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Assessing the geographic distribution of same sex and opposite sex couples across the United States: implications for claims of causality between traditional marriage and same sex unions

John W. Graham · Jason Barr

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Abstract The percent of households headed by married couples has recently fallen below 50%, while the percent of unmarried couples (both heterosexual and homosexual) continues to rise. Nationally-representative estimates of unmarried couples which first appeared in the 1990 and 2000 decennial Censuses are now available on an annual basis through the American Community Survey. In this paper we use state-level panel data from 2000–2006 on the percent of households headed by married couples, same sex couples and opposite sex unmarried couples to assess widespread claims in the popular press of causality across living arrangements. Based on Granger causality tests we can reject claims that an increase in same sex couples has caused either a decline in marriage or (except in one case) an increase in heterosexual cohabitation. There is mixed evidence whether or not opposite sex couples may have Granger caused same sex couples, but stronger evidence that marriage and heterosexual cohabitation are interrelated.

Keywords Gay and lesbian households · Heterosexual cohabitation · Marriage

JEL Classifications J120 · J150

1 Introduction

As recently as 1970, more than 70% of all households in the United States were headed by married couples; by 2000 less than 52% were married couples, and by

J. W. Graham (✉) · J. Barr
Department of Economics, Rutgers University, Newark, NJ 07102, USA
e-mail: jwgraham@andromeda.rutgers.edu

J. Barr
e-mail: jmbarr@andromeda.rutgers.edu

2005 this percentage appears to have fallen below 50%. While a large portion of this decline can be attributed to the growth in one-person households and single-parent families, another contributing factor is likely to be the growing number of households headed by unmarried couples, both opposite sex and same sex. Until recently, however, the direct causal relationship (if any) between married and unmarried couples could not be studied in any detail because there was no national count of the number of unmarried couples until the 1990 Census (Casper et al. 1999). Since then, social scientists, political pundits and even the general public have speculated about potential causal links between the decline in marriage and the growth in the number of both heterosexual couples who choose not to marry and homosexual couples who cannot marry.

The most dramatic example of the belief that marriage has suffered directly from a growing presence of unmarried couples—in this case, same sex couples—has been the debate surrounding recent federal and state efforts to define and defend marriage. In response to a ruling by the Supreme Court of Hawaii favorable to gay couples, Congress passed and President Clinton signed the Defense of Marriage Act (DOMA) in September 1996. DOMA defines marriage as a legal union between one man and one woman for purposes of all federal law and further decrees that states need not recognize a marriage from another state if it is between persons of the same sex. To date, 44 states have enacted their own DOMA laws, and 26 states have gone even further by amending their state constitutions to prohibit same sex marriage.[1]

Behind this marriage protection legislation is the widespread but often unstated belief that allowing same sex couples to marry would undermine traditional marriage. Perhaps surprisingly, there is no peer-reviewed social science evidence either for or against this belief. What little evidence does exist comes mostly from political pundits and journalists such as Gallagher (2004) and Kurtz (2004). For example, Kurtz has argued that demographic data from Scandinavia "prove the case" that extending marriage-like benefits to same sex couples has *caused* a decline in marriage rates and marital fertility. Responding to Kurtz, Eskridge and Spedale (2006) examine in detail the legislative history of same sex registered partnerships in northern Europe and argue that marriage in Nordic countries has not suffered from the legalization of same sex unions. Badgett (2004) also uses European data to refute Kurtz and goes even further by arguing the direction of causation may actually be in the other direction, concluding: "changes in heterosexual marriage made the recognition of gay couples more likely."

To date, no advocate on either side of this debate has used US data to examine potential causality between same sex unions and traditional marriage. One reason for this omission has been (until recently) a lack of consistent, nationally-representative data over time on unmarried couples in general and on same sex couples in particular who, due to social stigma and their small numbers, are difficult to count. The annual March Current Population Survey has been counting both opposite sex and same sex couples since 1996, but it does not report the number of

[1] This count, accurate as of May 2008, is based on data compiled by the Human Rights Campaign (http://www.hrc.org/documents/marriage_prohibitions.pdf).

same sex couples in any of its official publications (presumably because there are so few).[2] The 2000 Census revised the methodology by which it counts same sex couples, which makes direct comparisons with 1990 difficult. Fortunately, a new large-scale annual Census Bureau survey known as the American Community Survey (ACS) has been counting unmarried couples on a consistent basis since the late 1990s.

In this paper we use state-level data from the 2000 Census along with ACS data from 2000 to 2006 to study changes over time and space in the geographic distribution of married and unmarried same sex and opposite sex couples. We test one specific measure of causality between living arrangements known as Granger causality as modified for use with panel data (Greene 2003, pp. 551–555). Based on these tests, we can reject hypotheses that an increase in same sex couples has Granger caused either a decline in marriage or (except for one case) an increase in heterosexual cohabitation. There is mixed evidence whether opposite sex couples can be said to have Granger caused more same sex couples, but stronger evidence that marriage and heterosexual cohabitation are interrelated.

The results of our statistical analysis do not address the marriage debate head on, since no state permitted same sex couples to marry until Massachusetts did so in 2004. Even still, we believe our analysis advances the debate to the extent that the presence of more same sex unmarried couples, whose relationships have been found to be similar to heterosexual couples (Kurdek 2004; Jepsen and Jepsen 2006), represent many of the same threats to traditional marriage, real or imagined by opponents of homosexual marriage. Furthermore, states with more same sex couples are likely to exhibit greater tolerance toward gays and lesbians generally and to experience greater political pressures in favor of the legal recognition of their relationships.[3] Rauch (2004) has argued that the secular decline in marriage in the United States has been caused not by same sex *married* couples, but by the increased presence of same sex *unmarried* couples, whose largely successful efforts to obtain domestic partner benefits in the workplace have reduced the incentives of opposite sex cohabiting couples to marry. Our statistical analysis can be viewed as a direct test of the Rauch hypothesis, and our results offer little support for it.

The plan of the paper is as follows. Section 2 reviews the decennial Census and annual ACS data on couples. Section 3 speculates on possible reasons why homosexual and heterosexual living arrangements might be related. Section 4 exploits the time series dimension of the panel data to test whether the presence of same sex couples can be said to be the cause or the effect of the living arrangements of opposite sex couples. Section 5 summaries our findings and suggests avenues for future research.

[2] Ash and Badgett (2006) found only 482 same sex couples across 9 years of CPS data.

[3] Political science literature on the impact of gay populations is mixed. Barclay and Fisher (2003) find that a higher state prevalence of same sex couples increases the probability of gay-negative legislation, while Haider-Markel et al. (2000) find just the opposite result.

2 Census and ACS data on married and unmarried couples

Counting the number of married and unmarried couples in the United States has never been easy. Since 1880 the decennial Census has provided counts of married couples based on a "relationship to household head" question. From a given list of relationship responses, the selection of "husband/wife" would identify the household as a family unit headed by a married couple. Starting in 1990, the Census Bureau added "unmarried partner" as another possible relationship response "to measure the growing complexity of American households and the tendency for couples to live together before getting married" (Simmons and O'Connell 2003). Individuals who selected this response are classified as non-family households headed by an unmarried couple, which can be further divided into "opposite sex" and "same sex" couples since gender is also ascertained.[4] One obvious limitation of this approach to counting all couples is that if neither individual is the household head, then the couple (married or unmarried) will not be counted.

Beyond this limitation, it is likely that unmarried partner households in general and same sex couples in particular are undercounted for at least two reasons. First, some unmarried partners are likely to have selected "husband/wife" as their relationship response. Opposite sex unmarried partners who did so would be misclassified as married couples. Same sex partners who did so were "flagged for further review and allocation" (U.S. Bureau of the Census 2001). In 2000, most of these cases were changed to "unmarried partner" but in 1990 a complex statistical procedure reallocated them to any relationship response "consistent with the age/sex/marital status profile of the respondent."[5] As a result of this reallocation, the undercount of same sex couples is known to be much greater in the 1990 Census (and makes a direct comparison with 2000 impossible). A second reason unmarried partners would be undercounted is if (out of concern for their privacy) they selected "housemate/roommate" as their relationship status. One recent study (Badgett and Rogers 2004) estimates an undercount of same sex couples in 2000 of at least 16% on this basis alone.

Despite these limitations, Census data remain the most reliable national estimates of married and unmarried couples available. In 2000 the Census Bureau counted a total of 54,493,232 households headed by married couples, 5,475,768 headed by opposite sex unmarried couples and 594,391 headed by same sex couples, of which 301,026 were male partners and 293,265 female partners. Married couples were 51.66% of all households; opposite sex unmarried couples were 4.63% and same sex couples 0.56% (see Table 1). Census data also showed that couples were unequally distributed across the states. Vermont and California reported the highest incidence of same sex couples at 0.80%; North Dakota had lowest at 0.27%. Alaska had the highest incidence of opposite sex *unmarried* couples at 6.9%; Alabama had

[4] Response errors to the gender question can result in an incorrect allocation of unmarried couples between same sex and opposite sex. This problem is judged to be potentially significant in Census data, but less so in the ACS data where many interviews are conducted by telephone, and thus gender can be ascertained directly. See O'Connell and Gooding (2007).

[5] In theory, "unmarried partner" is one of the possible reallocations, but given the small number of such aggregate responses, it is unlikely many same sex "husband/wife" couples were so reallocated in 1990.

Table 1 Number and percent of households headed by couples, married couples and unmarried partners

	2000	2001*	2002*	2003*	2004*	2005*
Number of households						
Headed by couples	59,969,000	59,066,563	59,701,488	60,343,109	60,838,243	61,264,872
Married couples	54,493,232	53,818,873	54,333,014	54,778,298	55,045,452	55,323,405
Unmarried partners	5,475,768	5,247,690	5,368,475	5,564,811	5,792,792	5,941,467
Opposite sex	4,881,377	4,634,652	4,740,542	4,901,160	5,064,168	5,186,798
Same sex	594,391	613,038	627,933	663,651	728,624	754,669
Male–male	301,026	326,894	331,274	351,264	383,521	401,512
Female–female	293,365	286,144	296,660	312,387	345,103	353,157
Total households	105,480,101	106,204,912	107,405,080	108,562,825	109,804,071	110,870,036
Percent of total households						
Headed by couples	56.85	55.62	55.59	55.58	55.41	55.26
Married couples	51.66	50.67	50.59	50.46	50.13	49.90
Unmarried partners	5.19	4.94	5.00	5.13	5.28	5.36
Opposite sex	4.63	4.36	4.41	4.51	4.61	4.68
Same sex	0.56	0.58	0.58	0.61	0.68	0.68
Male–male	0.29	0.31	0.31	0.32	0.35	0.36
Female–female	0.28	0.27	0.28	0.29	0.31	0.32

* Based on 3-year moving average data

Source: 2000 are from the 2000 census. 2001–2005 are from the 2000–2006 American Community Survey

the lowest at 2.9%. Utah had the highest percentage of *married* couples at 63.2%; New York State was lowest at 46.6% (see Table 2).

Until recently, researchers interested in national estimates of unmarried couples have had to rely upon just the 1990 and 2000 Censuses and faced the inevitable problem of reconciling the two counts. Fortunately, this situation has begun to change. In the late 1990s the Census Bureau developed and began to implement a new large-scale annual survey modeled on Census questionnaires. Now called the American Community Survey (ACS), its two purposes are to provide up-to-date household information of the type that until now has only been available every 10 years and to save money by eliminating the need for the costly Census long-form. Like the Census, the ACS asks a basic relationship to household head question which can generate estimates of same sex couples and opposite sex unmarried and married couples both nationally and by geographic regions (states, counties, congressional districts and urban areas). In 2000, the ACS was based on 587,519 completed interviews; by 2006 its sample size had grown to 1,968,362 completed interviews, making it by far the largest household survey in a non-Census year. Even still, the Census Bureau cautions that it may be necessary to average several years of ACS data to obtain greater reliability for smaller populations in specific geographic areas. For example, one recent study (Elliott and Dye 2005) averaged ACS data over 2000 to 2003 to get city-level estimates of same sex couples. In this paper all estimates shown in Tables 1 and 2 are based on three-year moving averages.[6]

Table 1 shows national estimates of the number and percent of households headed by couples, married couples, unmarried couples, opposite sex unmarried couples, same sex couples, male couples and female couples for each year from 2000 to 2005. As can be seen there, the percent of households headed by couples declined from 56.85 in 2000 to 55.26 in 2005. All of the decline can be attributed to a drop in married couples which fell from 51.66% in 2000 to 49.90% in 2005. Meanwhile, the percent of households headed by unmarried opposite sex couples remained fairly constant (rising from 4.63 to 4.68), while the percent headed by same sex couples, although quite low, rose somewhat more, from 0.56% in 2000 to 0.68 in 2005.

Table 2 lists the five states with the highest and lowest percentages of married couples, same sex couples and opposite sex unmarried couples in 2000 and 2005. It shows that unmarried couples are more unequally distributed across the 50 states than are married couples. Except for Utah and Idaho (with their large Mormon populations), the percent of households headed by married couple in the other 48 states is always within 10% of the 50-state average.[7] By contrast, the percent of households headed by same sex couples and by opposite sex unmarried couples are

[6] In other words, the 2005 estimates shown in Tables 1 and 2 are the average of 2004–2006 ACS data. Individual year ACS data are used only in the Granger causality tests in Table 3 since a moving average would change the time-series structure of the data on which the test depends. Granger tests using moving average data produced similar results and are available from the authors upon request.

[7] The 50-state average shown in Table 2 differs from the national average in Table 1 for two reasons. First, the national average includes Washington D.C.; second, the national average, unlike the state average, takes account of unequal populations across states.

Table 2 Ranking of states with the highest and lowest percentages of households headed by married couples, same sex couples and opposite sex unmarried couples: 2000 and 2005

Married couples				Same sex couples				Opposite sex unmarried couples			
2000		2005		2000		2005		2000		2005	
Highest		Highest		Highest		Highest		Highest		Highest	
Utah	63.2	Utah	62.1	Vermont	0.80	Vermont	0.97	Alaska	6.9	Maine	7.1
Idaho	58.9	Idaho	57.1	California	0.80	New Mexico	0.90	Vermont	6.7	Alaska	7.0
N Hampshire	55.3	N Hampshire	54.0	Washington	0.70	Massachusetts	0.90	Maine	6.7	Vermont	6.7
Iowa	55.1	Iowa	53.3	Massachusetts	0.70	Washington	0.89	Nevada	6.5	N Hampshire	6.4
Wyoming	54.8	Wyoming	53.2	Oregon	0.67	Oregon	0.87	N Hampshire	6.3	Oregon	6.3
State average	52.6 (2.6)	State average	50.7 (2.7)	State average	0.52 (0.13)	State average	0.65 (0.14)	State average	4.7 (0.9)	State average	4.8 (0.9)
Lowest		Lowest		Lowest		Lowest		Lowest		Lowest	
New York	46.6	New York	45.3	N Dakota	0.27	S Dakota	0.34	Alabama	2.9	Alabama	2.9
Rhode Island	48.2	Mississippi	46.7	S Dakota	0.29	N Dakota	0.39	Utah	3.0	Utah	3.1
Louisiana	48.9	Louisiana	46.8	Iowa	0.32	W Virginia	0.42	Arkansas	3.5	Mississippi	3.9
Massachusetts	49.0	Rhode Island	46.8	Montana	0.34	Mississippi	0.44	Oklahoma	3.5	Oklahoma	3.9
Nevada	49.7	New Mexico	47.1	Nebraska	0.35	Idaho	0.46	Kansas	3.7	Kansas	3.9

Source: 2000 data are from the 2000 Census. 2005 is a 3-year average of 2004–2006 data from the American Community Survey

Note: State average represents the mean of the 50 individual states values. Standard deviations are shown in parentheses

often more than 20% above (or below) the average state. For example, in 2005, 9 (7) states had at least 20% more same sex (opposite sex) couples and 10 (5) states at least 20% fewer than did the average state. State rankings of couples have remained fairly stable between 2000 and 2005, although year by year rankings of same sex couples display somewhat greater volatility than do rankings of opposite sex couples. This may reflect a greater difficulty counting same-sex couples. It may also be due to recent accelerated changes state by state in laws and attitudes towards same sex unions.

With a few notable exceptions, a comparison of the top and bottom ranked states by types of couples suggests that states with a higher (lower) incidence of same sex couples also have a higher (lower) incidence of opposite sex unmarried couples and a lower (higher) incidence of married couples. This perception is reinforced by calculating the Spearman correlations between state rankings of couples: the correlation between same sex and opposite sex unmarried couples in 2000 is positive and statistically significant at 0.54; and the correlation between same sex and married couples in 2000 is significantly negative at −0.57.[8] These correlations are consistent with the conservative view expressed by Kurtz (2004) that same sex couples reduce the propensity of opposite sex couples to marry and increase the likelihood of cohabitation. On the other hand, they are also consistent with the liberal view expressed by Badgett (2004) that it is the decline in marriage and the rise in heterosexual cohabitation that have allowed for an increase in the presence of same sex couples. Clearly, correlation alone does not imply causation. Can economic models of the family provide some guidance?

3 Some hypotheses about correlations and causation in living arrangements

At first glance, economic theory might seem to have little to contribute to the debate over the direction of causality (if any) between same sex unions and traditional marriage. Assuming sexual orientation is largely immutable (and dichotomous), a secular increase in the number of same sex couples (drawn from an exclusively homosexual population) would not seem to diminish the pool of potential marriage partners among heterosexuals nor alter their incentives to marry.[9] In this section we argue that in looking for a link between the behaviors of these two populations, it is important to recognize the key role played by heterosexual cohabitation. Gary Becker's original models of marriage (Becker 1973; 1974) ignored cohabitation, limiting an individual's utility-maximizing lifestyle choices to either marrying or remaining single. In response to widely-publicized estimates of the growth in the number of unmarried couples (Bumpass and Sweet 1989), a new generation of family formation models (Lillard et al. 1995; Brien et al. 1999; Sahib and Gu 2002) enlarged the choice set to include cohabitation as a third option, viewing it largely

[8] State rankings of married couples and opposite sex unmarried couples are not highly correlated: the Spearman correlation is −0.31 for 2000, which is not statistically significant.

[9] Some homosexuals marry a partner of the opposite sex, but few observers would argue this practice is good either for the institution of marriage or for the individuals involved.

as an intermediate step towards marriage used by some risk-averse individuals to acquire more information about potential mates.

Suppose a couple is trying to decide whether to begin their new life together by marrying now or simply living together. They know that formal marriage offers some distinct advantages over cohabitation (such as greater access to employer and government provided spousal benefits), but marriage is also more costly to dissolve if something goes wrong.[10] In addition, marriage confers society's blessings upon them, while cohabitation may stigmatize them as "living in sin." Couples weigh the expected costs and benefits of marriage against those of cohabitation and select the lifestyle which offers greater net benefits. The outcome of this calculation might be expected to vary by geographic region and over time if the economic and social costs and benefits of marriage and cohabitation differ across space and time.

One obvious explanation for the secular decline in marriage is simply that the social cost (or moral stigma) of cohabitation declined in the United States and many other western countries. What caused this change to occur? In part it was surely the result of changing values and social norms brought on by a decline in the impact of religion in everyday life. The introduction of the birth control pill (Goldin and Katz 2000) along with a marked shift in the sex ratio at marriageable age (Heer and Grossbard-Shechtman 1981), both factors which helped to spawn the Women's Liberation Movement, played a key role as well. In addition, important legal changes should be noted such as the right to privacy established by the Supreme Court in 1965 in Giswold v. Connecticut.[11] While all of these external factors may have played a contributing role, it is also likely that the increasing presence of unmarried couples (both opposite sex and same sex) was itself a further stimulus to the decline in moral stigma associated with both heterosexual and homosexual cohabitation. Both Kurtz (2004) and Gallagher (2004) appear to subscribe to this reduced stigma hypothesis and assert without proof that the growing visibility of same sex couples played a leading role in contributing to a moral climate of "anything goes." Badgett (2004) also invokes a reduced stigma hypothesis, but argues that the direction of causality runs from declining marriage rates and increasing heterosexual cohabitation to more same sex unions.

Rauch (2004) offers an alternative explanation for the secular decline in marriage at the expense of non-marital cohabitation which depends less on moral stigma and more on changing economic incentives. Because gay and lesbian couples cannot marry, they do not generally have access to government and employer-provided spousal benefits such as pensions and health insurance. Understandably, this has given rise to a demand for "domestic partner" benefits in the workplace. As of 2007, more than half of all "Fortune 500" companies offered such benefits

[10] The GAO has identified 1,138 federal statutory provisions in the United States Code as of December 31, 2003 in which marital status is a factor in determining or receiving benefits, rights and privileges (http://www.gao.gov/docdblite/details.php?rptno=GAO-04-353R%20).

[11] Legal scholars argue this precedent led to the decision in Eisenstadt V. Baird (1972) which struck down a ban on the sale of contraceptives to unmarried couples and to Lawrence v. Texas (2003) which struck down state sodomy laws. Although no longer enforced, seven states (North Carolina, Virginia, West Virginia, Florida, Michigan, Mississippi and North Dakota) still have anti-cohabitation laws on their books.

according to the Human Rights Campaign, as did a growing number of state and local governments.[12] But for reasons of equity, many employers have felt compelled to extend these benefits to the long-term partners of their unmarried heterosexual employees as well (Badgett 2001, ch. 4). As a result, this has altered the choice calculus of heterosexual couples who now realize they no longer need to marry to have access to job-related spousal benefits. This argument suggests that it is the rising incidence and political power of same sex couples (who cannot marry) that has eroded some of the traditional benefits of marriage for opposite sex couples. Indeed, as Rauch argues, it is precisely because same sex couples cannot marry that this change has occurred. He goes on to speculate that allowing same sex couples to marry would reduce the push for domestic partner benefits and thus increase the incentives for cohabiting heterosexuals to marry as well.

4 Testing causality between married and unmarried couples

In analyzing causal links between variables, most observers agree that prior beliefs and a plausible theory are the strongest foundations upon which to argue that Y does or does not cause X. In the absence of theory, Clive Granger (1969) proposed a simple statistical test, now widely used in the social sciences and referred to as "Granger causality." Essentially, in a linear regression of a given variable (X) against its own past values, Granger causality exists when past values of another variable (Y) are found to contribute significantly to the explanatory power of the regression. According to Hamilton (1994, pp. 302–309), the key question that Granger causality testing addresses is how useful some variables are for forecasting others and, as a result, "it seems best to describe these as tests of whether Y helps forecast X rather than tests of whether Y causes X." It is also important to emphasize that a finding of Granger non-causality would not preclude the possibility of other forms of causality such as contemporaneous or forward-looking causality.

We test whether the percent of households that are headed by same sex couples Granger causes either the percent that are opposite sex unmarried couples or the percent that are married couples (and vice-versa). Formally, let X_{it} be the percent of households that are headed by same sex couples in year t and state i, and Y_{it} be the percent headed by married couples (or opposite sex unmarried couples). We test the null hypothesis "X does not forecast Y" by estimating two regressions:

$$Y_{it} = \alpha_0 + \sum_{\tau=1}^{m} \alpha_\tau Y_{it-\tau} + \sum_{\tau=1}^{m} \beta_\tau X_{it-\tau} + \lambda_t + v_i + \varepsilon_{it} \quad (1)$$

$$Y_{it} = \alpha_0 + \sum_{\tau=1}^{m} \alpha_\tau Y_{it-\tau} + \lambda_t + v_i + \varepsilon_{it} \quad (2)$$

[12] As of 2007, the website of the Human Rights Campaign lists 270 "Fortune 500" companies, 13 state governments and 144 cities and counties that provide health benefits to domestic partners. (http://www.hrc.org/issues/workplace/search_employers.htm)

where $i = 1,\ldots,50$ indicates the state, $t = 1,\ldots,7$ indicates the year and $\tau = 1,\ldots,m$ are time lags. Also, λ_t is a year dummy variable, v_i is a state fixed-effect and ε_{it} is the random error term. Based on Eqs. 1 and 2, we test the null hypothesis that the group of coefficients β_1 to β_m is equal to zero. If we reject the null hypothesis, then we can reject that X does *not* forecast Y and thus we can say that X Granger causes Y. To test for the possibility of causality in the other direction, we also test the null hypothesis "*Y* does not forecast *X*" by running the same two regressions above, but reversing *X* and *Y*. In all of this analysis, the number of right-hand side lagged terms (*m*) is arbitrary, but as Hamilton (1994, p. 305) observes, test results "can be surprisingly sensitive to the choice of lag length."

Before turning to the results, a note about estimation is in order. The regressions are run with panel data from the 50 states from 2000 to 2006. Given the presence of lagged dependent variables on the right hand side, an ordinary least squares regression with dummy variables for each state could produce biased coefficient estimates for the α's (Hsiao 1986); as a result, an alternative estimation procedure is required. We use the procedure developed by Arellano and Bond (1991). The initial step of this procedure is first-differencing to eliminate the fixed-effects. However, first-differencing then creates another problem in that the lagged dependent variable is now correlated with the error term (since now $Cov(Y_{it-1}, \varepsilon_{it-1}) \neq 0$). Thus, in order to obtain consistent estimates of the coefficients, the second step of this procedure is to use higher order lags of the dependent variables (and the exogenous variables) as instrumental variables, since these lagged variables can be considered exogenous.[13]

Table 3 summarizes the results of Granger causality tests (using χ^2-tests based on the Wald statistic) with right hand variable lags of 1, 2 and 3 years. (Higher order lags would reduce the sample to 100 or fewer observations.) The table gives the probability values for the null hypothesis that X does not forecast Y. Probability values less than or equal to 0.05 are shown in bold, which indicate a rejection of the null hypothesis with 95% confidence or greater. For each lag length, results for two forms of the regression equation are given. The first form of the equation does not include lagged values of the third couples variable, while the second form of the equation does. For example, in the first row of the table, when the dependent variable is married couples and the main causal variable is same sex couples, the third variable is opposite sex unmarried couples. The second form of the equation is included to see if the results are sensitive to the inclusion of additional control variables, and in general we find that they are not.

Based on the results in Table 3, there is no evidence same sex couples forecast opposite sex married couples (row 1), and little evidence (just one case out of six) they forecast opposite sex unmarried couples (row 3). More precisely, we can say that taking into account the historical evolution of the percent of same sex couples

[13] Estimation was done using the *xtabond* command in Stata 9.2. Also note that Arellano-Bond procedure is valid when there is no second order autocorrelation of the error terms and the instruments are strictly exogenous. In all of the regressions we ran (whose results are given in Table 3), hypothesis tests indicate that the above two assumptions are valid. These results are available upon request. The results in Table 3 are based on annual data; results for the moving average data are available upon request. They are generally similar to the annual data results.

Table 3 Granger causality tests between same sex (SS) and opposite sex married (MC) and unmarried (OS) couples

	Null Hypothesis	Prior 1 yr		Prior 2 yrs		Prior 3 yrs	
		W/o other vars.	With other vars.	W/o other vars.	With other vars.	W/o other vars.	With other vars.
(1)	%SS does not forecast %MC	0.314	0.313	0.647	0.597	0.620	0.694
(2)	%MC does not forecast %SS	0.896	0.966	**0.036**	**0.051**	0.307	0.484
(3)	%SS does not forecast %OS	0.726	0.454	0.147	0.126	**0.024**	0.128
(4)	%OS does not forecast %SS	0.454	0.454	0.597	0.856	0.077	0.270
(5)	%OS does not forecast %MC	**0.047**	**0.050**	0.172	0.180	0.134	0.117
(6)	%MC does not forecast %OS	**0.030**	**0.024**	**0.044**	**0.039**	0.236	0.694
	# obs.	250	250	200	200	150	150

Probability values for χ^2-tests on the omission of lagged values of the potentially causal variable

Note: Results in bold represent a rejection of the null hypothesis with 95% confidence or greater

All regressions contain year dummy variables

in a state does not improve our ability to forecast the marital behavior of opposite sex couples in that state; or in other words, same sex couples do not Granger cause opposite sex couples. Thus, our findings offer almost no support for Rauch's conjecture that increases in *unmarried* same sex couples led to changes in the marital behavior of heterosexual couples. They also cast at least some doubt on the views expressed by Kurtz and Gallagher that *married* same sex couples would do so.

Also based on Table 3, there is no evidence that opposite sex unmarried couples Granger cause same sex couples (row 4). The evidence is mixed, however, whether married couples Granger cause same sex couples (row 2): using a two year lag, married couples do help forecast same sex couples, but not when lags are either one year or three years long. Thus, we find at most some limited support for the argument expressed by Badgett that it was changes in the marital behavior of opposite sex couples that led to increases in same sex couples.

Although not the primary focus of this paper, for sake of completeness, Table 3 also tests causality between opposite sex married and unmarried couples. Looking at rows 5 and 6, there is some evidence (two cases out of six) that opposite sex unmarried couples help forecast married couples and even more evidence (four cases out of six) that married couples help forecast opposite sex unmarried couples. Taken together, these two findings suggest that marriage and cohabitation decisions by opposite sex couples are interrelated (a result which is not unexpected) or caused by similar external forces.

5 Summary and conclusions

Nationally-representative estimates of the number and geographic location of unmarried opposite sex and same sex couples which first appeared in the 1990 and 2000 Censuses are now available on an annual basis in the American Community Survey. In this paper we used 2000 Census and 2000–2006 ACS data by state on the percent of households headed by married and unmarried couples to investigate claims of causality across living arrangements. From a statistical point of view, we can reject the hypothesis that an increase in the presence of same sex couples has Granger caused either a decline in traditional marriage or (in most cases) an increase in cohabitation among opposite sex couples. We can also reject the hypothesis that heterosexual cohabitation Granger caused same sex couples. There is mixed, but at most limited, evidence that married couples Granger caused same sex couples. Finally, it does appear that marriage and cohabitation by opposite sex couples are interrelated, or caused by similar external forces. Taken together, these findings offer no support for Rauch's hypothesis that *unmarried* same sex couples caused the marital behavior of opposite sex couples to change. They also suggest that both claims and counter-claims of causality expressed in the recent political debate over same sex marriage should be viewed with considerable caution.

ACS data show that unmarried couples are more unequally distributed across states than are married couples and that the distribution of same sex couples has been changing more rapidly than that of other couples. Our causality results are notable, but they leave unexplained what does account for the highly uneven cross-state distribution of these couples. To what extent does the distribution of unmarried couples, particularly same sex couples, depend on historical accident, state laws, social and religious attitudes or perhaps economic factors? Using 2000 Census data, Black et al. (2002) showed that the distribution of same-sex couples across large metropolitan areas depended positively on the cost of housing, but that the distribution of opposite-sex unmarried couples did not. Beyond housing costs, their analysis was unable to uncover other statistically significant determinants of location. Identifying the economic, social, religious, cultural and political factors which underlie the location decisions of unmarried couples is an intriguing and unfinished project for social scientists.

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Appendix

Regression results tables

Table A1 Dependent variable: %SS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ΔSS_{t-1}	−0.149	−0.143	−0.15	−0.467	−0.487	−0.493	−0.245	0.057	−0.025	0.086	0.085	0.158
	(1.73)	(1.65)	(1.73)	(3.47)**	(3.82)**	(3.84)**	(0.58)	(0.09)	(0.04)	(0.09)	(0.11)	(0.17)
ΔSS_{t-2}				−0.36	−0.348	−0.35	−0.188	0.038	0.002	0.089	0.032	0.111
				(3.52)**	(3.55)**	(3.54)**	(0.60)	(0.08)	0.00	(0.11)	(0.05)	(0.14)
ΔSS_{t-3}							0.129	0.27	0.249	0.347	0.317	0.377
							(0.63)	(0.91)	(0.87)	(0.65)	(0.71)	(0.69)
ΔSS_{t-4}										0.036	0.068	0.048
										(0.28)	(0.48)	(0.30)
ΔOS_{t-1}	0.014		0.014	0.004		0.005	0.002		0.009	0.021		0.043
	(0.75)		(0.75)	(0.18)		(0.25)	(0.08)		(0.31)	(0.53)		(0.84)
ΔOS_{t-2}				−0.017		−0.007	−0.052		−0.033	−0.054		−0.026
				(0.89)		(0.39)	(2.09)*		(1.11)	(1.43)		(0.59)
ΔOS_{t-3}							−0.042		−0.043	−0.013		−0.017
							(1.89)		(1.67)	(0.27)		(0.33)
ΔOS_{t-4}										0.038		0.044
										(0.78)		(0.82)
ΔMC_{t-1}		−0.001	.0004		0.003	0.004		0.017	0.015		0.03	0.032
		(0.13)	(0.04)		(0.35)	(0.42)		(0.77)	(0.70)		(1.30)	(1.12)
ΔMC_{t-2}					0.022	0.022		0.035	0.03		0.035	0.029
					(2.54)*	(2.42)*		(1.73)	(1.43)		(1.13)	(0.76)
ΔMC_{t-3}								−0.003	−0.005		−0.001	−0.011
								(0.23)	(0.37)		(0.06)	(0.55)
ΔMC_{t-4}											0.006	0.004
											(0.37)	(0.24)

Table A1 continued

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Const.				0.063	0.057	0.076	0.037	0.021	0.027	0.003	0.027	0.013
				(8.88)**	(9.51)**	(4.46)**	(1.23)	(0.53)	(0.73)	(0.03)	(0.53)	(0.19)
# Obs.	250	250	250	200	200	200	150	150	150	100	100	100

Absolute value of z statistics in parentheses, Year dummies included in all regs., coeffs. not shown

* Significant at 5%; ** significant at 1%

Table A2 Dependent variable: %OS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ΔSS_{t-1}	0.083		0.181	−0.025		0.11	−0.188		−0.245	−0.23		−0.316
	(0.35)		(0.75)	(0.09)		(0.40)	(0.70)		(0.89)	(0.59)		(0.71)
ΔSS_{t-2}				−0.486		−0.466	−0.585		−0.604	−0.475		−0.578
				(1.86)		(1.73)	(2.14)*		(2.09)*	(1.12)		(1.17)
ΔSS_{t-3}							−0.713		−0.588	−0.974		−1.085
							(2.70)**		(1.84)	(1.44)		(1.27)
ΔSS_{t-4}										−0.012		−0.064
										(0.02)		(0.11)
ΔOS_{t-1}	−0.011	0.034	0.033	−0.111	−0.026	−0.042	−0.563	−0.352	−0.46	−0.789	−0.232	−0.849
	(0.11)	(0.31)	(0.31)	(0.76)	(0.17)	(0.27)	(2.65)**	(1.58)	(1.88)	(0.96)	(0.50)	(1.16)
ΔOS_{t-2}				−0.077	−0.067	−0.064	−0.346	−0.232	−0.295	−0.497	−0.226	−0.555
				(0.78)	(0.66)	(0.64)	(2.50)*	(1.59)	(1.89)	(1.09)	(0.76)	(1.17)
ΔOS_{t-3}							−0.222	−0.15	−0.179	−0.294	−0.107	−0.298
							(2.33)*	(1.49)	(1.72)	(1.08)	(0.58)	(1.06)
ΔOS_{t-4}										−0.027	0.055	−0.029
										(0.15)	(0.50)	(0.20)
ΔMC_{t-1}		0.075	0.079		0.106	0.108		0.074	0.032		0.078	−0.038
		(2.17)*	(2.25)*		(2.48)*	(2.54)*		(1.43)	(0.54)		(0.85)	(0.25)
ΔMC_{t-2}					0.045	0.034		0.052	0.006		0.058	−0.042
					(1.24)	(0.94)		(1.22)	(0.14)		(0.82)	(0.33)
ΔMC_{t-3}								0.059	0.036		0.081	0.01
								(1.80)	(1.01)		(1.55)	(0.11)
ΔMC_{t-4}											0.04	0.016
											(0.85)	(0.24)

Table A2 continued

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Const.	0.086	0.10296	0.102	0.157	0.118	0.098	0.275	0.317	0.294	0.324	0.188	0.324
	(5.36)**	(6.04)**	(5.94)**	(5.38)**	(1.91)	(1.54)	(4.59)**	(5.73)**	(4.91)**	(1.37)	(2.23)*	(2.51)*
# Obs.	250	250	250	200	200	200	150	150	150	100	100	100

Absolute value of z statistics in parentheses, Year dummies included in all regs., coeffs. not shown

* Significant at 5%; ** significant at 1%

Table A3 Dependent variable: %MC

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ΔSS_{t-1}		0.537	0.545	0.035		0.067	0.833		0.666	0.999		0.698
		(1.01)	(1.01)	(0.06)		(0.10)	(1.13)		(0.94)	(0.99)		(0.67)
ΔSS_{t-2}				−0.505		−0.553	0.558		0.307	0.48		0.389
				(0.84)		(0.90)	(0.72)		(0.41)	(0.43)		(0.34)
ΔSS_{t-3}							0.839		0.764	1.7		2.334
							(1.11)		(0.98)	(1.52)		(1.81)
ΔSS_{t-4}										0.516		0.955
										(0.56)		(0.94)
ΔOS_{t-1}	0.314		0.313		0.393	0.39		0.317	0.375		0.558	0.686
	(1.98)*		(1.96)*		(1.78)	(1.79)		(1.35)	(1.45)		(1.44)	(1.63)
ΔOS_{t-2}					0.008	0.019		0.463	0.506		0.317	0.404
					(0.04)	(0.11)		(2.14)*	(2.22)*		(0.92)	(1.06)
ΔOS_{t-3}								0.34	0.353		−0.07	−0.013
								(1.95)	(1.97)*		(0.25)	(0.04)
ΔOS_{t-4}											−0.382	−0.403
											(1.64)	(1.72)
ΔMC_{t-1}	−0.002	−0.038	0.011	−0.024	0.079	0.05	0.003	−0.054	−0.003	0.169	0.285	0.278
	(0.02)	(0.39)	(0.11)	(0.17)	(0.47)	(0.29)	(0.02)	(0.29)	(0.01)	(0.43)	(0.65)	(0.63)
ΔMC_{t-2}				0.048	0.098	0.065	0.132	0.131	0.171	0.296	0.319	0.374
				(0.44)	(0.84)	(0.55)	(0.84)	(0.90)	(0.99)	(1.07)	(1.09)	(1.16)
ΔMC_{t-3}							−0.023	−0.015	−0.003	0.133	0.102	0.193
							(0.25)	(0.17)	(0.03)	(0.82)	(0.63)	(1.01)
ΔMC_{t-4}										0.187	0.163	0.187
										(1.17)	(1.06)	(1.11)

Table A3 continued

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Const.	−0.253	−0.242	−0.256	−0.307	−0.311	−0.323	−0.316	−0.364	−0.374	−0.122	−0.106	−0.193
	(6.64)**	(6.41)**	(6.70)**	(4.63)**	(4.58)**	(4.91)**	(1.89)	(2.62)**	(2.35)*	(0.44)	(0.44)	(0.82)
# Obs.	250	250	250	200	200	200	150	150	150	100	100	100

Absolute value of z statistics in parentheses, Year dummies included in all regs., coeffs. not shown

* Significant at 5%; ** significant at 1%

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