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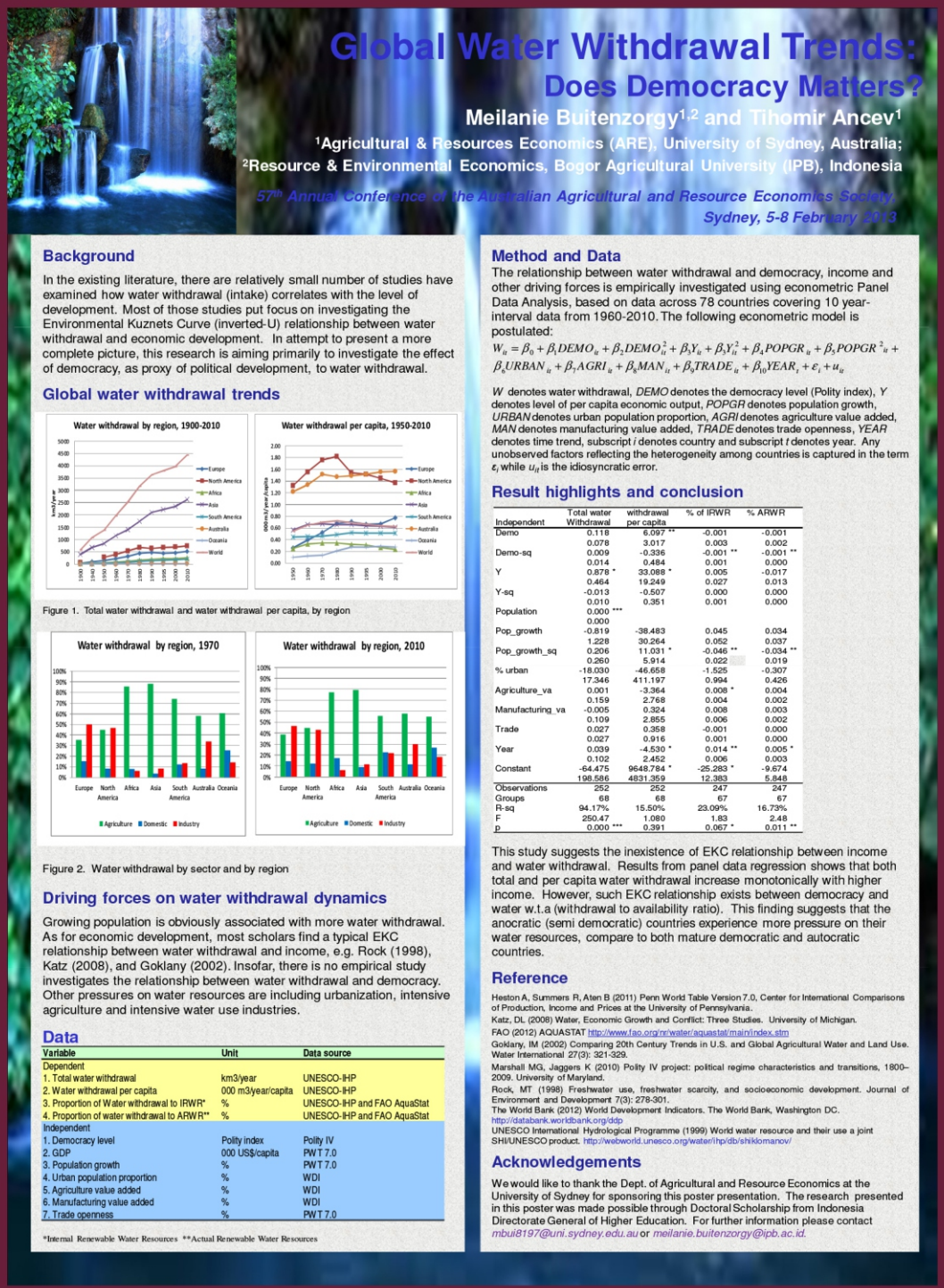

Global Water Withdrawal Trends: Does Democracy Matters?

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Background

In the existing literature, there are relatively small number of studies have examined how water withdrawal (intake) correlates with the level of development. Most of those studies put focus on investigating the Environmental Kuznets Curve (inverted-U) relationship between water withdrawal and economic development. In attempt to present a more complete picture, this research is aiming primarily to investigate the effect of democracy, as proxy of political development, to water withdrawal.

Global water withdrawal trends

Figure 1. Total water withdrawal and water withdrawal per capita, by region

Figure 2. Water withdrawal by sector and by region

Driving forces on water withdrawal dynamics

Growing population is obviously associated with more water withdrawal. As for economic development, most scholars find a typical EKC relationship between water withdrawal and income, e.g. Rock (1998), Katz (2008), and Goklany (2002). Insofar, there is no empirical study investigates the relationship between water withdrawal and democracy. Other pressures on water resources are including urbanization, intensive agriculture and intensive water use industries.

Data

Variable	Unit	Data source
Dependent		
1. Total water withdrawal	km3/year	UNESCO-IHP
2. Water withdrawal per capita	000 m3/year/capita	UNESCO-IHP
3. Proportion of Water withdrawal to IRWR*	%	UNESCO-IHP and FAO AquaStat
4. Proportion of water withdrawal to ARWR**	%	UNESCO-IHP and FAO AquaStat
Independent		
1. Democracy level	Polity index	Polity IV
2. GDP	000 US$/capita	PWT 7.0
3. Population growth	%	PWT 7.0
4. Urban population proportion	%	WDI
5. Agriculture value added	%	WDI
6. Manufacturing value added	%	WDI
7. Trade openness	%	PWT 7.0

*Internal Renewable Water Resources **Actual Renewable Water Resources

Method and Data

The relationship between water withdrawal and democracy, income and other driving forces is empirically investigated using econometric Panel Data Analysis, based on data across 78 countries covering 10 year-interval data from 1960-2010. The following econometric model is postulated:

$$W_{it} = \beta_0 + \beta_1 DEMO_{it} + \beta_2 DEMO_{it}^2 + \beta_3 Y_{it} + \beta_3 Y_{it}^2 + \beta_4 POPGR_{it} + \beta_5 POPGR^2{}_{it} + \beta_6 URBAN_{it} + \beta_7 AGRI_{it} + \beta_8 MAN_{it} + \beta_9 TRADE_{it} + \beta_{10} YEAR_t + \varepsilon_i + u_{it}$$

W denotes water withdrawal, *DEMO* denotes the democracy level (Polity index), *Y* denotes level of per capita economic output, *POPGR* denotes population growth, *URBAN* denotes urban population proportion, *AGRI* denotes agriculture value added, *MAN* denotes manufacturing value added, *TRADE* denotes trade openness, *YEAR* denotes time trend, subscript *i* denotes country and subscript *t* denotes year. Any unobserved factors reflecting the heterogeneity among countries is captured in the term ε_i while u_{it} is the idiosyncratic error.

Result highlights and conclusion

Independent	Total water Withdrawal	withdrawal per capita	% of IRWR	% ARWR
Demo	0.118	6.097 **	-0.001	-0.001
	0.078	3.017	0.003	0.002
Demo-sq	0.009	-0.336	-0.001 **	-0.001 **
	0.014	0.484	0.001	0.000
Y	0.878 *	33.088 *	0.005	-0.017
	0.464	19.249	0.027	0.013
Y-sq	-0.013	-0.507	0.000	0.000
	0.010	0.351	0.001	0.000
Population	0.000 ***			
	0.000			
Pop_growth	-0.819	-38.483	0.045	0.034
	1.228	30.264	0.052	0.037
Pop_growth_sq	0.206	11.031 *	-0.046 **	-0.034 **
	0.260	5.914	0.022	0.019
% urban	-18.030	-46.658	-1.525	-0.307
	17.346	411.197	0.994	0.426
Agriculture_va	0.001	-3.364	0.008 *	0.004
	0.159	2.768	0.004	0.002
Manufacturing_va	-0.005	0.324	0.008	0.003
	0.109	2.855	0.006	0.002
Trade	0.027	0.358	-0.001	0.000
	0.027	0.916	0.001	0.000
Year	0.039	-4.530 *	0.014 **	0.005 *
	0.102	2.452	0.006	0.003
Constant	-64.475	9648.784 *	-25.283 *	-9.674
	198.586	4831.359	12.383	5.848
Observations	252	252	247	247
Groups	68	68	67	67
R-sq	94.17%	15.50%	23.09%	16.73%
F	250.47	1.080	1.83	2.48
p	0.000 ***	0.391	0.067 *	0.011 **

This study suggests the inexistence of EKC relationship between income and water withdrawal. Results from panel data regression shows that both total and per capita water withdrawal increase monotonically with higher income. However, such EKC relationship exists between democracy and water w.t.a (withdrawal to availability ratio). This finding suggests that the anocratic (semi democratic) countries experience more pressure on their water resources, compare to both mature democratic and autocratic countries.

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