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Water Scarcity and Virtual Water Trade in the Mediterranean

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Abstract

Virtual water trade refers to the implicit content of water in the production of goods and services. When trade is undertaken, there is an implicit exchange of water. Furthermore, when water gets scarce, water intensive goods become more expensive to produce and the economy compensates through higher water imports. This paper is about applying the concept of virtual water to the problem of future water scarcity in the Mediterranean area, also induced by the climate change. The aim is assessing to what extent water trade is a viable adaptation option to the problem of water scarcity. To this end, a computable general equilibrium model is extended with satellite data on sectoral water consumption, and used to assess future scenarios of water availability. It is found that virtual trade may curb the negative effect of water scarcity, yet the consequences in terms of income and welfare remain quite significant, especially for some regions.

Keywords
Computable General Equilibrium Models, Water, Virtual Water, Water Scarcity, Climate Change

JEL Codes
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1. Introduction

Water availability is a key factor in many societies, shaping cultures, economies, history and national identity. This is especially true in the Mediterranean, where water resources are limited and very unevenly distributed over space and time.

There is a growing concern about water resources in this region. On the demand side, during the second half of the 20th century, water demand has increased twofold, reaching 280 km^3/year (UNEP, 2006). Much of the demand comes from agricultural activities (45% in the North, 82% in South and East), but other industries also contribute significantly (most notably, tourism) and more competition for water resources can be easily foreseen in the near future.

On the supply side, many countries are already affected by over-exploitation of renewable water resources (often generating salt-water intrusion) and exploitation of non-renewable resources (including the so-called "fossil water"). In addition, most regional climate models predict a reduction in precipitation and water run-off in low-latitude regions, including the Mediterranean (although forecasts are affected by relevant uncertainty). Reduced precipitations are often associated with droughts, desertification, increased variability over time (which, somehow paradoxically, may give raise to floods).

Much can be done through improved water management, proper water pricing and international cooperation for transboundary rivers and aquifers. It is estimated (UNEP, ibid.) that improved water demand management would make it possible to save 25% of water demand. Additional measures, such as the use of return water from agricultural drainage, the reuse of treated wastewater for irrigation, freshwater production through desalination of seawater or brackish water, may prove to be effective.

Water pricing is also an important issue. Water is sometimes free, under-priced, or even subsidized, especially in agriculture. Economic theory suggests that when prices are not in line with the social marginal values, resources are inefficiently allocated. On the other hand, introducing water pricing is not easy and it would affect the structure of regional economies and trade flows (Berritella et al., 2008). In the same vein, transboundary rivers and aquifers (e.g., the Jordan river) are often plagued by a classic "Tragedy of the Commons", possibly bringing about social tensions and conflicts. Some pessimistic viewers have even envisaged future "water wars".

Since water is an essential production factor, especially in agriculture, its scarcity would result in higher production costs and lower productivity. This effect may operate through both market and non market mechanisms. If water is priced and its price gets higher, more production costs bring about higher market prices for water intensive products. If water is not priced, there will be lower yield per unit of conventional production factor (labour, capital, land). In any case, this would be a reduction in the supply of water-needing goods, and the law of supply and demand in each market would push prices upward.

We can therefore expect water scarcity to cause higher prices and lower production volumes for water intensive industries and for those regions which are more severely constrained in terms of water resources. In turn, this loss of competitiveness would imply a shift away from water intensive activities in production and consumption, which ultimately saves water.

How strong is this market-mediated water saving effect? To what extent may this effect complement other policies in water management and supply? To better investigate these and other related questions Allan (1993) introduced the useful concept of "virtual water", that is, the implicit content of water in the production of goods and services, whereas "virtual water trade" refers to the implied exchange of water through conventional trade (Chapagain and Hoekstra, 2003).

In the next section, the concept of virtual water will be discussed in more detail, and some estimates of virtual water trade for Mediterranean countries will be presented and examined. On the basis of these estimates, a computable general equilibrium model of the world economy, specifically disaggregated for the Mediterranean, is used to quantitatively assess future scenarios of climate change and water availability. Simulation results of this model will be presented and discussed in section 3. A final section will provide some concluding remarks.

2. Virtual Water Trade in the Mediterranean region

The virtual water content of a good is defined as the volume of water that is actually used to produce that product. This will depend on the production conditions, including place and time of production and water use efficiency. Producing one kilogram of grain in an arid country, for instance, can require two or three times more water than producing the same amount in a humid country (Hoekstra, 2003).

When a good is exported, its virtual water content is implicitly exported as well. Vice versa, when one good is imported, the water used in its origin country of production is virtually imported. A trade matrix of value or quantity flows could then be translated in terms of virtual water equivalent flows, allowing one to see whether one country is a net importer or exporter of virtual water, and which are its trade partners.

Intuitively, we would expect water scarce (abundant) countries to be virtual water importers (exporters). This may not always be the case, however, particularly if water management is poor and water resources are over-exploited.

In order to get a picture of virtual water trade in the Mediterranean, we classify the world in 14 regional economies, obtained through aggregation from the GTAP 7.1 database.[1] These are: Albania, Croatia, Cyprus, Egypt, France, Greece, Italy, Morocco, Spain, Tunisia, Turkey, Rest of Europe, Rest of Middle East and North Africa, Rest of the World.

Chapagain and Hoekstra (2004) provide estimates of total water consumption for 164 crops in 208 countries. We aggregate the data to the 14 regions and 7 agricultural industries of the GTAP data base, and we make a comparison between water consumption, by crop and region, and value of production (at 2004). This allow us to create an estimate of virtual water content by unit of output (in monetary terms).

Applying the unit virtual water coefficients to a set of origin/destination matrices of trade flows, for each agricultural industry, it is then possible to translate trade flows in virtual water equivalents. The sum of all translated matrices provides a picture of virtual water trade flows associated with trade in agricultural products.

The matrix of bilateral virtual water trade flows, related to trade in agricultural products, is presented in the Appendix (Table A1). Table 1 shows the virtual water balance of trade for all

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[1] See: http://www.gtap.org .

regions in the set, where positive (negative) numbers mean that a country is a net exporter (importer) of virtual water.

	BT	BTR
Albania	-621	-82%
Croatia	-476	-40%
Cyprus	-630	-73%
Egypt	-12,640	-65%
France	16,932	32%
Greece	-1,971	-29%
Italy	-20,467	-63%
Morocco	-2,263	-21%
Spain	-3,521	-8%
Tunisia	-2,049	-53%
Turkey	-191	-2%
Rest.Euro	-98,397	-48%
Rest MENA	-53,372	-74%
RoW	179,667	16%

Table 1 – Virtual Water Trade Balance (millions of m^3*)*

As we can see, all Mediterranean countries, with the exception of France, are net importers of virtual water through the trade in agricultural products. Italy is the largest importer of water, but figures depend on the magnitude of trade flows and, therefore, on the size of the regional economy. To highlight how much each individual economy depends on virtual water flows, we divided the trade balance (BT) by the *sum* of exports and imports, to get the index shown in the column BTR. According to this index, the regions which are most dependent on virtual water imports are: Albania, Cyprus, Egypt, Italy, Tunisia and Rest of Middle East – North Africa.

From the trade flows matrix (Table A1) it is also possible to compute the net virtual water exchange for all pairs of regions. Figure 1 displays, on a map of the Mediterranean, the largest flows, and their direction. The thickness of the arrow line depends on the magnitude of the flow: larger lines are for net flows exceeding one billion of m^3, the others are associated with flows between 300 and 1,000 millions of m^3.

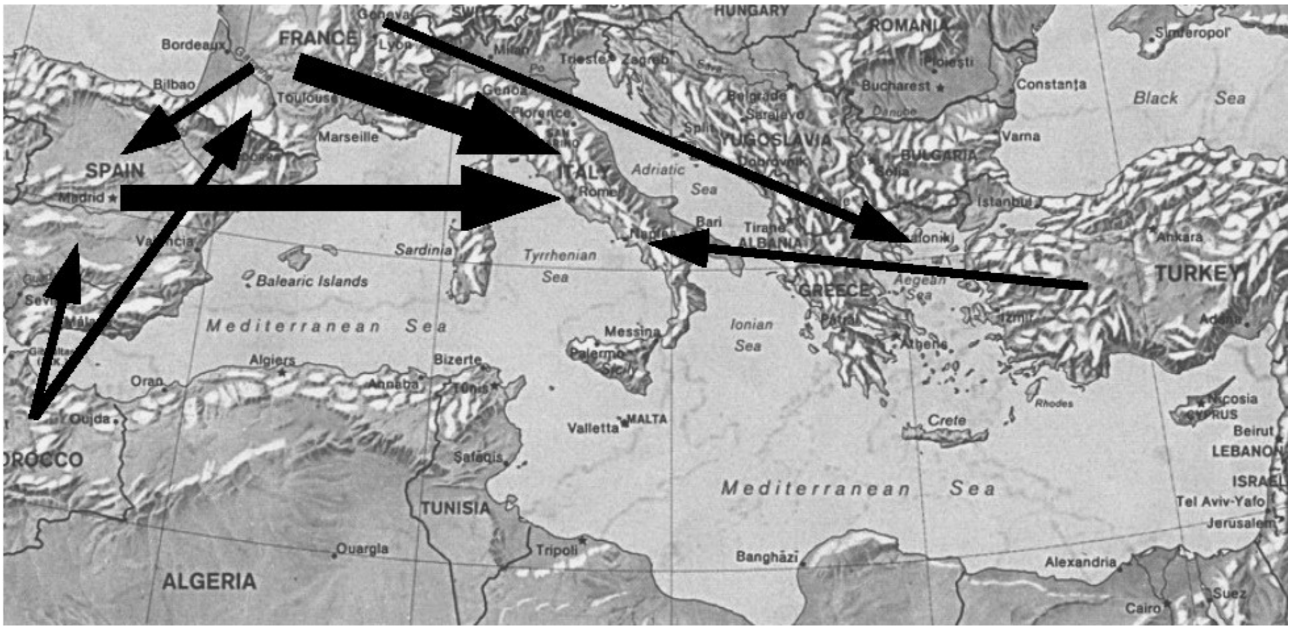

Figure 1 – Largest net flows of virtual water trade in the Mediterranean

3. Assessing future water availability and virtual trade in a general equilibrium model

Our analysis of future water availability in the Mediterranean is based on data provided by Strzepek and Boehlert (2009), summarized for some countries[2] in Table 2.

	M.A.R. 2000	Ag. 2000	M-I 2000	EFR	WCI	W 2050	D 2050
Albania	114.2	6.8	2.5	38.1	0.0	95.3	89.4
Cyprus	0.7	0.2	0.1	0.2	0.4	0.7	0.7
Egypt	60.2	89.7	16.4	0.6	1.0	60.4	60.5
France	138.8	9.7	37.3	42.8	0.0	120.6	114.3
Italy	93.6	9.6	24.4	42.2	0.4	88.0	78.8
Morocco	10.8	9.9	1.6	3.4	1.0	4.7	5.7
Spain	11.1	2.5	1.8	3.9	0.5	10.3	8.4
Tunisia	3.3	3.8	0.6	0.9	1.0	3.2	4.3
Turkey	131.6	26.6	9.5	42.0	0.3	99.0	129.7

Table 2 – Data on water consumption and future availability

The second column in the table shows, for each country, the Mean Annual Runoff of water in the year 2000. The following three columns display estimates of water use for agriculture, municipal and industrial consumption (2000), and "environmental flow requirement", that is, the amount of water which is considered to be necessary to preserve aquatic ecosystems.

We build an index of water constraint (WCI), by considering the ratio of water consumption in agriculture over the MAR net of non-agricultural water use. The WCI is equal to this ratio, unless the ratio is greater than one (in this case it is set to one) or the ratio is lower than 0.25 (in this case it

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[2] Data for Croatia and Greece are missing in the original data set. Whenever appropriate, we applied data for Italy and Spain, respectively.

is set to zero). This index is used to understand how much each country is actually constrained by its water resources. If the WCI index is greater than one, as it is the case for North African countries, it means that water use currently exceeds the MAR, possibly meaning that non renewable water reservoirs are exploited. If, vice versa, the WCI is zero, it means that water resources are abundant, and relatively minor variations in water availability will have no effects on the economy. The intermediate case ($0.25 < WCI < 1$) is for countries that can be considered "partially water constrained". Although the MAR exceeds total water use in 2000, we cannot exclude (since data cover the whole region and one year) that water scarcity may be a problem in some areas and in some periods of the year.

The remaining two columns shows estimates of future mean annual runoff, for the year 2050, generated by two global climate models, combined with the CLIRUN II hydrologic model (Strezepek et al., 2008). The "W" scenario, obtained from NCAR, estimates a relatively wetter climate, whereas the "D" scenario (from CSIRO) is relatively drier.[3] We can see that the climate models predict a reduction of precipitations and run-off for most Mediterranean countries, with dramatic effects for Morocco, whereas some other countries are not significantly affected. In addition to the W and D cases, we consider an intermediate one (labeled "M"), which has been got as a simple average of W and D estimates. This latter scenario is introduced to provide a central value and a sensitivity analysis for our results.

We use the information above to simulate the climate change effects on agricultural productivity and virtual water in a general equilibrium model.[4] We consider the 2000-2050 percentage change in the MAR for the three scenarios (W, M, D), and we assume that the multifactor productivity in all agricultural sectors varies by the same change, multiplied by the WCI. This means that, if a country is already water constrained, any drop in surface water availability directly translates into lower yield for all crops. Conversely, if the country is only partially constrained, only some of the water change will be felt through a productivity impact.

Since the exogenous shock is introduced in the general equilibrium model as a shift in multifactor productivity for agriculture, we can expect that the new equilibrium will be characterized by loss (gain) of competitiveness for those industries and regions which have high (low) water intensity, whenever water availability is assumed to be lower in the future. Following the basic Heckscher-Ohlin logic, countries will tend to specialize in those productions which are intensive in the factors which are relatively abundant, including water. Trade flows will adjust accordingly, with more virtual water flowing towards water-stressed regions.

Before examining the simulation results in terms of virtual water, let us consider some aggregate macroeconomic indicators, accounting for the overall impact of the varying water availability on national income and welfare. Table 3 presents simulation results for the Gross Domestic Product (GDP) and the Equivalent Variation (EV). The latter is a measure of welfare, amounting to the hypothetical variation in income (at constant prices) which would have generated the same impact in terms of consumer utility of the exogenous shocks considered in the simulations.

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[3] This holds globally, not necessarily at the regional level.

[4] The model is the standard, comparative static, GTAP model, with a specific regional and industrial aggregation.

	var. GDP %			EV (M US$)		
	W	**M**	D	W	**M**	D
Albania	-0.03	**-0.04**	-0.06	-9	**-13**	-17
Croatia	-0.28	**-0.51**	-0.74	-108	**-192**	-276
Cyprus	-0.23	**-0.13**	-0.04	-35	**-23**	-12
Egypt	0.1	**0.11**	0.13	162	**171**	181
France	-0.01	**-0.01**	-0.01	-522	**-623**	-723
Greece	-0.64	**-1.32**	-1.99	-1,388	**-2,816**	-4,244
Italy	-0.2	**-0.34**	-0.49	-3,450	**-5,830**	-8,210
Morocco	-15.7	**-14.4**	-13.1	-7,529	**-6,891**	-6,253
Spain	-0.53	**-1.07**	-1.61	-5,215	**-10,559**	-15,903
Tunisia	-1.02	**2.81**	6.63	-262	**817**	1,897
Turkey	-1.67	**-0.88**	-0.1	-4,684	**-2,443**	-203
Rest.Euro	-0.22	**-0.22**	-0.22	-18,515	**-18,816**	-19,117
Rest MENA	-0.74	**-0.74**	-0.74	-5,485	**-5,458**	-5,431
RoW	0.34	**0.34**	0.34	86,122	**86,142**	86,161

Table 3 – Simulation results: macroeconomic indicators

Generally speaking, climate models predict a reduction of water availability in the Mediterranean, with negative consequences in terms of national income and welfare. The loss depends on the amount of reduction of water resources, but also on the share of agricultural activities in the economy. There is a special case, where the model predicts a dramatic fall of about 14.4% of the GDP in Morocco, which is already water constrained and it is supposed to face a significant reduction of precipitations and run-off. Tunisia, another water-constrained country, may gain under the D scenario. Significant reductions of GDP and welfare are estimated for Spain and Greece. Only one country gets benefits in all settings: Egypt. This is not because of an increase in water resource stocks (which are basically unchanged) but because of improvements in relative competitiveness vis-à-vis its neighboring countries.

Table 4 shows the *increase* in virtual water *imports*, by country. In other words, this is a measure of water savings obtained through trade in agricultural goods. Of course, those countries which are experiencing larger reductions in agricultural productivity, induced by water shortage, are also the ones which are getting more virtual water from abroad. Morocco, for example, virtually imports some additional 11,644 millions of cubic metres of water.

There is, of course, a relationship between reductions of productivity in agriculture and virtual water imports. Figure 2 plots on a diagram the pairs (variations in productivity, additional net imports of virtual water – relative to trade volume), for each country. It also plots some other points, obtained through a simple linear interpolation. It is found that, on average, a reduction of 1% in agricultural productivity in some Mediterranean country is associated with additional net virtual water imports, which are 2.14% of the sum of baseline virtual water imports and exports. This would amount to 694 millions of cubic metres of water in Italy, 417 in Egypt, 145 in Greece, 232 in Morocco, 889 in Spain, 255 in Turkey.

	W	**M**	D
Albania	41	**41**	41
Croatia	130	**199**	268
Cyprus	51	**42**	33
Egypt	624	**597**	566
France	-1,697	**-1,701**	-1,705
Greece	754	**1,355**	1,956
Italy	2,328	**3,292**	4,256
Morocco	12,671	**11,644**	10,617
Spain	3,524	**6,740**	9,958
Tunisia	674	**-1,295**	-3,265
Turkey	3,037	**1,705**	373
Rest.Euro	12,918	**12,905**	12,891
Rest MENA	16,501	**16,501**	16,502
RoW	-51,556	**-52,025**	-52,490

Table 4 – Increases in VW Imports (millions of m^3)

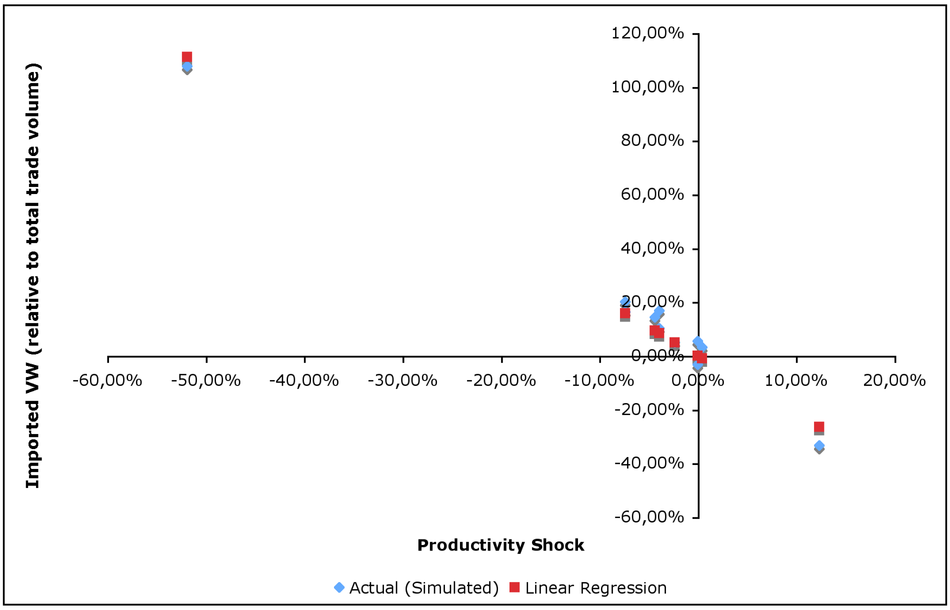

Figure 2 – Virtual Water / Productivity relationship

How effective is the virtual water mechanism in curbing the effects of water scarcity? Generally speaking, we could say that its effectiveness is related to the degree of flexibility in the economic system, that is, how easy it may be substituting factors in production processes, consumption goods, or origin of imported products.

To analyze this, we conduct an additional simulation experiment. We run the general equilibrium model under the "middle" scenario M, but this time we constraint one country (Spain) not to increase its imports (or exports) of agriculture goods, thereby not increasing virtual water imports (or exports).[5] Results in terms of GDP and EV are reported in Table 5, together with differences

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[5] This was done by keeping exogenously fixed at the baseline level those trade flows of agricultural goods, involving Spain, which were increasing under the M base simulation, while making endogenous a productivity parameter

with respect to the unconstrained case.

	var. GDP %		EV (M US$)	
	M	Difference	**M**	Difference
Albania	-0.05	-0.01	-13	0
Croatia	-0.51	0	-193	-1
Cyprus	-0.13	0	-24	0
Egypt	0.11	0	171	0
France	-0.01	0	-713	-90
Greece	-1.32	0	-2,813	3
Italy	-0.34	0	-5,799	31
Morocco	-14.45	-0.05	-6,891	0
Spain	**-1.34**	**-0.27**	**-13,099**	**-2,540**
Tunisia	2.79	-0.02	782	-35
Turkey	-0.89	-0.01	-2,439	5
Rest.Euro	-0.22	0	-18,748	68
Rest MENA	-0.74	0	-5,465	-7
RoW	0.34	0	85,895	-247

Table 5 – Macroeconomic indicators for the M-Spain constrained simulation

We can see that imposing a "no virtual water" constraint for Spain reduces GDP and EV not only for Spain, but also for all its trading partners. In particular, Spanish GDP is reduced by an additional -0.27%. The welfare impact is equivalent to a reduction of 2,540 millions of US$ for Spain, and to 2,813 millions US$ for the whole world. This may be considered as the cost of the virtual water constraint or, equivalently, the value of virtual water for Spain.

The global amount of virtual water trade depends on how easily it may be to substitute domestic production with imports, and imports sources among themselves. In general equilibrium models like the one we are using in this simulation exercise, it is customary to assume that goods within the same sector, but produced in different places, are imperfect substitutes.[6] When relative prices change, so does the import pattern, where the sensitivity of import shares to relative prices is determined by exogenously given elasticity of substitution parameters.[7]

Table 6 shows how results would change, for the M scenario, when elasticities of substitution for all agricultural products are reduced by 50%. Basically, countries which were importing virtual water now import much less, whereas virtual water exporters now export less.

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associated with each constrained flow.

[6] This is called "Armington assumption". It accounts for product heterogeneity in large aggregates, by which, for example, Tunisian agricultural goods are indeed different products than Italian agricultural goods.

[7] In models based on the standard GTAP frameworks, there is a two levels process. First, domestic products are substituted (in production and consumption) with an import composite. Second, within the import composite, there is substitution among alternative foreign supplies.

	M	**M-low**
Albania	**41**	**23**
Croatia	**199**	**121**
Cyprus	**42**	**23**
Egypt	**597**	**352**
France	**-1,701**	**-1,319**
Greece	**1,355**	**773**
Italy	**3,292**	**2,121**
Morocco	**11,644**	**7,196**
Spain	**6,740**	**4,057**
Tunisia	**-1,295**	**-733**
Turkey	**1,705**	**970**
Rest.Euro	**12,905**	**7,197**
Rest MENA	**16,501**	**9,269**
RoW	**-52,025**	**-30,050**

Table 6 – Increases in VW Imports with reduced elasticities (millions of m^3*)*

Since the volume of virtual water trade depends on elasticities of substitution, one may wonder what determines the value for these parameters, and what could make them changing. In general, elasticities of substitution tell us how easy the substitution process may be for consumers and firms. Elasticities will be high (and the virtual water trade mechanism more effective) when goods produced in different locations are perceived as similar, in the sense that they have similar effects on production processes, or on consumer's utility.

This characteristic may not be purely subjective, or determined by technology. To the extent that specific policies may increase the degree of substitutability, the same policies could enhance the virtual trade mechanism.

4. Concluding remarks

Virtual water is nothing new. Any time there is trade in goods, whose production involves some consumption of water, we can say there is a virtual water exchange. What is interesting to see is how effective is this, autonomous, market driven adjustment mechanism in curbing the negative impact of water scarcity, particularly in relation to climate change.

Climate change is expected to alter the precipitations pattern, and consequently the availability of surface water. Water availability will increase in some countries, which are often already water abundant, whereas it will decrease in some other regions, like the Mediterranean. Our numerical simulations suggest that the virtual water mechanism can help in reducing the impact of water scarcity, but it can only do that marginally.

The effectiveness of virtual water trade is related to the degree of flexibility within the regional economic systems. More flexible production processes, more globalization and integration, lower transport costs and other barriers to trade, they would all contribute in making economic systems more resilient to outside shocks, including those related to water scarcity and agriculture productivity.

Our analysis is intended to demonstrate the potential usefulness of the virtual water concept, particularly is association with issues of water scarcity and climate change. Yet, it is also subject to a number of caveats, suggesting directions for improvements and future research.

First, future water availability should be better estimated. Regional climate models still provide quite divergent predictions for precipitations at the country, or sub-country, level. Better hydrological models are required to translate climate scenarios into estimates of water resources and runoff. Furthermore, alternative and concurrent uses of water, for the future, should be more carefully evaluated, especially for municipal, industrial, and environmental purposes.

Second, there is a need to better understand the link between water availability and productivity, in agriculture and elsewhere. What drives our simulations is exogenous changes in productivity, not water. But, to what extent a decline in water availability translates into lower productivity (yield in agriculture)? What is the role of improved water efficiency?

A number of research projects have recently started to tackle these and other issues. We believe that new important insights will come up in the near future.

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References

Allan, J.A. (1993) ‘Fortunately there are substitutes for water otherwise our hydro-political futures would be impossible’ In: ODA, *Priorities for water resources allocation and management*, ODA, London, pp. 13-26.

Berrittella, M., K.Rehdanz, R.Roson and R.S.J. Tol (2008), “The Economic Impact of Water Taxes: a Computable General Equilibrium Analysis with an International Data Set”, *Water Policy*, vol.10(3), pp. 259-271.

Chapagain, A.K. and A.Y. Hoekstra (2003) “Virtual water trade: A quantification of virtual water flows between nations in relation to international trade of livestock and livestock products”, in: A.Y. Hoekstra (ed.), *Virtual water trade, Proceedings of the International Expert Meeting on Virtual Water Trade*, Value of Water Research Report Series No. 12, UNESCO-IHE Delft.

Chapagain, A.K. and A.Y. Hoekstra (2004), *Water Footprints of Nations*, Volume 2: Appendices, Value of Water Research Report Series No. 16, UNESCO-IHE Delft.

Hertel, Thomas W., editor (1997), *Global Trade Analysis: Modeling and Applications*, Cambridge University Press, New York.

Hoekstra, A.Y. (2003), “Virtual Water: an Introduction”, in: A.Y. Hoekstra (ed.), *Virtual water trade, Proceedings of the International Expert Meeting on Virtual Water Trade*, Value of Water Research Report Series No. 12, IHE Delft.

Strzepek, K., R. Balaji, H. Rajaram and J. Strzepek (2008), *A Water Balance Model for Climate Impact Analysis of Runoff with emphasis on Extreme Events*, Mimeo.

Strzepek, K. and B. Boehlert (2009), *Competition for Water for the Food System*, Mimeo.

UNEP – Plan Bleu (2006), *Facing water stress and shortage in the Mediterranean*, Blue Plan Notes n.4, October 2006.

Appendix

	ALB	CRO	CYP	EGY	FRA	GRE	ITA	MOR	SPA	TUN	TUR	ROE	RMA	ROW	Total
ALB	0.00	0.29	0.02	0.06	4.31	4.69	18.40	0.02	1.15	0.01	1.32	25.58	0.43	13.32	69.61
CRO	6.90	0.00	2.41	2.81	9.49	2.97	71.76	0.27	3.73	0.09	2.51	157.40	4.40	89.72	354.45
CYP	0.03	0.71	0.00	0.50	3.05	5.31	8.95	0.01	1.40	0.01	6.13	68.89	10.13	14.09	119.20
EGY	15.44	2.90	4.86	0.00	55.16	91.41	255.94	26.78	52.91	39.55	104.98	978.82	1,020.81	773.10	3,422.64
FRA	26.94	9.40	104.75	45.30	0.00	541.87	4,562.23	863.17	4,246.48	233.47	76.04	18,523.43	2,926.89	2,652.17	34,812.13
GRE	83.35	16.71	52.03	5.35	45.01	0.00	242.29	0.92	36.14	1.09	30.89	1,662.27	49.54	165.29	2,390.88
ITA	24.73	49.39	5.34	4.25	652.24	171.31	0.00	2.84	272.62	2.97	27.27	3,700.04	487.83	577.45	5,978.27
MOR	0.61	3.17	0.71	2.59	1,640.89	4.86	124.58	0.00	346.33	8.49	3.10	1,398.51	57.97	684.59	4,276.40
SPA	1.48	30.26	7.28	3.40	3,799.14	121.60	1,465.00	41.23	0.00	32.02	30.05	12,375.59	411.07	671.44	18,989.56
TUN	0.18	0.90	0.48	0.51	229.90	4.19	103.63	55.81	76.83	0.00	5.73	220.94	91.30	129.44	919.86
TUR	8.35	16.07	0.94	57.11	327.14	143.09	620.13	6.99	160.75	22.63	0.00	2,746.23	407.70	1,328.89	5,846.02
ROE	80.24	284.10	148.22	162.76	3,175.27	890.49	3,524.87	287.43	3,815.00	385.56	1,122.66	28,424.40	4,715.02	6,427.47	53,443.50
RMA	1.04	2.28	44.93	139.08	395.03	42.73	246.42	5.89	107.23	33.30	98.32	1,016.27	3,860.28	3,196.22	9,189.02
ROW	441.70	414.16	377.51	15,638.92	7,543.18	2,337.46	15,201.52	5,248.39	13,389.81	2,209.63	4,527.74	80,542.63	48,517.77	451,848.32	648,238.74
Total	690.99	830.35	749.47	16,062.63	17,879.82	4,361.99	26,445.74	6539.76	22510.37	2968.83	6,036.74	151,840.99	62,561.14	468,571.50	

Table A1 – Baseline virtual water trade flows (millions of m^3)