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Analysing the effects of environmental amenities on social economic indicators in the Murray Darling Basin

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Research question

- What is the effect of environmental amenities on local economic growth indicators?

Population migration



Employment



Income



Literature review

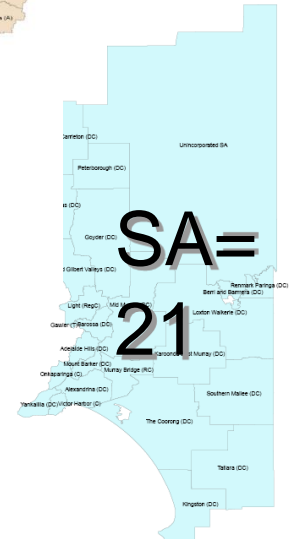
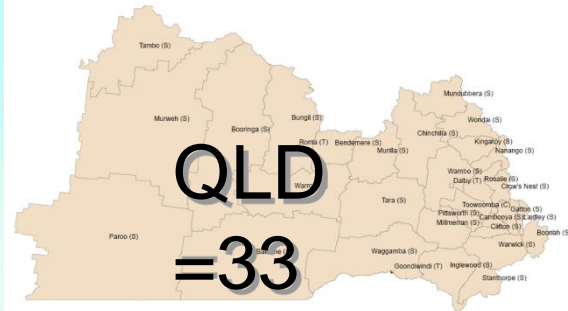
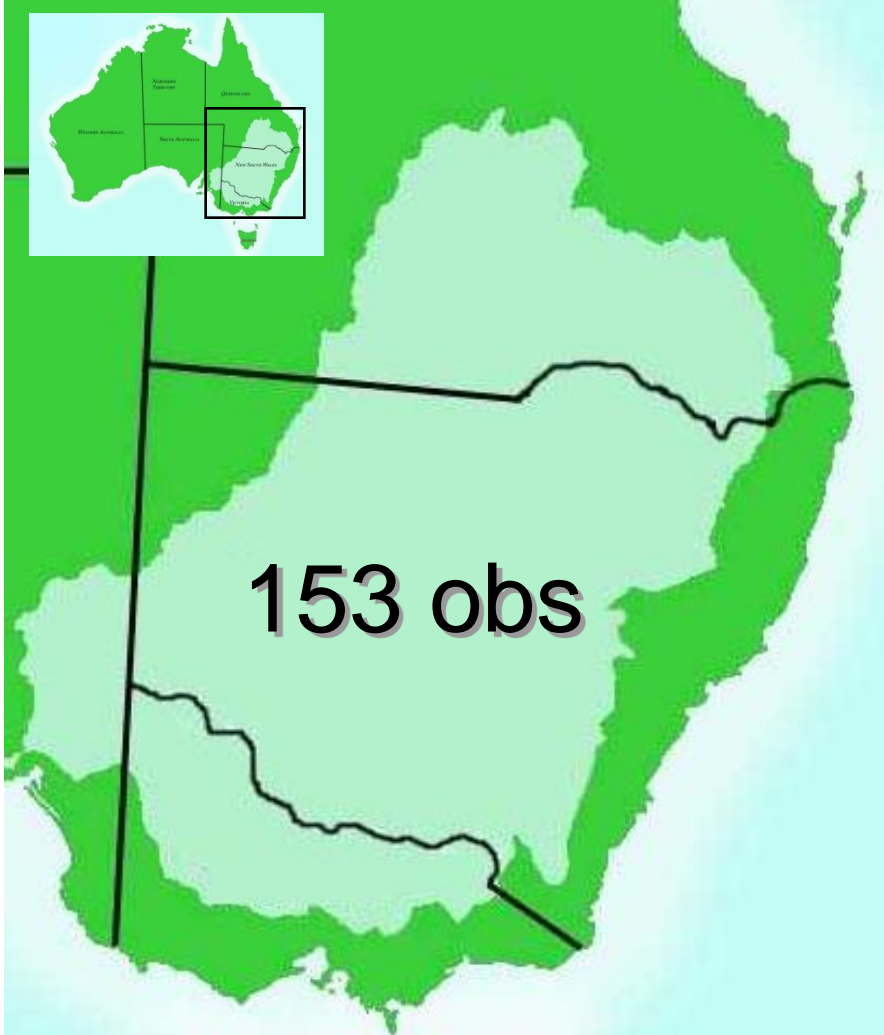
- **Lifestyle migration**
 - Amenity migrants e.g. sea change, tree change
 - Quality of life
- **Growth theory suggests that distribution of wealth depends on**
 - Tangible endowments e.g. land, labour and capital
 - Latent factor inputs e.g. amenities, public goods & services (Marcouiller et al. 2004)

Literature review

- **Economic growth & amenity**

- Deller et al. (2001) The role of amenities and quality of life in rural economic growth. *Amer.J.Agr.Econ.* 83(2):352-365.
- Wu, J. and S. Mishra (2008). Natural amenities, human capital, and economic growth. *Frontiers in Resource and Rural Economics*. J. Wu, P. W. Barkley and B. A. Weber. Washington DC, Resources for the Future 94-107.
- Waltert and Schlapfer (2010). Landscape amenities and local development: A review of migration, regional economic and hedonic pricing studies. *Ecol.Econ.* 70(2010): 141-152.

Study site



Structural model of growth

Based on Deller et al.2001

$$\begin{aligned} \Delta P &= \alpha_P + \gamma_{1P}\Delta E + \gamma_{2P}\Delta I + \beta_{1P}P_{t-1} + \beta_{2P}E_{t-1} + \beta_{3P}I_{t-1} + \sum \delta_{1P} \Omega^P + \sum \eta_{1P} A + \varepsilon_P \\ \Delta E &= \alpha_E + \gamma_{1E}\Delta P + \gamma_{2E}\Delta I + \beta_{1E}P_{t-1} + \beta_{2E}E_{t-1} + \beta_{3E}I_{t-1} + \sum \delta_{1E} \Omega^E + \sum \eta_{1E} A + \varepsilon_E \\ \Delta I &= \alpha_I + \gamma_{1I}\Delta P + \gamma_{2I}\Delta E + \beta_{1I}P_{t-1} + \beta_{2I}E_{t-1} + \beta_{3I}I_{t-1} + \sum \delta_{1I} \Omega^I + \sum \eta_{1I} A + \varepsilon_I \end{aligned}$$

$\Delta P, \Delta E, \Delta I$ % Change in population, employment and median income over 2000-06 for each LGA

$P_{t-1}, E_{t-1}, I_{t-1}$ Initial condition (2000) for population, employment and income

$\Omega^P, \Omega^E, \Omega^I$ Initial condition (2000) for social, economic and climate variables

A Natural amenity variables

Social, economic, climate and natural amenity variables

- **Social variables**

- High school graduates (%) in 2001
- University graduates (%) in 2001
- Home ownership (%) in 2001
- Indigenous population (%) in 2001

- **Economic variables**

- Population, employment and income
- Pasture area (relative to size of LGA)
- Crop area (relative to size of LGA)

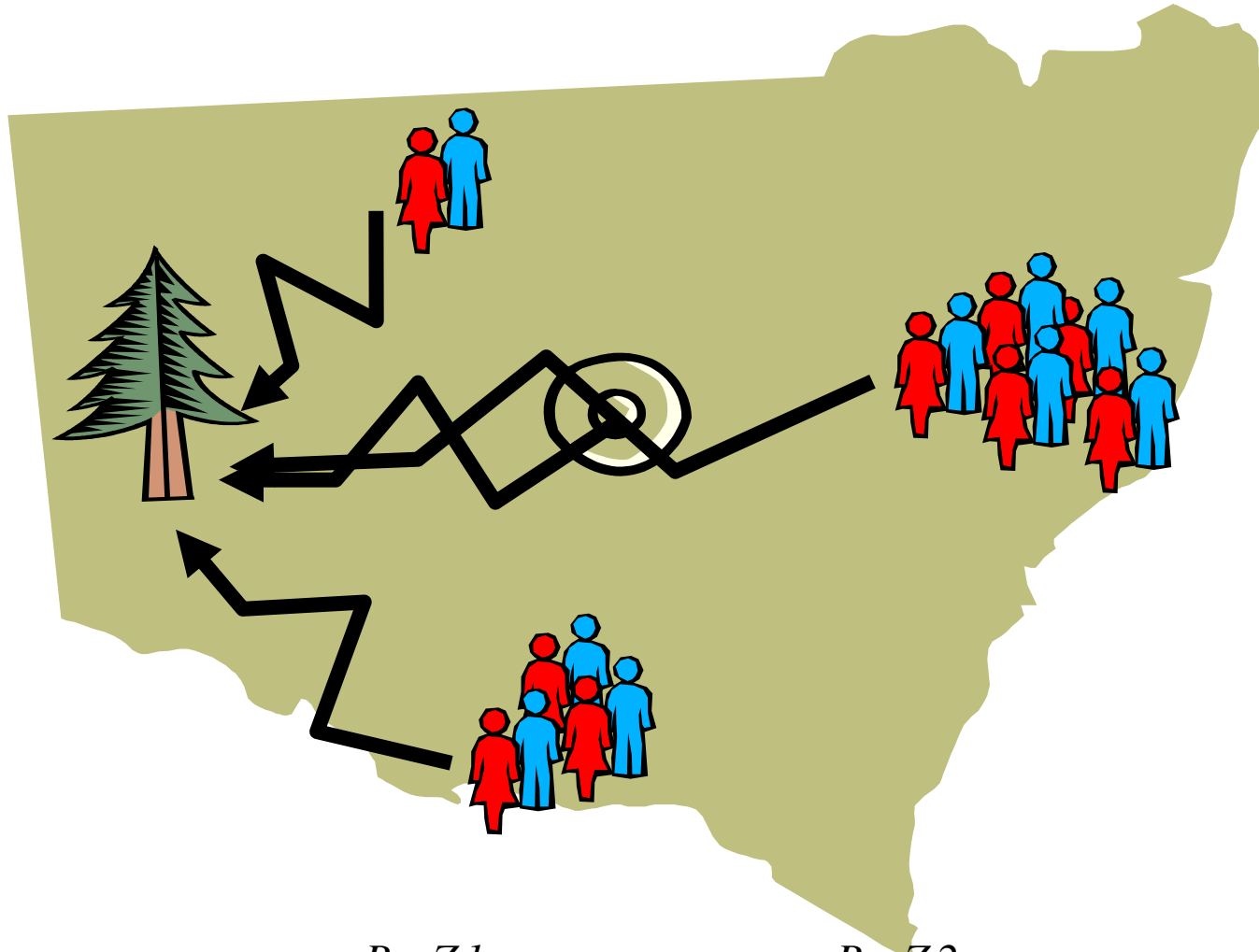
- **Climate variables**

- Average annual temperature in 2001
- Average annual rainfall in 2001

- **Natural/man-made amenity variables**

- Lakes, rivers, forests → Distance, area, quality*
- Airport, train station → Distance

Distance to natural amenities



$$W(\text{Dist}) = \text{Distance}(Z1) * \frac{\text{Pop}Z1}{\text{Total Pop}} + \text{Distance}(Z2) * \frac{\text{Pop}Z2}{\text{Total Pop}} + \text{Distance}(Z3) * \frac{\text{Pop}Z3}{\text{Total Pop}}$$

Incorporating spatial effects

- **Aspatial model**

$$\Delta P = \alpha_P + \gamma_{1P}\Delta E + \gamma_{2P}\Delta I + \beta_{1P}P_{t-1} + \beta_{2P}E_{t-1} + \beta_{3P}I_{t-1} + \sum \delta_{1P} \Omega^P + \sum \eta_{1P} A + \varepsilon_P)$$

- **Spatial model**

$$\begin{aligned} \Delta P_i = & \alpha_P + \gamma_{1P}\Delta E_i + \gamma_{2P}\Delta I_i \\ & + \lambda_{1P}W\Delta P_j + \lambda_{2P}W\Delta E_j + \lambda_{3P}W\Delta I_j \\ & + \dots + \sum \eta_{1P} A + \varepsilon_i \end{aligned}$$

$$\varepsilon_i = \rho W \varepsilon_j + u$$

Spatial 3-stage least squares

Based on Kelejian and Prucha (2004)

- **Estimates simultaneous systems of spatially correlated cross-sectional equations**
- **Accounts for**
 - Cross-equation correlation of the error terms
 - Endogeneity
 - Potential spatial autocorrelation
 - Disturbances
 - Endogenous/Exogenous variables

Prelim results: endogenous variables

Variable	Δ Population		Δ Employment		Δ Income	
	Coeff		Coeff		Coeff	
Endogenous variables						
Population change i	-		1.1585	***	-1.5237	***
Employment change i	0.8316	***	-		1.5369	***
Median income change i	-0.1565	***	0.2049	***	-	
Spatial autoregressive parameter in the endogenous variable (λ)						
Population change j	-1.6994		9.3257	***	-13.9190	*
Employment change j	2.1913		-7.3158	***	13.5719	**
Median income change j	-0.9604		-0.1089		-2.5586	*
Spatial autoregressive parameter of the disturbance (ρ)						
Population change	2.7415		-		-	
Employment change	-		17.2297		-	
Median income change	-		-		11.9726	

Prelim results: economic & social variables

Variable	Δ Population	Δ Employment	Δ Income
	Coeff	Coeff	Coeff
Population density in 2001	-0.3633	0.5021	5.0650 *
Employment density in 2001	-	-18.2990	- 262.1959 **
Median income in 2001	-0.0025	0.0038	-0.0225 **
College graduates	-	-	181.1689
Homeowners	-3.6442	2.7016	-
Indigenous population	11.2859 **	-13.6959 ***	19.4573
High school graduates	21.8269 **	-20.5119 **	1.9359

Prelim results: environmental variables

	Δ Population	Δ Employment	Δ Income
Variable	Coeff	Coeff	Coeff
Length of non perennial river ⁻¹	-1.10E-06 *	-	3.81E-06
Distance to park ⁻¹	379.9498	-697.0811 *	2548.213 *
Park greenness	0.7851 **	-1.2421 ***	2.5977 *
<i>R-square</i>	0.9327	0.9880	0.8902
No of observations	153	153	153

Conclusion

- **In the MDB**

- Migration and economic growth are generally affected by economic and social factors
- Spatial effects of neighbouring LGAs influences employment and income change

- **Amenity migration?**

- Higher forest health → more population and increased income but less employment growth

- **Policy implication?**

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Thank you

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Descriptive statistics

2001-06	QLD	NSW	VIC	SA
%ΔPopulation density	1.61	-1.71	0.47	4.20
%Δ Employment density	4.49	0.34	3.55	7.33
%Δ Median income	27	19.8	24.41	24.84
2001				
Population	201,657	638,090	457,395	197,294
%Home ownership	24.58%	25.08%	28.55%	28.57%
%College graduates	4.1%	3.99%	4.8%	3.8%
%Indigenous population	4.1%	6.4%	0.83%	1.5%