

Consumo de agua a nivel residencial caracterización y modelamiento

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Agua y ciudad

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- Problema del estudio: ¿qué explica el consumo de agua residencial en Chile?
- Perspectiva dinámica: ¿Cuál es el rol del
 - clima (cambio climático)
 - Desarrollo económico (urbanización e ingreso)
- Distinguir efectos climáticos de largo plazo
- Si el consumo de agua residencial en Chile es una función de clima entonces cuál es el efecto del cambio climático en el futuro.
- Como abordar estimaciones con limitaciones que imponen datos disponibles

¿Como se modela el Consumo?

Modelos de elección Continua / Discreta

Hewitt & Hanemann (1995), Corral et al. (1998), Pint (1999) y
Olmstead & Hanemann (2007)

Nivel de agregación: Hogares

Modelación Dinámica

Naugues & Thomas (2003), Garcia & Reynaud (2004), Musolesi &
Nosvelli (2007)

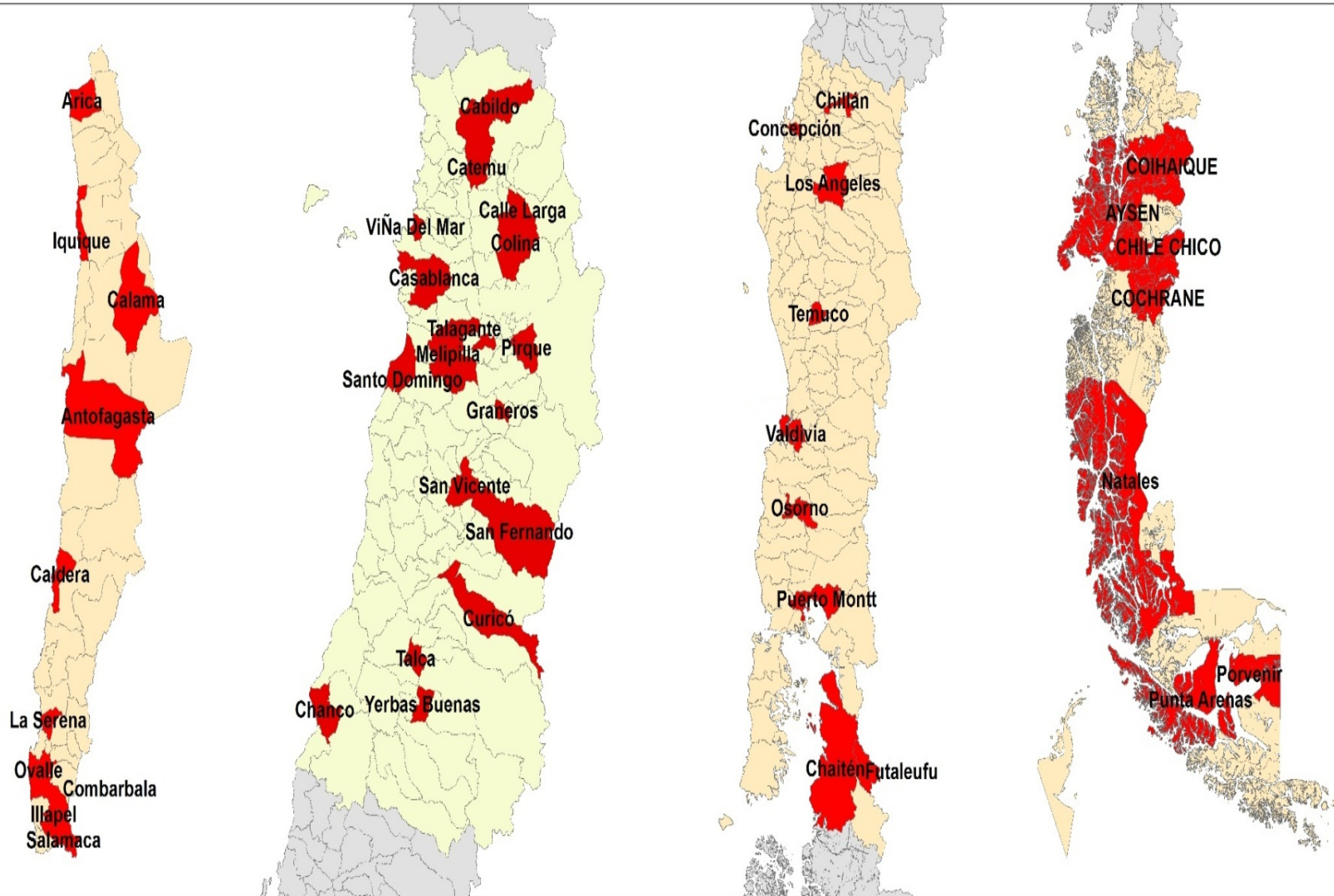
Nivel de agregación: Localidad u Hogares

Técnicas de Datos de Panel

Martinez-Espiñeira (2002), Mazzanti & Montini (2006), Frondel &
Messner (2008)

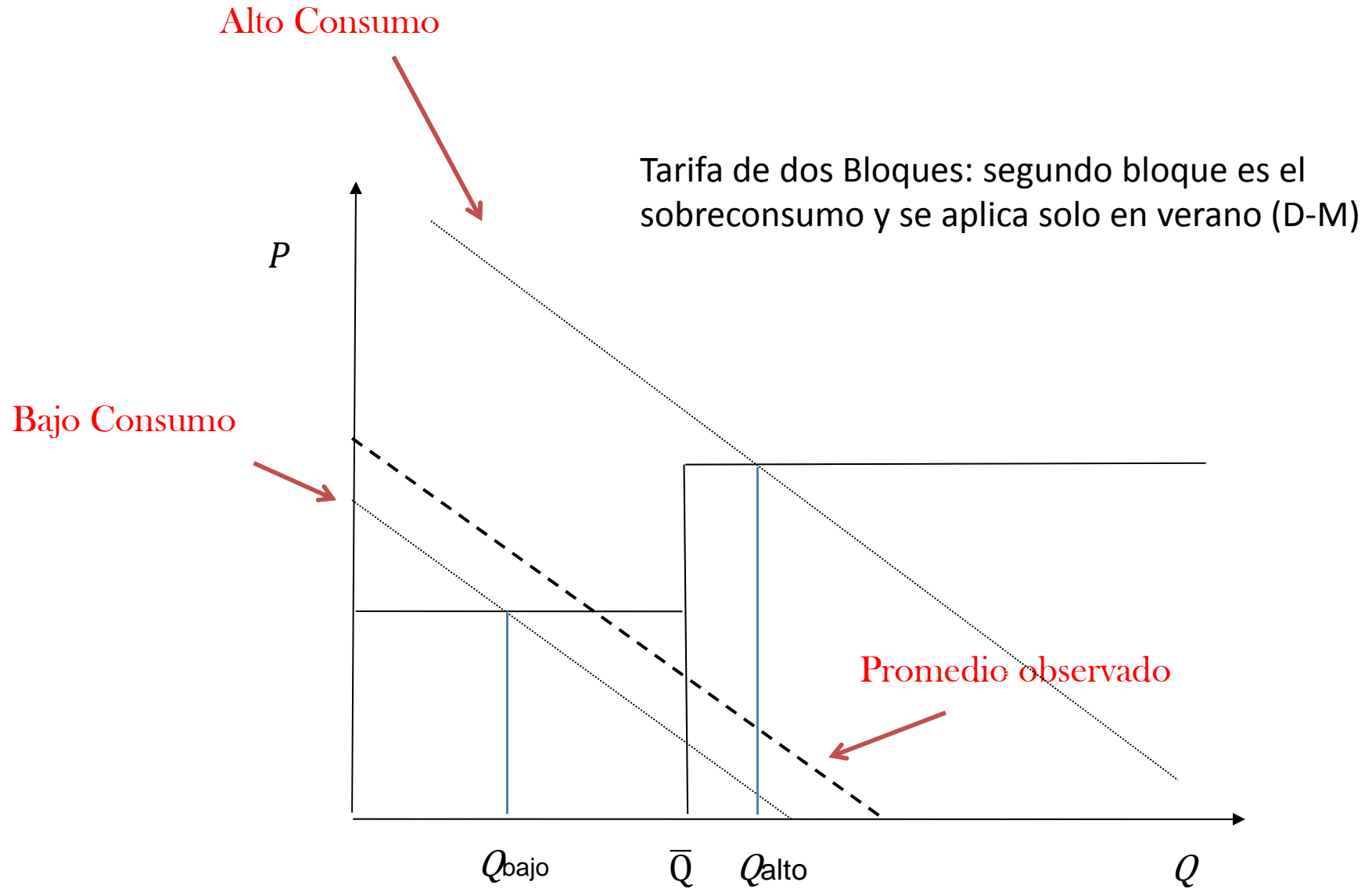
Nivel de agregación: Localidad u Hogares

Datos de precio y consumo



44 comunas, consumo agregado mensual de 1998 to 2010 Fuente SISS

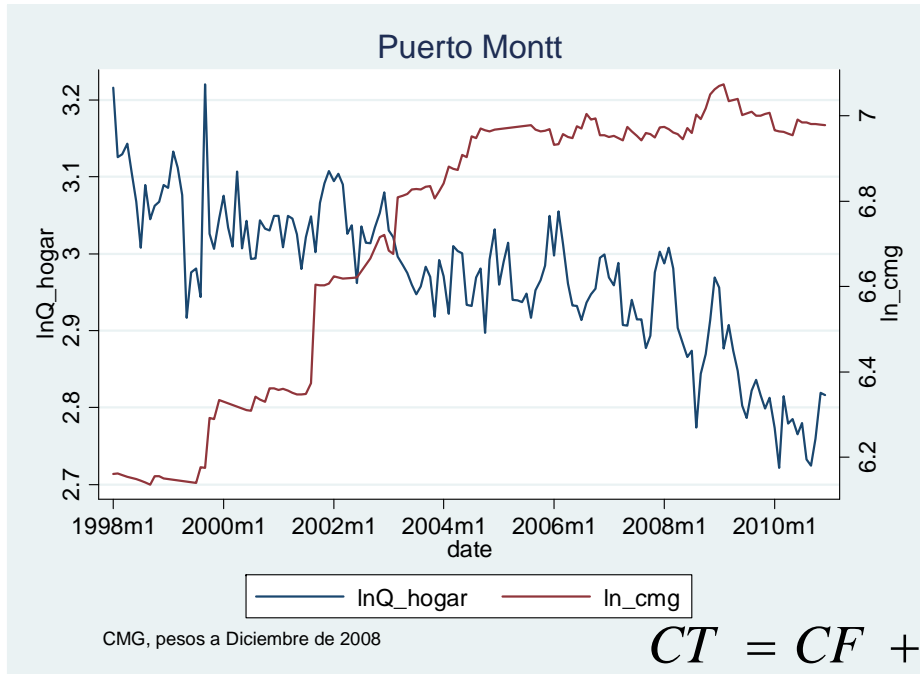
tarifas



Datos

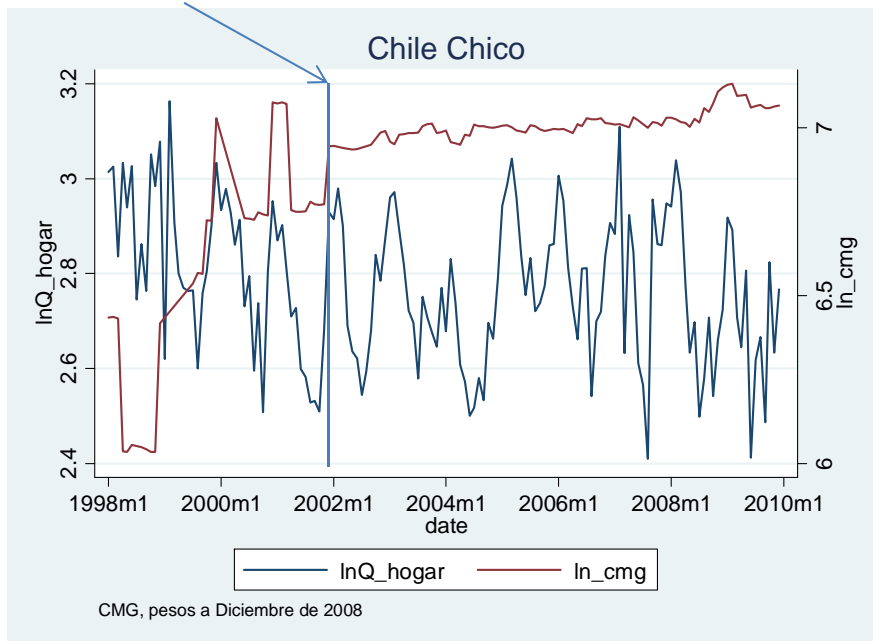
No tiene sobreconsumo

3 tipos de regímenes tarifarios

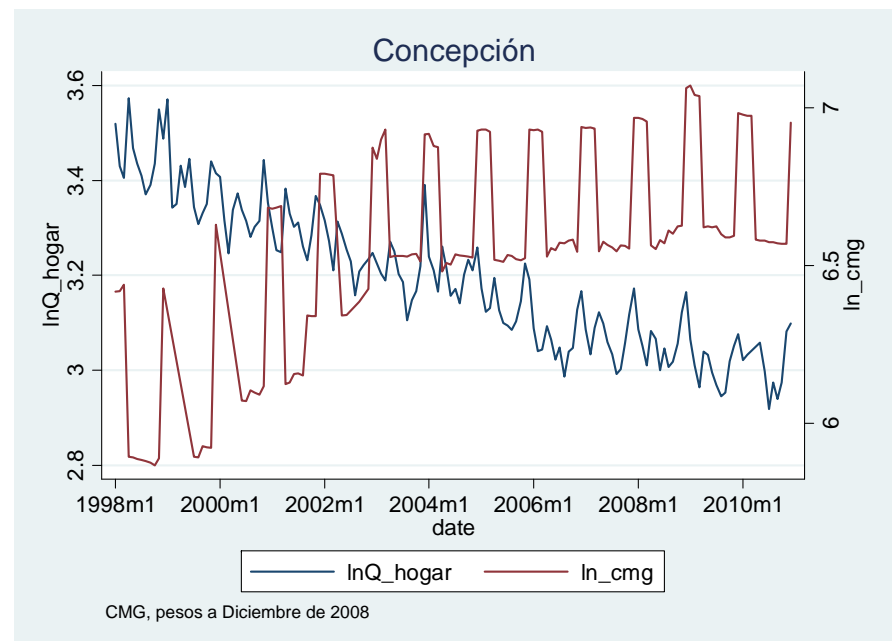


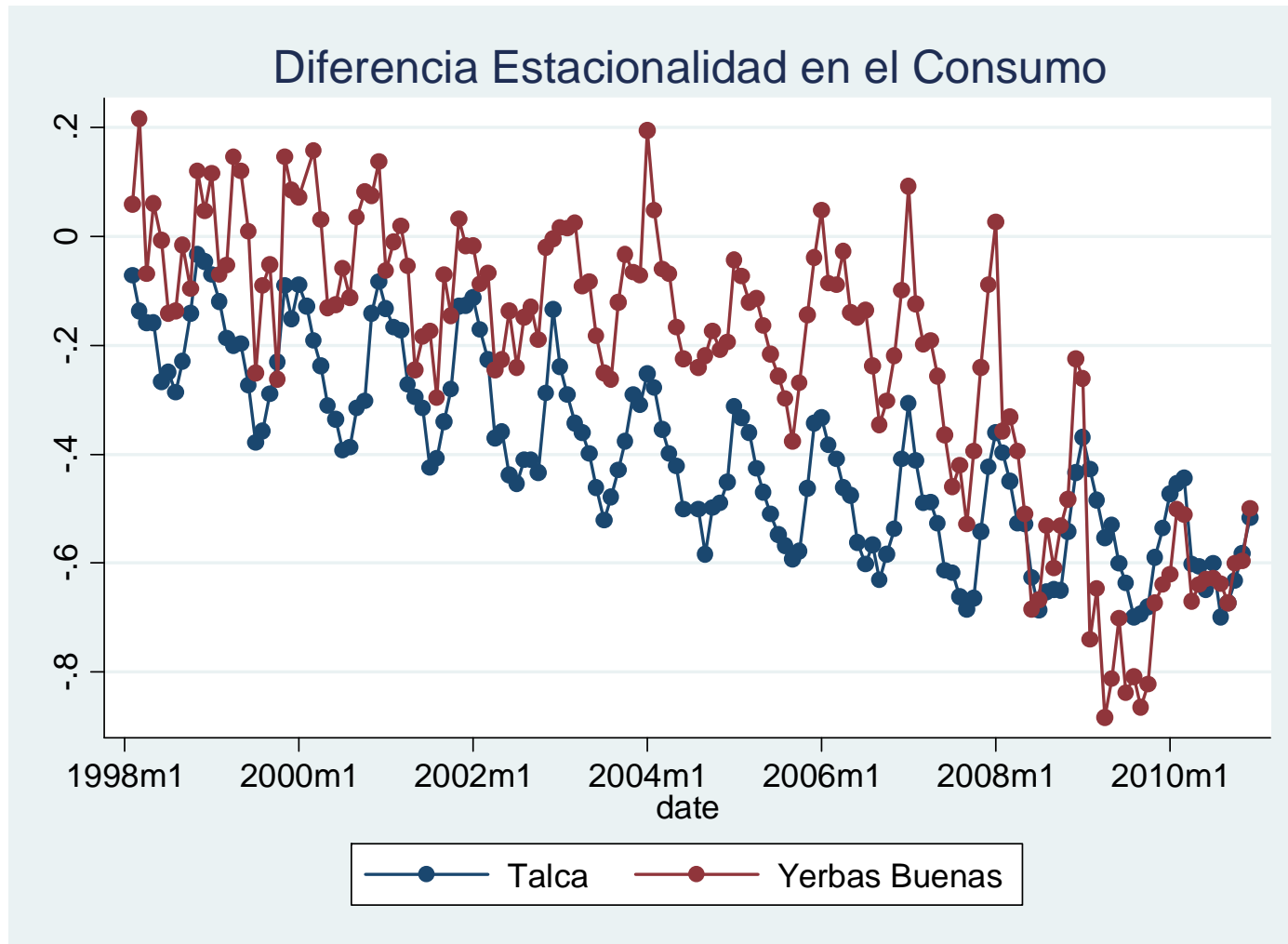
$$CT = CF + (q_T * CV \pi) D_1 + (\bar{q} * CV + \pi * SC) D_2$$

Abandona sobre consumo el 2002



Tiene sobreconsumo

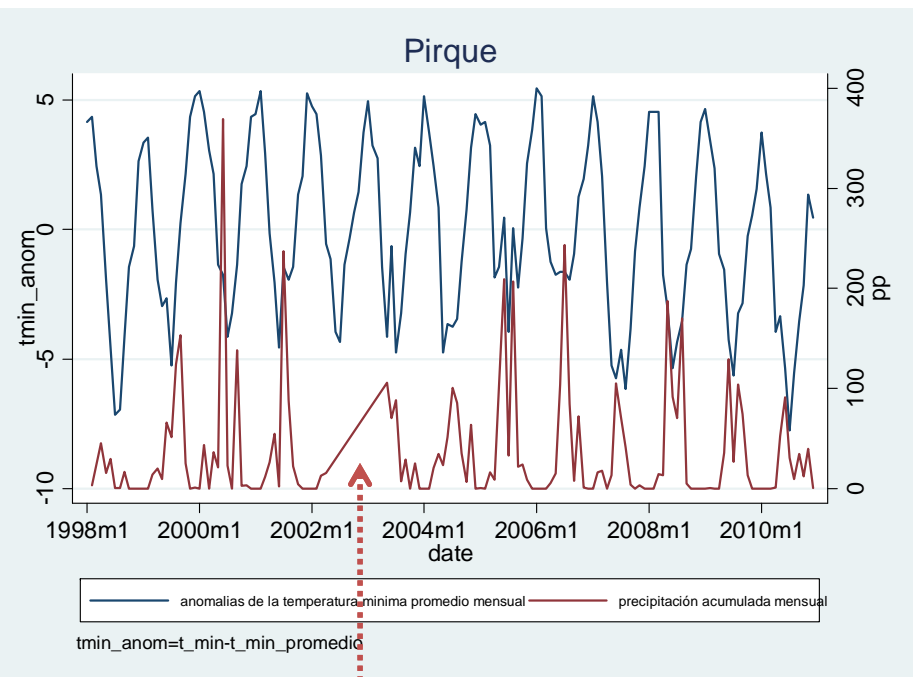
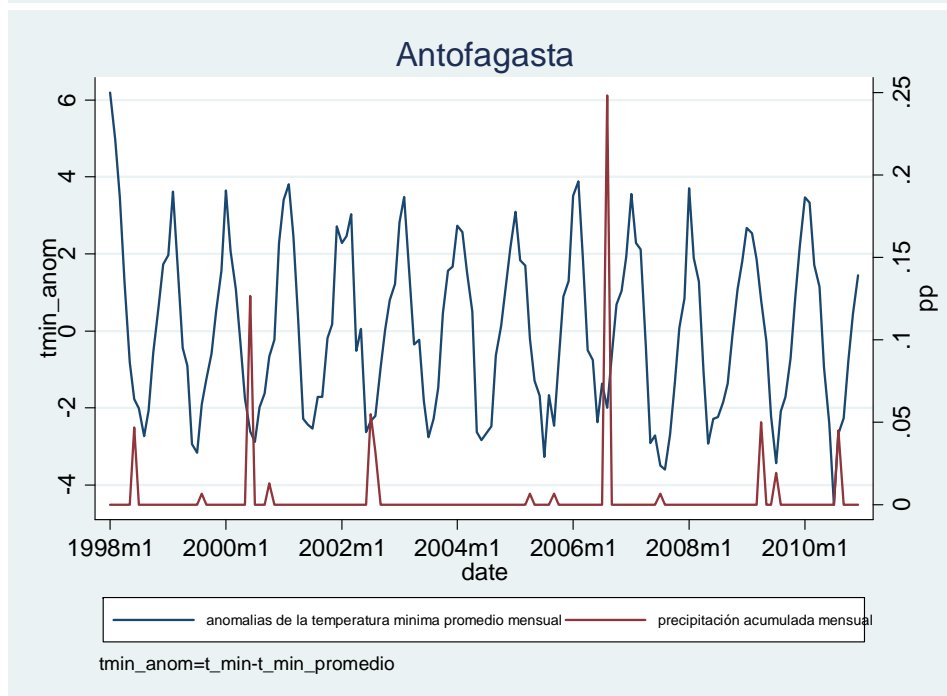
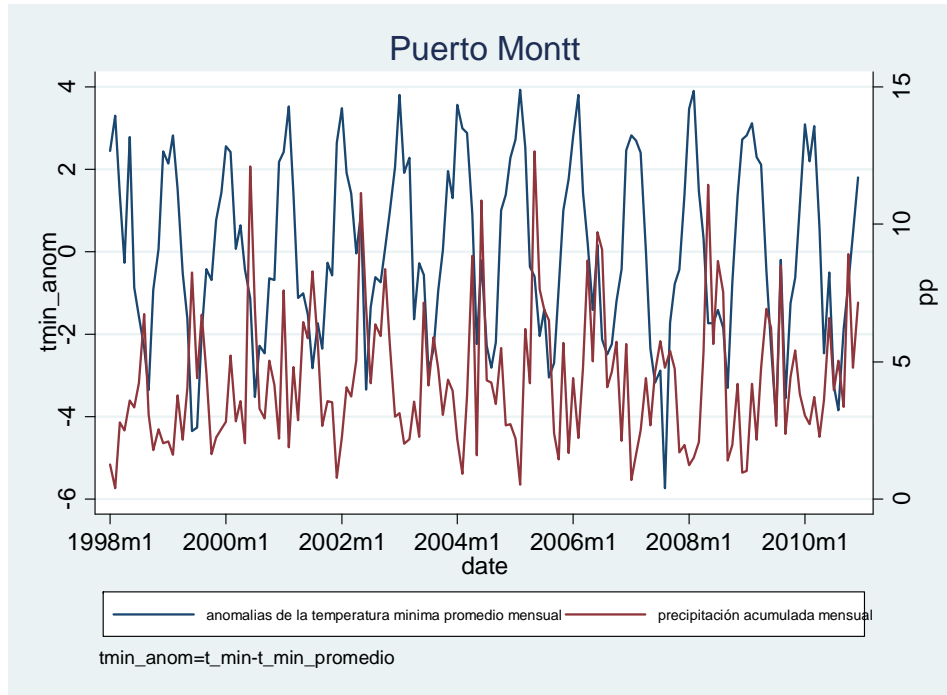




Nivel de Urbanización promedio: Talca 95%, Yerbos Buenas 11%

Datos

precipitación y anomalías de temperatura



faltan datos

Modelo

Variables climáticas (clima y tiempo)

$$\ln Q = \alpha + \beta_1 \ln T_v + \beta_2 \ln T_{sc} * d_p * d_{sc} + \gamma' Cl + \delta' Z + \varphi' D + \sigma' Z + \nu_i + \varepsilon_{it}$$

Características del hogar y municipio

estacionalidad

Zona Geográfica

Donde: $\varepsilon_{it} = \rho * \varepsilon_{i, t-1} + \eta_{it}$

Tiempo, temperatura: $M_{it} = \frac{T.\max_{t,i} - \overline{T.\max_{s,i}}}{\overline{T.\max_{s,i}}}$

Medido como desviación porcentual respecto de promedios para la temporada

Modelo

Variable	Variable Description	Source	Mean	Standard Deviation
InQ	Log monthly household water consumption (cubic meters)	SISS	2.84	0.31
InTv	Log variable rate of water and sewage (\$/cubic meters)	SISS	6.80	0.29
InTsc	Log overconsumption rate of water and sewage in summer (\$/cubic meters)	SISS	7.26	0.36
InIT	Log total income (million \$)	CASEN	13.39	0.29
InH_km2	Log population per square kilometer	INE / SINIM	3.33	2.21
Tme.Prom.Est	Seasonal mean of the average temperature (°C)	DMC	4.37	2.88
TMax.cp	Percentage change of the maximum temperature over the seasonal average.	DMC	0.00	0.08
PP. Prom. Est	Seasonal mean of the precipitation (monthly, millimeters)	DMC	16.96	28.00
PP.cp	Percentage change of precipitation over the seasonal average.	DMC	-0.19	1.06
Ocupación	Employment rate (%)	CASEN	0.91	0.03
Urb	Urbanization rate (%)	CASEN	0.76	0.20
Pobreza	Poverty rate (%)	CASEN	0.12	0.05
Pers_hogar	Persons per household (number)	CASEN	3.53	0.35
Tmedia.prom. * Urb	Interaction between seasonal mean temperature and urbanization rate.	DMC / CASEN	11.68	3.74
D_p	Dummy for summer (1 from December to march, 0 from April to November)	-	-	-
D_sc	Dummy for the use of overconsumption prices (1, if the municipality applies two block part tariff, 0 if not)	-	-	-
ZG	Categorical variable of geographic zone. 1-North, 2-Centre, 3-South	-	-	-

	Basic	With Climate variables	With HH and Municipal variables	With some Interaction variables
VARIABLES	Log consumo por hogar			
Log Variable rate	-0.1322*** (0.0159)	-0.1593*** (0.0138)	-0.1380*** (0.0131)	-0.1385*** (0.0131)
Log Over-consumption rate *Dp*Dsc	-0.0030*** (0.0009)	-0.0041*** (0.0010)	-0.0039*** (0.0009)	-0.0039*** (0.0009)
Log Income	0.2635*** (0.0082)	0.2805*** (0.0072)	0.1961*** (0.0124)	0.1944*** (0.0124)
Log habitants per km2	0.0392*** (0.0107)	0.0212*** (0.0089)	0.0070 (0.0086)	0.0069 (0.0086)
Intra- seasonal mean temp.		0.0075*** (0.0008)	0.0076*** (0.0008)	0.0103*** (0.0018)
Maximum temperature Δ%		0.1172*** (0.0072)	0.1183*** (0.0072)	0.1179*** (0.0072)
Seasonal Precipitation * North		-0.0044*** (0.0005)	-0.0044*** (0.0005)	-0.0042*** (0.0005)
Seasonal Precipitation * Centre		0.0040*** (0.0004)	0.0041*** (0.0004)	0.0039*** (0.0005)
Seasonal Precipitation * South		0.0044*** (0.0005)	0.0045*** (0.0005)	0.0042*** (0.0005)
Employment rate			0.3360*** (0.1239)	0.3330*** (0.1235)
Urbanization rate			0.4655*** (0.0726)	0.5084*** (0.0769)
Poverty rate			0.3743*** (0.0839)	0.3718*** (0.0836)
Household habitants			0.0832*** (0.0168)	0.0825*** (0.0168)
Intra-seasonal mean temperature * Urbanization rate				-0.0035* (0.0021)
Dummy summer (Dp)	0.0498*** (0.0057)	0.0263*** (0.0062)	0.0261*** (0.0062)	0.0264*** (0.0062)
Dummy seaside municipality on February	0.0562*** (0.0123)	0.0386*** (0.0125)	0.0390*** (0.0125)	0.0392*** (0.0125)
Constant	0.0572*** (0.0068)	-0.0033 (0.0062)	0.0088 (0.0065)	0.0089 (0.0065)
Observations	5,164	5,164	5,164	5,164
Municipalities	42	42	42	42
R ² Adj.	0.691	0.804	0.824	0.824
R ² Within	0.693	0.806	0.826	0.826
R ² Between	0.378	0.491	0.263	0.264
R ² Overall	0.327	0.446	0.285	0.287
Standard errors in parenthesis				

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Household inhabitants			0.0832*** (0.0168)	0.0825*** (0.0168)
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Standard errors in parenthesis				
*** p<0.05, ** p<0.1, * p<0.15				

Resultados

Variable	Cambio	Impacto Promedio
Tasa de ocupación	$\Delta 5\%$ (92% a 97%)	2.40%
Tasa de Urbanización	$\Delta 5\%$ (70% a 75%)	1.55%
Tasa de Pobreza	$\Delta 5\%$ (10% a 15%)	1.40%
Personas por hogar	1 persona (3 a 4)	10.80%

Variable	Localidad	Impacto Promedio
Temperatura ($\Delta +1^\circ\text{C}$ en punta)	Talca (ln.Ing: 13.4, ln.Cmg: 26.6, Urb: 95%)	-0.32%
	Yerbas Buenas (ln.Ing: 12.8, ln.Cmg: 16.5, Urb: 11%)	1.98%
	Muestra (ln.Ing: 13.4, ln.Cmg: 13.3, Urb: 76%)	0.36%

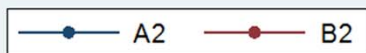
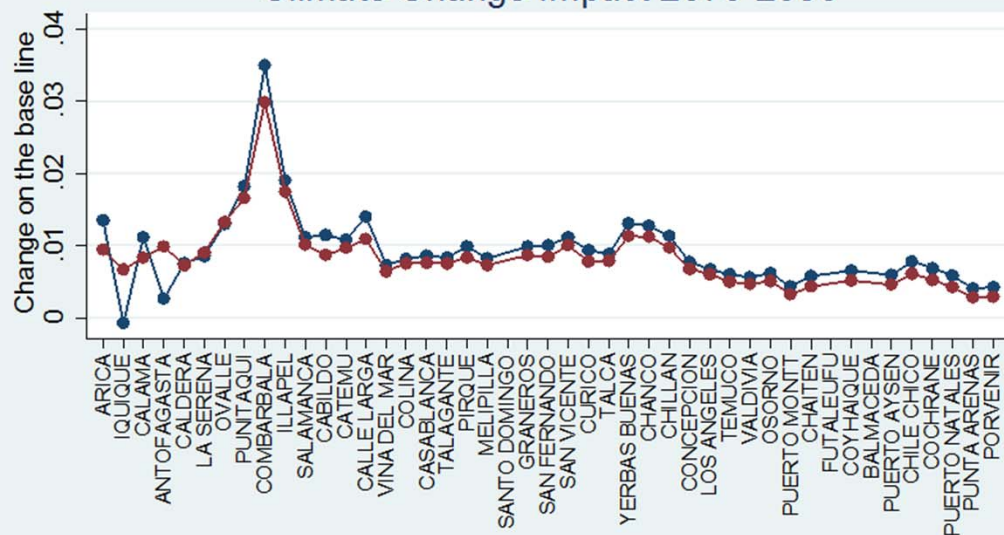
Resultados

- Elasticidad de precio es comparable con estimaciones en la literatura. Aprox. -0.1 (lit: ≈ -0.3 ver Arbués et al., 2003)
- Consumo por hogar poco sensible a cambios en tarifa sobreconsumo. (por bajo % hogares que la pagan)
- Los atributos de la Comuna y los Hogares no cambian el efecto de las variables del modelo básico. Agregan mas información al modelo.
- Impacto del ingreso es importante, pero también incidencia de pobreza esta positivamente correlacionada con el consumo (ceteris paribus). ¿por qué? ¿Efecto subsidio?

Resultados

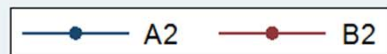
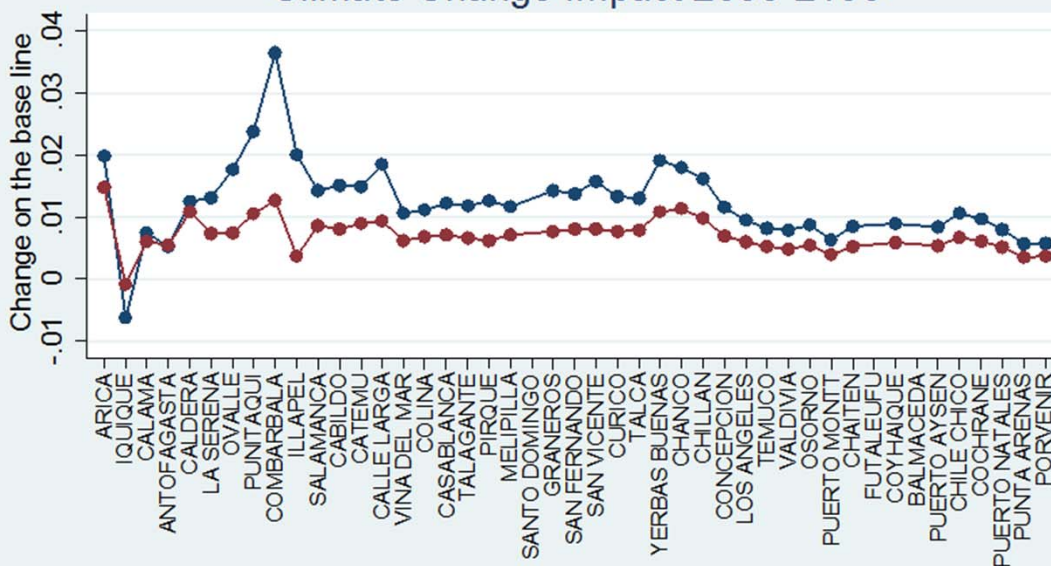
- Temperatura es más relevante que precipitación en consumo residencial (no ag).
- Grado de urbanización importante en niveles y depende de fluctuaciones de temperatura – probablemente debido al consumo exterior. (de 10 a 90 % de urbanización implica aumento de 40% en consumo por hogar)
- Las variables de interacción entre la temperatura y las características demográficas suavizan el impacto del clima en el consumo.

Climate Change Impact 2070-2080



Municipalities ordered from north to south

Climate Change Impact 2090-2100



Municipalities ordered from north to south

Conclusiones

- Demanda es relativamente inelástica a precio pero elástica a ingreso
- Es posible verificar efecto de la tarifa de sobreconsumo (con datos agregados)
- Temp y ppt (clima) tiene efecto, pero
- Temp (tiempo) tiene un mayor efecto
- Urbanización aumenta consumo pero disminuye efecto del clima
- Investigación futura con datos a nivel de hogar
- Explorar en mas detalle efecto pobreza
- modelar explícitamente tarifa punta