*\*, and \*\*\* indicate significance at the 10 percent, 5 percent, and 1 percent levels.

- (1)-(2) Excludes five most water abundant countries, per capita  
(3)-(4) Excludes five most water abundant countries  
(5)-(6) Excludes five largest countries  
(7)-(8) Excludes five richest countries



Table A3, Continued: Robustness Checks

Explanatory variables	Dependent variable: log of exports per country and industry					
	(9)	(10)	(11)	(12)	(13)	(14)
Water interaction, direct and indirect, blue	0.058** (0.025)		0.053* (0.031)		0.058* (0.03)	
Water interaction, direct and indirect, green and blue		0.054** (0.024)		0.047 (0.029)		0.052* (0.029)
Capital interaction	0.13** (0.066)	0.13** (0.066)	0.13** (0.063)	0.13** (0.063)	0.13** (0.064)	0.13** (0.064)
Skilled labor interaction	0.23*** (0.041)	0.23*** (0.041)	0.24*** (0.045)	0.24*** (0.045)	0.24*** (0.045)	0.24*** (0.045)
Land interaction	0.16 (0.145)	0.16 (0.147)	0.15 (0.29)	0.15 (0.29)	0.15 (0.29)	0.15 (0.29)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.71	0.71	0.72	0.72	0.72	0.72
Number of observations	10,957	10,957	10,590	10,590	10,619	10,619

*Notes:* Water interaction stands for the interaction between water abundance and water intensity. Direct and indirect refer to direct and indirect water use. Blue focuses only on blue water used. Blue and green refers to both blue and green water used. Standard errors clustered by country and industry. \*, \*\*, and \*\*\* indicate significance at the 10 percent, 5 percent, and 1 percent levels.

(9)-(10) Excludes five poorest countries

(11)-(12) Excludes five least water abundant countries, per capita

(13)-(14) Excludes five least water abundant countries

## Data Description

### A.Non-Water Data Sources

Industry-level trade flows, stocks of human and physical capital, and skill and capital intensities are from Nunn (2007), which come from the following sources. Trade flows are from Feenstra (2000), and are converted from the original 4-digit SITC codes to the BEA 1997 IO industry classification. Stocks of human capital and physical capital are from Antweiler and Trefler (2002) and are for the year 1992. Human capital stocks are measured as the natural log of the ratio of workers completing high school to those not completing high school, and physical capital stocks are the natural log of average capital stock per worker. I construct the land stock measure as the natural log of arable land in hectares per capita in 1997. Hectares of arable land by country are from the World Bank. Skill and capital intensities of production are from Bartelsman and Gray (1996). I supplement the number of agricultural industries for which the skill and capital intensity measures are available using skill and capital shares for agricultural sectors from the Global Trade Analysis Project (GTAP). Shares are constructed as the ratio of skill or capital requirements to total factor requirements for a sector. The GTAP sectors are matched to 6-digit HS categories using the concordance provided by GTAP, which are then matched to the 1997 IO classification using the BEA concordance. When an IO classification maps into more than one GTAP sector, I take the average skill and capital measures. To ensure that the GTAP and Nunn intensities are consistent in magnitude, I scale the GTAP agricultural factor intensity measures by their output-weighted average and apply it to the output-weighted intensity for agricultural industries provided by Nunn.

Land intensity of production is measured as the ratio of land use to total factor use for a sector. These data are also from GTAP and are concorded to IO industry classifications using the procedure described above.

### B.Price of Water

The price for water supplied by public utilities is from Global Water Intelligence. It is calculated as the average variable utility price of water across major cities in the United States in the year 2007 and is \$0.175/m<sup>3</sup>. Prices of water not intermediated by utilities are from Brewer et al. (2007) and are measured as the average price of water trades for agricultural and industrial use in Western U.S. states over the years 1987 to 2005. Prices are adjusted to 2002 dollars. The average agricultural price is \$0.013/m<sup>3</sup>, and prices for manufacturing industries range from \$0.019/m<sup>3</sup> to \$0.026/m<sup>3</sup>. Manufacturing prices are scaled by the amount of 2003 gross state product that occurs in Western relative to Eastern U.S. states in each sector, and uses the relationship between Western and Eastern utility prices to infer a non-utility price for water in the Eastern United States. Gross state product is from the BEA. The sectoral water-intensity measure is the ratio of the cost of water use over value added plus the cost of water use. The cost of water use is measured as the quantity of water not provided by utilities (direct water use quantity from BHV (2010) less publicly supplied water use from the BEA IO tables) times the non-utility water prices described above, plus the IO value of publicly supplied water use. Value added is from the BEA IO tables.

### C. Agricultural Water Use

To adjust the water intensity measures by country for agriculture, I match the 14 agricultural sectors from the IO classification with 11 sectors from the Mekonnen and Hoekstra (2011) data via the HS6 to IO1997 concordance. Mekonnen and Hoekstra (2011) provide data on green and water use for individual country in the different agricultural sectors. I divide for each individual country the water use in its agricultural sectors by the US sector level green and blue water use. I multiply the ratios obtained from these divisions with the U.S. water intensity based on BHV (2010) that we used before for each of the agricultural sectors of the countries in the dataset.