The geography of Australia's Marriage Law Postal Survey outcome

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Abstract

After years of public debate about same-sex marriage, the Australian Government put the issue to the electorate in the 'Australian Marriage Law Postal Survey' in late 2017. The survey asked voters whether the law should be changed to allow same-sex couples to marry. Nationally, 61.6% of voters responded 'Yes'. But there were marked variations by electoral division, with the proportion of 'Yes' votes varying from 26.1% to 83.7%. The aim of this paper is to explore the geographical pattern of the percentage of voters responding 'Yes' by federal electoral division and identify its correlates. Results of the survey by federal electoral division were obtained from the Australian Bureau of Statistics (ABS); other variables for electoral divisions were obtained from the ABS and the Australian Electoral Commission. Multiple linear regression and geographically weighted regression were employed to establish the relationship between the percentage of 'Yes' responses at the electoral-division level and the characteristics of electoral divisions' populations. In 133 of 150 electoral divisions there was a majority of 'Yes' responses. Strong predictor variables of the percentage 'Yes' vote included the proportions of: the population describing themselves as having no religion, those with post-school educational qualifications, those with a birthplace in Oceania, Europe or the Americas, and those who did not vote for conservative parties in the 2016 federal election. A marginally better fit was obtained with geographically-weighted regression. In conclusion, the geographical pattern of responses in the Australian Marriage Law Postal Survey is closely associated with a small number of characteristics of an electoral division's population.

Keywords: Same-sex marriage; Australia; Marriage Law Postal Survey; regression; geographically-weighted regression; LGBT

1. INTRODUCTION

Marriage equality has been on the Australian political agenda for much of the present century, particularly after other countries introduced same-sex marriage from the early 2000s (Chamie & Mirkin, 2011). Responding to increased public support for same-sex marriage (Perales & Campbell, 2018; Smith, 2016), in 2017 the Liberal-National Coalition Government directed the Australian Bureau of Statistics (ABS) to canvass the views of the public through the Australian Marriage Law Postal Survey (AMLPS). Effectively a plebiscite, the AMLPS was open to all those on the electoral register at 24th August 2017—all Australian citizens aged 18 and over except those serving prison sentences of more than three years. Unusually, the whole exercise was conducted by post with voting open between 12th September and 7th November 2017. Participation was voluntary. Eligible voters were asked "Should the law be changed to allow same-sex couples to marry?" and instructed to mark either a 'Yes' or 'No' box and then post back their completed form (ABS 2017a). The results announced by the ABS on 15th November 2017 revealed a participation rate of 79.5% of voters and a 'Yes' vote of 61.6%. A bill to change the law was passed by parliament shortly afterwards, and the amended Marriage Act came into effect on 9th December 2017. It represented a highly significant day not only for Australia's non-heterosexual population (Wilson & Shalley, 2018), but also Australians more generally (Pennay et al., 2018).

The plebiscite results prompt questions such as 'Who voted 'Yes'?', 'Which areas voted 'Yes' to the greatest extent?' and 'What are the determinants of these patterns?'. ABS published the number and percentage of 'Yes' and 'No' votes for each of the 150 federal electoral divisions, as well as voting participation rates by gender and age group (ABS 2017b). These data are internationally unique—as Australia is only the second country in the world after Ireland to constitutionally legalise same-sex marriage through a national vote—

and enable examination of the spatial patterning of the plebiscite outcomes. Further, nearly concurrent Census data (August 2016) and Federal election data (November 2016) based on the same geographical units were linked to the AMLPS data. This confluence provides us with an exceptional opportunity to examine the ecological relationships between the plebiscite results and a range of theoretically relevant social factors (such as the religious and political composition of electorates). The aim of the present study is to leverage these unique data to answer the following research questions: (1) What was the spatial pattern of the AMLPS outcome by electoral division? and (2) What are the correlates of the percentage 'Yes' vote?

2. PREVIOUS EVIDENCE

The bulk of previous international research on the correlates of support for marriage equality and rights for same-sex couples is largely based on survey data from individuals, focusing on the explanatory role of religiosity, political views, education, age, gender, cultural background, and area of residence (e.g. Anderson et al., 2017; Oppenheimer et al., 2014; Sloane et al., 2017; Webb & Chonody, 2014). In Australia, a recent study by Perales & Campbell (2018) found stronger support for the statement "Homosexual couples should have the same rights as heterosexual couples do" amongst individuals who were non-religious, highly educated, under 40 years of age, female, living in a metropolitan area, on high income, Australian-born, English-speaking, and non-heterosexual.

To our knowledge, the only previous ecological study is McAllister & Snagovsky (2018), who conducted an analysis of the AMLPS results. Their primary focus was on the voting patterns of four socio-economic area types identified by factor analysis, and the views of local Members of Parliament (MPs) on same-sex marriage. They found that the percentage

'Yes' vote by electoral division was positively associated with affluence, proportion of lesbian (but not gay) couples, plebiscite turnout, and MP levels of support for same-sex marriage; and negatively associated with immigrant areas and electorates with higher proportions of older married residents. Their linear regression model achieved an adjusted R^2 of 0.78.

Our approach differs from that of McAllister & Snagovsky (2018) in several ways. First, while their study took a political science perspective, we adopt a geographical perspective. This is valuable, as there is sizeable evidence—largely from the US—that social attitudes, values and political voting patterns are geographically clustered (Lesthaeghe & Neidert, 2009; Rentfrow, 2010). In our application, this involves paying attention to the geographical clustering of voting over the Australian territory through data visualization, as well as considering whether and how the predictors of the 'yes' vote vary spatially—accomplished through application of geographically weighted regression (GWR). Second, McAllister & Snagovsky's (2018) study relied on factor analysis, while we use a small number of independent variables motivated by earlier micro-level findings (e.g., Perales & Campbell, 2018).

3. DATA AND METHODS

3.1. Data

Australia is divided into 150 federal electoral divisions for elections to the House of Representatives, with the distribution based generally on population size. The median Estimated Resident Population of electoral divisions in 2016 was 160,560, however, these divisions vary immensely in geographical extent, ranging from 32km^2 (Grayndler, inner Sydney) to 1.63 million km^2 (Durack, outback Western Australia). The electoral division

bounds are shown in Figure 1. Those electoral divisions referred to in the Results section are highlighted in red.

Figure 1 about here

The dependent variable in our models was the percentage of 'Yes' responses to the question "Should the law be changed to allow same-sex couples to marry?" obtained from the AMLPS results (ABS, 2017b). Based on the findings of previous research, an initial set of 11 independent variables was constructed from the AMLPS results (ABS, 2017b), the ABS 2016 Census of Population and Housing (ABS, 2017c), ABS Estimated Resident Populations (ABS, 2018), and results from the 2016 federal election published by the Australian Electoral Commission (AEC, 2017). The variables are listed in Table 1 along with summary descriptive statistics. The full dataset is available as a supplementary file.

Table 1 about here

The participation rate, defined as the number of participants as a percentage of eligible voters, was obtained from the AMLPS. The participation of those aged 18-34 was included as a separate variable because younger voters tend to be more progressive than older voters (Armenia & Troia, 2017). We expected higher participation of this age group to be positively correlated with a 'Yes' outcome.

All variables derived from 2016 Census data were created from data obtained via the ABS TableBuilder Pro tool (ABS, 2017c) and were restricted to Australian citizens aged 18 years and over as the eligible participating population. All were expected to be positively correlated

with a ‘Yes’ outcome. The percentage of people identifying their religion as ‘no religion’ was used as a general indication of lack of religiosity and therefore less support for traditional sexual and moral attitudes (Perales et al., 2018). The percentage of non-Indigenous people born in Oceania (including Australia), Europe and the Americas was also used as a proxy for more open attitudes to sexual diversity due to greater acceptance of non-heterosexual orientations in those continents. The percentage of people with any post-school education was used as an indicator of openness to diversity in general, while the percentage of adults in a cohabiting same-sex relationship was expected to be indicative of relatively more supportive attitudes to sexual diversity in the local area—consistent with theories of inter-group contact (Smith et al., 2009). The percentages of females and younger people (aged 18-34) were included because these groups are generally more supportive of same-sex relationships. Based on previous micro-level findings (Perales & Campbell, 2018), the percentage of residents with personal incomes of $2,000 or more per week was also expected to be positively correlated with a ‘Yes’ outcome.

Population density was calculated as the 2016 Estimated Resident Population (ERP) for each electoral division divided by the size of the electoral division in km^2 (ABS 2018). We expected higher population density to be positively correlated with a ‘Yes’ outcome because individuals in densely population areas are more likely to interact with a greater diversity of people (Smith et al., 2009).

We also included the percentage of Coalition (Liberal and National party) votes from the 2016 federal election for the House of Representatives (AEC, 2017). Because of the preferential voting system in Australia these data consist of the two-party preferred vote between the Coalition and the other major party in the electorate (usually the Australian

Labor Party). The Liberal/National Coalition includes both major conservative parties in Australian politics. We therefore expected higher proportions of Coalition support to be negatively correlated with a 'Yes' vote.

3.2. Methods

To answer the first question 'What was the spatial distribution of the AMLPS outcome by electoral division?' we created choropleth maps of the percentage 'Yes' and 'No' votes. We then examined the bivariate relationships between the percentage 'Yes' vote and the 11 independent variables. The natural log was selected for three variables to obtain a more linear relationship with the 'Yes' percentage, these being: population density, percentage born in Oceania, Europe or the Americas, and percentage in same-sex relationships. To analyse the correlates of the percentage 'Yes' vote we initially fitted an Ordinary Least Squares linear regression model using all 11 independent variables (Model 1). A second model was then created using backwards step-wise regression to choose an optimised model without compromising model accuracy (Model 2). This relied on a 10-fold cross validation to estimate the average prediction error of the models (Kassambara, 2018). The function defined the best model as the one with the lowest Root Mean Squared Error (RMSE). Our syntax code is available as a supplementary file.

We subsequently applied GWR to determine whether there was any spatial variability in the influence of the independent variables on the percentage of 'Yes' responses. A GWR model allows the coefficients of the independent variables to vary spatially and provides the opportunity to test whether this improves our understanding of how the independent variables impact the dependent variable in both strength and direction over space (Fotheringham et al., 2000). Because of Australia's geography, adaptive bi-square spatial kernels were used. These

accommodate both the variation in population size of electoral divisions and the fact that geographically larger and sparsely populated electorates are located next to one another, as are smaller and more densely populated electorates (Fotheringham et al., 2002). GWR can incorporate coefficients that vary geographically as well as global coefficients which do not. We set population density as global and allowed all others to vary locally. We then selected the best model on the basis of the Akaike Information Criterion (AIC).

4. RESULTS

4.1. Geography of the vote

Nationally 61.6% of Australians who participated in the AMLPS responded 'Yes' to the survey question, though there was considerable variation by electoral division, as shown in Figure 2. The percentage 'Yes' response ranged from a low of 26.1% in the western Sydney electorate of Blaxland to a high of 83.7% in the inner city electorates of Sydney and Melbourne. Although only 17 of the 150 electoral divisions had 'Yes' responses under 50%, electorates closer to State and Territory capital city centres were more strongly supportive of changing the law compared to rural and remote electorates. Examining the majority 'No' responding electoral divisions (Figure 3), there was an obvious clustering in western Sydney and rural Queensland (west and north-west). The other two 'No' electorates were in Melbourne, but geographically separated.

Figures 2 and 3 about here

4.2. Bivariate relationships

Figure 4 shows the relationship between the percentage 'Yes' vote and each of the 11 independent variables. The strongest positive linear relationships were for the percentages of

people with no religion and post-school education. Positive relationships were also observed for the log of percentage of adults in same-sex relationships, the proportion of females, AMLPS participation and the participation of those aged 18-34, and the percentage of residents on high incomes. Weaker positive associations were evident for the log of percentage born in Oceania, Europe and the Americas, and the log of population density. No clear relationship was observed with the percentage of people voting for the Coalition in the 2016 federal election and the percentage of eligible voters aged 18-34.

Figure 4 about here

4.3. Linear regression

An ordinary least squares linear regression model was initially fitted to the data, with all independent variables included (Model 1). The results are provided in Table 2. Most relationships between the 'Yes' vote and the independent variables are in the expected direction, except for a slight negative relationship with the overall participation rate. Model 1 explains 92.3% of the geographic variation in the 'Yes' vote but includes a number of non-significant independent variables at $p<0.05$ (log of percentage adults in same-sex relationships, percentage females, percentage younger people, participation rate).

Table 2 about here

After applying the backward step regression process, the optimised regression model (Model 2) explains 91.8% of the variation in the 'Yes' outcome with a small number of population characteristics of each electorate: no religion, post-school qualifications, being born in Oceania, Europe and the Americas, Liberal/National voting in the last federal election, and

the population density of the electorate. All predictors were statistically significant at $p<0.001$.

As hypothesised, all explanatory variables had a strong and positive correlation with the 'Yes' outcome except for the percentage of Liberal/National voting, which had the expected negative relationship (Table 2). Model 2 predicts that a 1 percentage point increase in the percentage of Coalition voting decreases the percentage of 'Yes' responses by 0.15 percentage points, while a 1 percentage point increase in the percentage of the population with no religion increases the percentage of 'Yes' responses by 0.5 percentage points. A 1 percentage point increase in the percentage of the population with any post school education increases the percentage of 'Yes' responses by 0.6 percentage points. Being born in countries in Oceania, Europe and the Americas had a slightly lower impact on the 'Yes' outcome in an electorate. The model predicts that a 1 percentage point increase in the percentage of people born in these countries increases the mean percentage of 'Yes' responses by 0.42 percentage points[1]. A 1 percentage point increase in population density only increases the percentage of 'Yes' responses by 0.006 percentage points.

4.4. Geographically weighted regression

The previous results show that the simple linear regression model performs well. However, it is a global model and assumes that the relationship between the variables and the percentage 'Yes' outcome is the same across areas within the country. Mapping of the dichotomous overall 'Yes' and 'No' outcome by electoral division identified a strong clustering of 'No' electorates in western Sydney and the rural west and north west of Queensland, accounting

[1] When interpreting the logged coefficient we used the Taylor expansion of the function $f(x) = log(1 + x)$ around $x_0 = 0$, to give us $log(1 + x) = x + O(x^2)$. Therefore in our example we can say that for a 1% increase in the percentage of people born in Oceania, Europe and the Americas, the difference in the expected mean percentage 'Yes' responses will be β^3 x $log(1.01) = 42.52$ x $0.00995 = 0.423$.

for 15 of 17 majority 'No' electorates in Australia. We therefore applied geographic weighting to determine whether it would improve on the global model and/or offer additional insights.

Results from the geographically weighted regression (Model 3) are presented in Table 3. Geographical variability tests indicated that population density was the only variable that did not vary significantly in its relationship with the percentage 'Yes' outcome. All other independent variables gave improved results when they were allowed to vary across electoral divisions. Hence, we selected this form of model (see supplementary material for results of geographical variability tests). Table 3 reports the coefficient, standard error and *t*-statistic for population density (as the global variable) and the mean, median, lower and upper quartiles for the coefficients of the remaining variables that were allowed to vary spatially.

Table 3 about here

Model 3 shows a slight improvement over Model 2, with the overall adjusted R^2 increasing from 0.918 to 0.933 and the AIC declining from 754 to 728. Both measures indicate that GWR provides a better fit with the data, and increased accuracy. However, whether this improvement assists in understanding whether attitudes towards same-sex marriage vary geographically is debatable. The direction of the relationship between the locally varying independent variables is entirely consistent with the global model (Model 2), and the observed difference in the range of coefficient values is fairly small. The GWR local R^2 values ranged from a minimum of 0.90 (electoral division of Lingiari) to a maximum of 0.95 (electoral division of Indi).

5. DISCUSSION AND CONCLUSION

This study has leveraged internationally unique electoral-level data from an Australian national plebiscite on same-sex marriage legislation linked to electoral-level data from multiple other data sources. Using these data, we generated novel insights into the ecological associations between support for same-sex marriage and a range of important socio-demographic predictors. Taking a geographical perspective, we showed that the highest percentage of 'Yes' votes in the AMLPS were recorded in the larger cities of Australia, especially in the inner suburbs. At the same time many rural electorates—perhaps surprisingly given their conservative reputations—returned majority 'Yes' votes, albeit with smaller margins.

Our modelling revealed that the percentage of 'Yes' votes in each electoral division was positively associated with the percentage of the Australian citizen population aged 18 years and above with: no religion; post-school educational qualifications; a birthplace in Oceania, Europe or the Americas; and population density. It was negatively associated with the percentage of people who voted for the Liberal/National Coalition in the 2016 federal election. The linear regression model (Model 2) and the geographically-weighted model (Model 3) respectively explained 92% and 93% of the geographic variability in the 'Yes' vote. These are better fits than we had expected. Part of the explanation may lie in the relatively coarse geography of just 150 electoral divisions; part of it may also be due to strong associations of certain population characteristics with attitudes and therefore with the way people voted in the AMLPS. Similarly high R^2 values have been obtained in other ecological studies (e.g., Matti and Zhou, 2017).

Although the micro-level literature suggests other population characteristics are associated with attitudes to same-sex relationships, six out of the 11 electorate-level independent variables were not significantly influential and were excluded from the final models. The range for some of these variables did not vary much across electoral divisions, which may explain their modest explanatory power. This applied to the percentages of females, younger people, same-sex couples and people with high incomes, and the participation rates.

To illustrate the relative importance of the different predictors in explaining the percentage of 'yes' votes, we undertook some further calculations. First, we re-estimated our optimised model (Model 2) excluding one predictor at a time. The loss in predictive power, measured by the adjusted R^2, was greatest when the birthplace variable was removed (0.131), followed by the education (0.075) and religion (0.060) variables (see Table 4). We also calculated standardized beta coefficients from Model 2 (see Table 5). This rescaling shows the effect on the outcome associated with a one standard deviation increase in each predictor, allowing predictors to be compared on the same scale. This generated the same ranking: standardized betas were largest for the birthplace (5.633), education (4.663) and religion (3.605) variables.

Tables 4 and 5 about here

While our study is not designed to predict individual-level behaviour, the comparative importance of aggregate-level measures of birthplace, education and religiosity is highly consistent with findings from earlier micro-level studies. The high predictive power of our birthplace variable is consistent with cross-national comparisons that situate countries in Oceania, Europe or the Americas in the upper end of the spectrum concerning public support for same-sex relationships (Valfort, 2017). They also align with individual-level Australian

studies comparing migrants by place of birth. For instance, Perales & Campbell (2018) reported that ~70% of migrants from English-speaking backgrounds supported equal rights, compared to just ~50% migrants from non-English-speaking backgrounds.

The results for our education variable also resemble those obtained in individual-level studies, indicating higher support of same-sex relations with higher educational levels (see e.g., Baunach, 2012; Perales & Campbell, 2018). The mechanisms connecting increased educational attainment to the development of more progressive attitudes towards equal rights include exposure to humanistic ideals, liberal values and a meritocratic system of achievement (Ohlander, Batalova & Treas, 2005).

Finally, previous international scholarship has also reported marked attitudinal divisions by religiosity (Baunach, 2012; Bramlett, 2012; Sherkat et al., 2011). Individuals who identify with a religion are generally less supportive of same-sex marriage than those who do not identify, which likely stems from the fact that religious teachings often assign negative connotations to same-sex relations (Perales et al., 2018). Similar results were obtained for Australia by Perales and Campbell (2018), who reported that 77.4% of people who did not identify with a religion support equal rights, compared to just 47% of people with no religion.

Our results may nevertheless have declining validity over time, as attitudes to same-sex relationships in Australia have shifted rapidly in recent years (Baunach, 2012; Wilkins, 2017) and because legislative reform can promote further attitudinal change (Flores & Barclay, 2016). Hence, attitudes towards same-sex marriage may become more favourable in the future due to changes in the population characteristics. Particularly, the proportions of Australians with post-school qualifications (ABS, 2017d) and reporting no religion (ABS,

2017e) is rising, and Australia's biggest cities are experiencing fast growth. On the other hand, Australia's immigrant intake is attracting new arrivals from countries in which identifying with a religion is normative, and this may exert influence in the opposite direction (Perales et al., 2018). And geography matters. At the regional and local scale the percentage of the population taking a positive view of same-sex relationships is likely to vary considerably in the future, as it did at the time of the AMLPS, and will be associated to a considerable extent with the geography of population composition.

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Table 1: Descriptive statistics of the variables by federal electoral division

Variable	Mean	Median	Standard deviation	Minimum	Maximum
Dependent variable					
% 'Yes' votes (YES)	61.2	61.8	10.2	26.1	83.7
Independent variables					
% overall survey participation (PARTIC)	79.4	80.0	4.3	50.1	86.0
% participation of younger people (18–34) (YOUNG_PARTIC)	72.6	72.5	6.2	43.2	84.3
% females (PER_FEM)	51.5	51.5	1.0	46.1	53.2
% younger people (18–34) (PER_YOUNG)	27.5	27.2	4.6	17.1	44.6
% with post school qualifications (POSTSCHED)	53.7	52.7	7.7	36.8	72.7
% with high personal income ($2000+ per week) (PER_HIGHINC)	9.8	7.9	5.9	3.3	30.9
% with birthplace in Oceania, Europe & the Americas (logged) (LN_BIRTH)	4.5	4.5	0.1	4.0	4.6
% with no religion (NO_REL)	29.7	30.0	7.3	11.2	50.5
% people in same-sex relationships (logged) (LN_SAME)	-0.9	-1.0	0.6	-2.1	1.6
% voting Liberal/National Party (PER_LNP)	50.3	51.1	11.3	27.6	74.9
Population density (logged) (LN_DENSITY)	5.2	6.1	2.8	-2.4	8.5

Table 2: Linear regression results

	Model 1			*Model 2*		
	Coeff.	Standard error	*p*	Coeff.	Standard error	*p*
% No religion (NO_REL)	0.50	0.05	<0.001	0.50	0.05	<0.001
% Post-school education (POSTSCHED)	0.38	0.10	<0.001	0.61	0.05	<0.001
% Birthplace Oceania, Europe & Americas (logged) (LN_BIRTH)	43.70	3.48	<0.001	42.52	2.78	<0.001
% people in same-sex relationships (logged) (LN_SAME)	0.62	0.75	0.408			
Population density of electorate (logged) (LN_DENSITY)	0.53	0.19	0.006	0.60	0.15	<0.001
% Liberal/National voting (PER_LNP)	-0.12	0.03	<0.001	-0.15	0.03	<0.001
% Females (PER_FEM)	0.46	0.35	0.197			
% Younger people (PER_YOUNG)	0.10	0.09	0.249			
% High personal income (PER_HIGHINC)	0.19	0.09	0.042			
% Participation (PARTIC)	-0.17	0.16	0.292			
% Participation younger people (YOUNG_PARTIC)	0.19	0.11	0.093			
n	150					
Adjusted R^2	0.923			0.918		
F(11,138)	162.2 (p<0.001)		F(5,144)	336.1 (p<0.001)		
AIC	751.6			753.9		

Table 3: Geographically Weighted Regression results

	Model 3			
	Coefficient	Standard error	*p*	
Global variable				
Population density of electorate (logged) (LN_DENSITY)	0.60	0.15	<0.001	
	Coefficient			
Local variables				
	Mean	Median	Lower quartile	Upper quartile
% No religion (NO_REL)	0.51	0.52	0.39	0.63
% Post-school education (POSTSCHED)	0.58	0.62	0.45	0.69
% Birthplace Oceania, Europe & Americas (logged) (LN_BIRTH)	40.83	43.18	39.68	43.93
% Liberal/National voting (LNP)	-0.14	-0.13	-0.14	-0.12
n	150			
Adjusted R^2	0.933			
AIC	728.3			

Table 4: Relative importance of independent variables (Model 2)

Model 2 minus…	Adjusted R^2	Reduction in adjusted R^2 compared to Model 2
% Birthplace Oceania, Europe & Americas (logged) (LN_BIRTH)	0.787	0.131
% Post-school education (POSTSCHED)	0.843	0.075
% No religion (NO_REL)	0.858	0.060
% Liberal/National voting (LNP)	0.900	0.018
Population density of electorate (logged) (LN_DENSITY)	0.910	0.008

Table 5: Standardization of independent variables (Model 2)

Independent variable	Standardized coefficients
% Birthplace Oceania, Europe & Americas (logged) (LN_BIRTH)	5.633
% Post-school education (POSTSCHED)	4.663
% No religion (NO_REL)	3.605
% Liberal/National voting (LNP)	-1.724
Population density of electorate (logged) (LN_DENSITY)	1.643