Club classification of US divorce rates

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Abstract: In this paper, we study the evolution of US divorce rates across states, from 1956 to 1998. By using a cluster algorithm, we identify different groups of states that converge (or diverge) with (or from) each other in the growth of their divorce rates. We find strong support for the club classification. For the overall 1956–1998 period, we obtain evidence of divergence from the common growth component, but when we split the sample, a different pattern is observed. In the pre-unilateral divorce reform period (1956–1972), we find that most of the states had converging divorce rates within several convergence clubs, while in the post-reform period (1973–1998) an intense divergent process took place in divorce rates, across states, within different divergence clubs.

Keywords: Divorce rate, convergence club, divergence club.

JEL: C12, C22, J12.

1. Introduction

In an influential article, Friedberg (1998) analyzed the effect of the no-fault unilateral divorce laws of the 1970s on the evolution of the US divorce rate. Using a state-based panel of divorce data from 1968 to 1988, Friedberg found that the adoption of unilateral divorce laws had a permanent influence on divorces, accounting for almost one-sixth of the rise in the divorce rate since the late 1960s. Later, Wolfers (2006) replicated Friedberg's exercise, extending the data period (from 1956 to 1998) and adding variables that explicitly model the dynamic response of divorce. Wolfers' results show that the no-fault unilateral divorce reforms had a positive effect on the divorce rate, but the effect was transitory; after a decade, no effect on the divorce rate could be discerned. These findings have been widely accepted, and the methodology has been used by others to analyze the dynamic response of divorce rates in other countries (for instance, González and Viitanen (2009) study the effect of divorce laws on a sample of European divorce rates).[1] In this paper, we do not pretend to explore the transitory or permanent impact of divorce law reforms on divorce rates; rather, we examine whether the transition to more liberal divorce laws implied a convergence or divergence of divorce across US states' divorce rates.

The liberalization of divorce laws leads to a decrease in the costs associated with divorce, which can make divorce more feasible. From a theoretical point of view, the number of divorces, and thus the divorce rate, would increase, since a greater number of couples value the now less-expensive divorce over marriage, although, as Becker (1981) argued, divorce law reforms may not affect the probability of marriage breakdown, since they only affect property rights. Following the Coase Theorem, under mutual consent divorce, the party who wants to divorce has to compensate their spouse, in such a way that mutual consent gives considerable power to spouses who do not want a divorce. The change to a unilateral system transfers the right to divorce to the spouse most wanting a divorce. In this case, it is the party who wants to continue married who must compensate the spouse who wishes to leave. When the re-assignment of property rights between spouses is accompanied by transfers between them, a stable aggregate divorce rate should be observed, and then divorce convergence would be expected.

[1] Of course, there are more determinants of divorce; e. g., child custody and child support laws (González-Val and Marcén, 2012), economic growth (South, 1985), price stability (Nunley, 2010), unemployment (Amato and Beattie, 2011), the birth-control pill (Marcén, 2014), and culture (Furtado et al., 2013).

Nonetheless, the aggregate divorce rate will change when compensation is not possible (see, for example, Allen, 2002) and so divorce convergence would not be possible across all US states.

The study of the evolution of divorce rates is considered important in the literature since divorce has been suggested as having an impact on both women and children. The possibility of divorce may increase female labor force participation, (Michael, 1985; Johnson and Skinner, 1986; Peters, 1986; Parkman, 1992), but it can also affect the economic status of divorced women and their children (Jarvis and Jenkins, 1999; Bedard and Deschênes, 2005). Divorce may also have a negative effect on the psychological well-being of children (Seltzer, 1994; Amato, 2000; Gruber, 2004; Gähler and Palmtag, 2014).

To analyze divorce convergence in the US, we utilize the Phillips and Sul (2007) panel convergence method on a sample of fifty US states and the District of Columbia, for the period 1956 to 1998. This methodology does not require any specific assumptions concerning the stationarity of the divorce rate, our variable of interest, and/or the existence of common factors. This cluster algorithm has been extensively used in the economic literature, for example, to explore convergence in the cost of living across US cities (Phillips and Sul, 2007), price convergence (Fischer, 2012), the historical population convergence of the US cities (González-Val and Lanaspa, 2014), the income convergence of member states of the European Union (Fritsche and Kuzin, 2011; Bartkowska and Riedl, 2012) and even the happiness club convergence in Europe (Apergis and Georgellis, 2014), among others. We add to this literature by exploring whether divorce rates converge across US states.

Our findings suggest that there was not a full convergence in divorce rates across the US. We do find empirical evidence of divergence clubs when we use the whole sample in the analysis, but, after dividing the sample into two periods, pre-reform (1956-1972) and post-reform (1973-1998), our results show that, in the pre-reform period, most of the states were converging in divorce rates while in the post-reform period, we find a divergent process in divorce rates across states within different divergence clubs. Then, even if the effects of divorce law reform disappear after a decade, as suggested by Wolfers (2006), these results would point to the reforms as a main determinant of the changes in the club classification, and of the change from convergence to divergence of divorce rates.

Section 2 presents the data used. In Section 3, we apply the cluster algorithm to identify different groups of states that converge with each other. Section 4 concludes.

2. Data

We use the same dataset as Wolfers (2006), testing the dynamic response of the divorce rate to a change in the legal regime that governs divorce, using data on the states' divorce rate between 1956 and 1998. The divorce rate (DR) is defined as the annual absolute number of divorces per thousand inhabitants in each state (the source is the *Vital Statistics of the United States*).

This is known as the crude divorce rate and represents the standard measure of the level of, and changes in, divorce. Nevertheless, this rate could be affected by the marital status structure of the populations to it relates. Divorce rates may be low either because marriage rates are low, or because marriages are less likely to end in divorce. To examine this issue, we could have used another measure of divorce rates, defined as the annual number of divorces per 1000 married population, but this analysis would have been less reliable due to the scarcity of data on the total number of marriages, which is only available when each census is collected, normally every 10 years (see Furtado et al., 2013; Marcén, 2014).

Table 1 incorporates information on the year in which no-fault unilateral reforms were passed. Since 1968, 31 states introduced no-fault unilateral reforms, with most of those reforms taking place during the late 1960s and 1970s, with only two exceptions of reforms implemented in the 1980s, following Gruber's (2004) classification. Unfortunately, information on the divorce rate is not available for all states during all the period considered (see Table 1). As we explain in detail below, for three states, (California, Indiana, and Louisiana) the analysis cannot be carried out because of data limitations. Table 1 also incorporates a summary of statistics of the divorce rates across states that points to a non-convergence in the evolution of the divorce rates at the state level during the period considered. There are important variations in the average divorce rates, with 15 states having an average divorce rate greater than 5 (the highest being Nevada, at 18.6), 27 states with an average divorce rate between 3 and 5, and 9 states with divorce rates lower than 3, (the lowest was 2.3, in the states of Massachusetts and New York). It is not only that these differences in the divorce rates may reflect potential

divergences in divorce rate growth, but also the fact of considerable dissimilarities in the gap between the minimum and maximum divorce rates in each state. For example, in the case of New Mexico, we observe a minimum divorce rate of 1.5 and a maximum of 9.1, while in Pennsylvania the minimum was 1 and the maximum 3.5.

3. Convergence clubs across states

To explore the evolution of US divorce rates across states, we apply a cluster algorithm that allows us to identify different groups of states that converge (or diverge) with (or from) each other in the growth of their divorce rates. The cluster procedure is based on the log $t-$test (Phillips and Sul, 2007, 2009), which focuses on the evolution over time of idiosyncratic transitions in relation to the common growth component. Other papers have studied the evolution of divorce rates, focusing on the possible differences in idiosyncratic transitions across states relative to the common growth component, such as that of González-Val and Marcén (2012), where the path of the common growth component of state divorce rates is analyzed through panel unit root tests.[2] This new approach is different from that of prior empirical studies of growth convergence clubs, such as the regression tree analysis used by Durlauf and Johnson (1995) and the predictive density of data used by Canova (2004) to identify different clusters of countries or regions. The procedure of Phillips and Sul focuses on divorce rate growth relative to the average rather than on individual state growth. Thus, their methodology enables us to identify the relative transitions that occur within subgroups, and to measure these transitions against the correlative of a common growth trend (Phillips and Sul, 2009). The regression model of the log $t-$test is

$$\log\frac{H_1}{H_t} - 2\log(\log t) = \beta_0 + \beta_1 \log t + u_t, \qquad \text{for } t = T_0,...,T \tag{1}$$

where $\frac{H_1}{H_t}$ is the cross-sectional variance ratio, H_t is the transition distance, $H_t = N^{-1}\sum_{i=1}^{N}(h_{it}-1)^2$, and h_{it} is the relative transition coefficient, defined as $h_{it} = \frac{\log DR_{it}}{N^{-1}\sum_{i=1}^{N}\log DR_{it}}$ (DR_{it} is the divorce rate of state i at time t.). These relative

[2] They find that the unit root null hypothesis cannot be rejected for most states, even when one or multiple structural breaks are allowed.

transition coefficients exclude the common growth component (μ_t) by scaling, measuring state i's transition element relative to the cross-section average. This means that h_{it} traces out state i's individual trajectory relative to the average, so Phillips and Sul (2009) call h_{it} the 'relative transition path.' Moreover, h_{it} also measures for each state i the departure from the common growth path μ_t in relative terms.

Thus, Eq. (1) simply represents a time series regression; the null hypothesis is growth convergence across all states, and the alternatives include no convergence and partial convergence among subgroups of states. As the t-statistic of the test refers to the coefficient β_1 of the $\log t$ regressor in Eq. (1), the test is called the '$\log t$' convergence test. It is important to note that not only the sign of the coefficient β_1 of $\log t$, but also its magnitude, measures the speed of convergence.

The cluster procedure performs the $\log t$ test for each of the groups and stops when the group of remaining states does not satisfy the convergence test. First, it defines an initial core primary group, and other groups are then formed according to certain criteria that maximize the value of the t-statistic. A much more detailed explanation of the constructive steps of the procedure can be found in Phillips and Sul (2007, 2009).

Figure 1 shows the path of all the states and demonstrates that it is not easy to infer any specific pattern. However, it seems clear that around the beginning of the 1970s there is a rise in the trend of divorce rates in all the states, followed by a subsequent fall in the second half of the 1980s. Wolfers (2006) identified the 1969–1977 period as the reform period, in which 28 states adopted unilateral divorce, but in most of these states the law changed in the first three years of the 1970s (see Table 1),[3] so the vertical red line indicates the intermediate year 1972.[4] The fall in rates in the 1980s, a decade later, coincides with the temporal duration of the effects of the unilateral reforms estimated by Wolfers (2006).[5]

[3] González-Val and Marcén (2012) find that many of the structural breaks detected in the state series are located in that brief period (1970–1973).
[4] We have tried different intermediate years to split the sample and the qualitative results are maintained.
[5] Although González-Val and Marcén (2012) suggest that the long-run effect of divorce law reforms on the divorce rate observed by Wolfers (2006) may be the result of both unilateral reforms and changes in the aftermath of divorce.

Table 2 shows the results of applying the cluster algorithm to our sample of states.[6] We consider three periods: 1956–1972 (pre-reform period), 1973–1998 (post-reform period) and 1956–1998 as a whole. The "club" column shows the number of states that are members of each group. The distribution of states within groups can be found in Table 3. From 1956 to 1998, the algorithm classifies states into three groups, revealing three different steady divorce rates in the US. Three remaining states (California, Indiana, and Louisiana) are excluded because the algorithm requires a balanced panel dataset, and Wyoming is not classified into any club. In each group, the estimated coefficient $\hat{\beta}_1$ is significant, strongly supporting the club classification, although most of the states (35) are classified into the residual group 3. Furthermore, $\hat{\beta}_1 < 0$ for the three groups, revealing evidence of divergence from the common growth component (divergence clubs). Figure 2 shows the path over time of the divorce rate of the states in each divergence club.

The number of groups and their composition significantly changes if we split the sample into two periods. When we consider the pre-reform period (1956–1972) the cluster procedure identifies five groups. California, Indiana and Louisiana are excluded due to data limitations and Wyoming is not classified into any club, again. The coefficient $\hat{\beta}_1$ is significant for all groups, but $\hat{\beta}_1 > 0$ for groups 1, 2 and 4 (containing most of the states, 21, 14, and 4, respectively) and $\hat{\beta}_1 < 0$ for groups 3 and five (6 and 2 states, respectively). Therefore, in this pre-reform period, most of the states, classified into three convergence clubs, were converging in divorce rates within each club; Figure 3 displays the evolution of the divorce rates by club.

However, when we focus on the post-reform period (1973–1998), we see a different picture. The algorithm classifies the states into six groups, and all of them are divergence clubs ($\hat{\beta}_1 < 0$). Two remaining states are not classified into any club (Nevada and Wyoming), and for these the convergence hypothesis is rejected; California, Indiana, and Louisiana are excluded because of missing data. Figure 4 shows the path over time of the divorce rate of the states by club. Again $\hat{\beta}_1$ is significant for all groups, but the estimated coefficients of the groups in this subperiod are greater than the coefficient of group 3 in the 1956–1998 period (-0.132) in which the majority of the

[6] The estimations were performed with the Gauss code kindly provided by Donggyu Sul on his webpage.

states are classified. Thus, the divergent process in divorce rates across states observed from 1956 to 1998 was concentrated in the post-reform period.

5. Conclusion

In this work, we examine the evolution of US divorce rates across states, using data for the period 1956-1998. We utilize a cluster algorithm that allows us to identify dissimilar convergent growth of divorce rates by state. The empirical evidence shows that, in the period considered, there was a clear divergence from the common growth component of the divorce rates across different clubs, but that this divergent process was especially intense in the post-reform period. In contrast, in the pre-reform period, we find that most of the states were converging in several convergence clubs.

Our findings suggest that the liberalization of divorce laws does not imply a divorce convergence across the US. From the pre-reform period to the post-reform period, most of the states move from one club to another, and from convergent clubs to divergent clubs. Of course, this is a time series analysis, which does not allow us to infer any causal relationship. After a careful examination of the laws relating to divorce, we do not observe a clear pattern. States passing similar divorce law reforms are located in different clubs. Neither the marital regime, nor the reforms in the aftermath of divorce, following Gray's (1998) classification and González-Val and Marcén (2012), are useful in explaining why some states are grouped with others. No geographical pattern can be deduced neither. However, our results indicate that there was an intense divergent process in divorce rates across states after divorce law reforms and a marked change from the patterns observed in previous decades, pointing to the important role of these reforms in the evolution of divorce rates.

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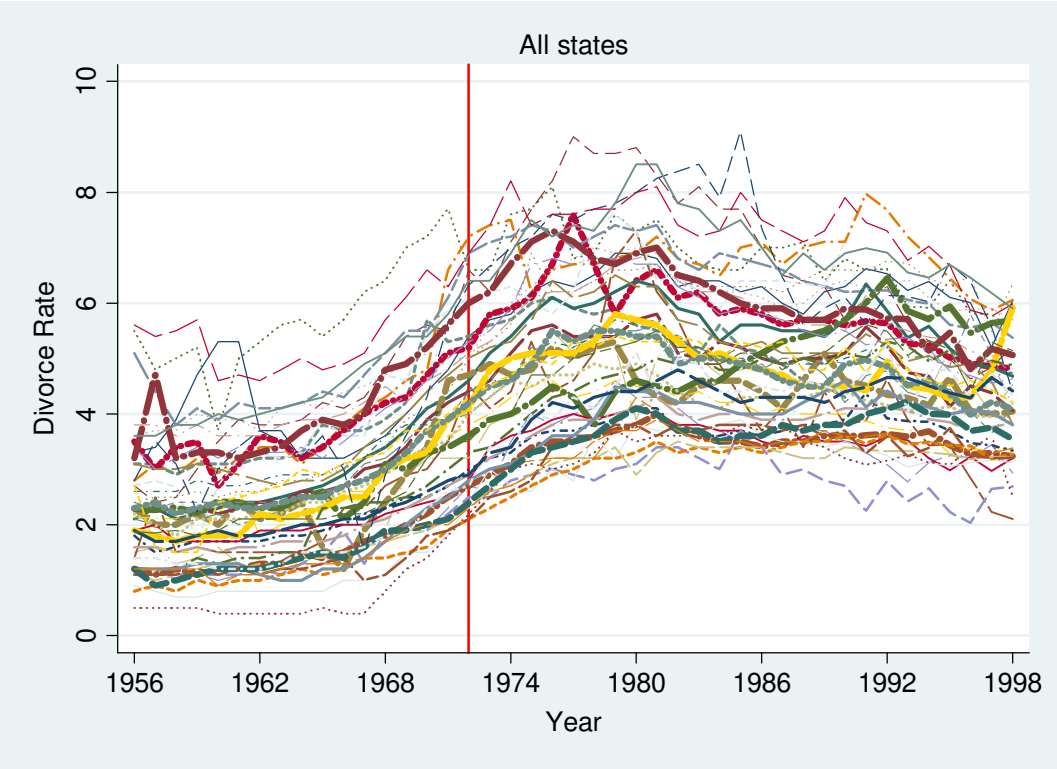
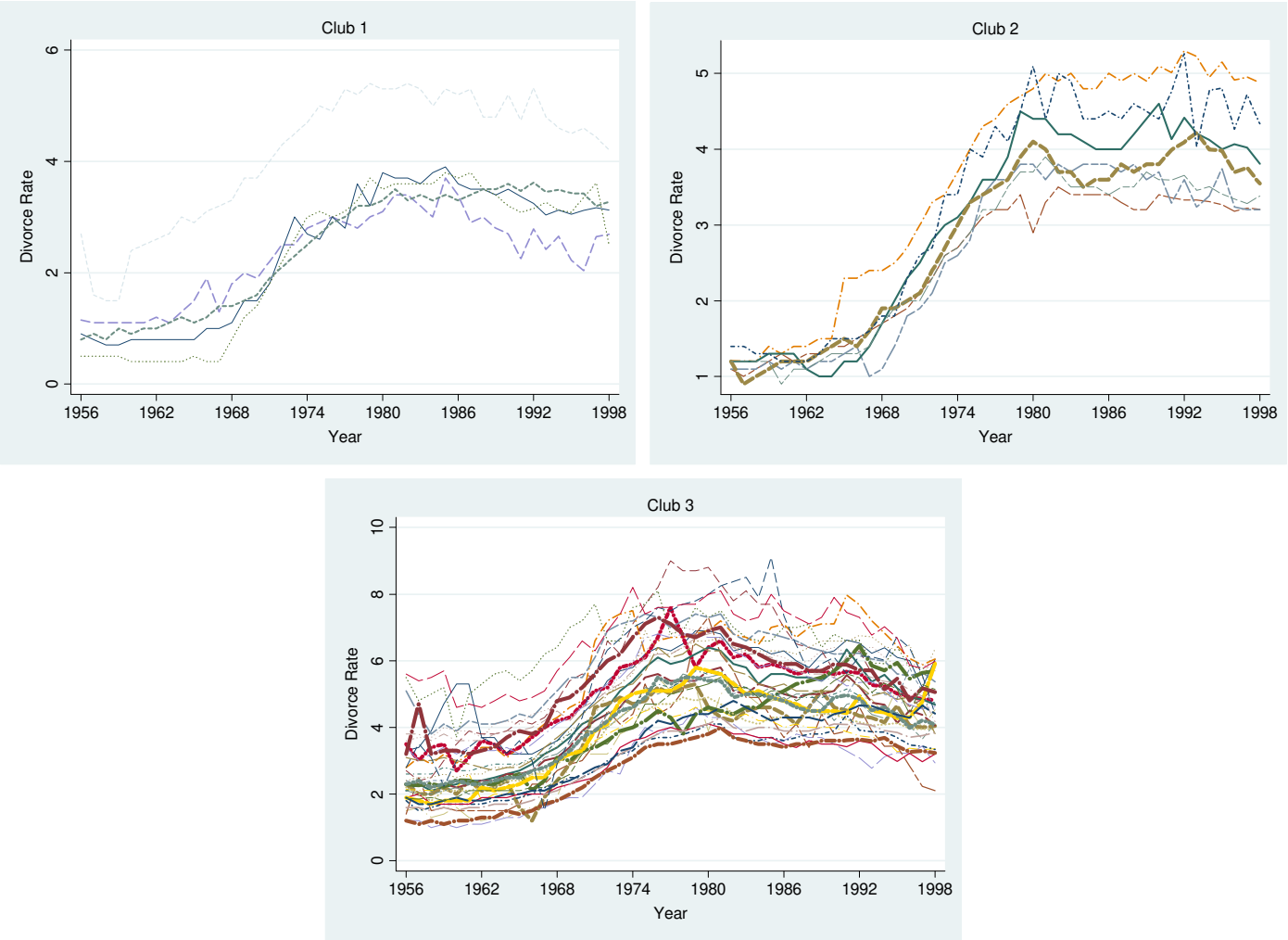
Figure 1. States' divorce rate paths, 1956–1998



Note: Nevada is not included because its extreme high divorce rate distorts the graph.

Figure 2. States' convergence clubs, 1956–1998



Note: Nevada is not shown within Club 3 because its extremely high divorce rate distorts the graph.

Figure 3. States' convergence clubs, 1956–1972

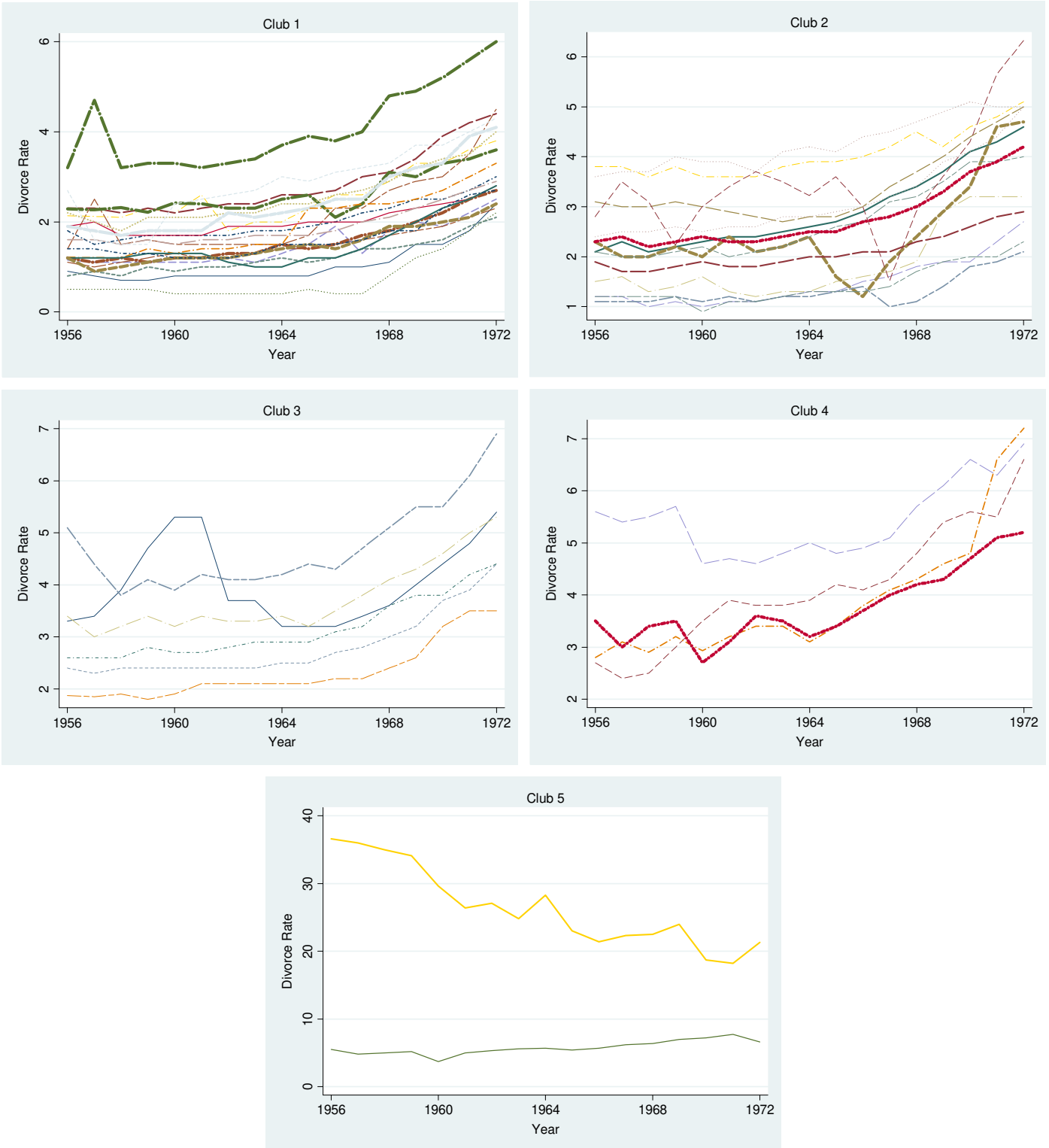


Figure 4. States' convergence clubs, 1973–1998

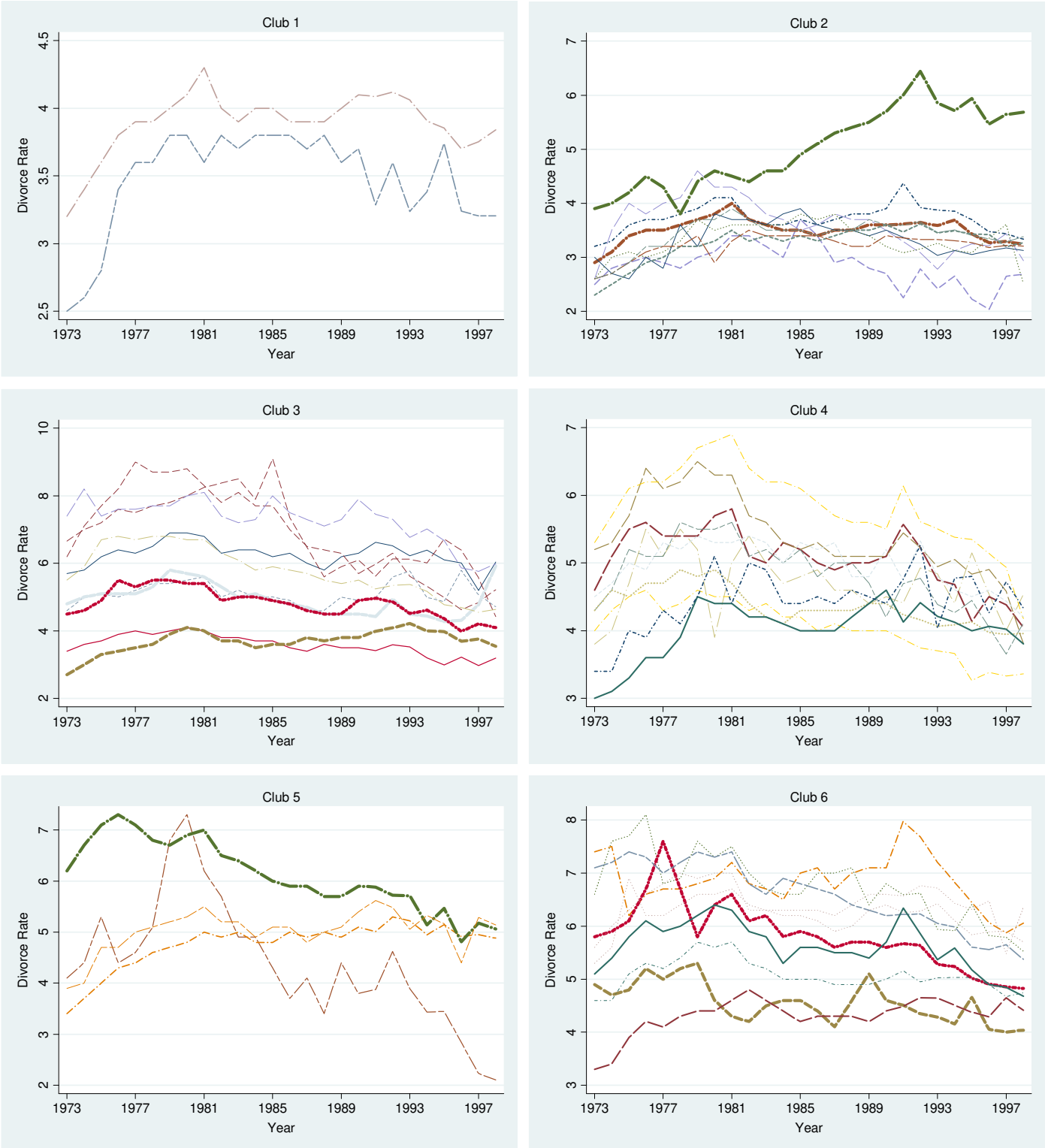


Table 1. State divorce rates: Descriptive statistics

State	Unilateral	Observations	Average	Max.	Min.	State	Unilateral	Observations	Average	Max.	Min.
Alabama	1971	1956–1998	5.4	6.9	3.2	Montana	1973 (1975)	1956–1998	4.6	6.5	2.7
Alaska	1935	1956–1998	5.8	9.0	2.4	Nebraska	1972	1956–1998	3.1	4.3	1.5
Arizona	1973	1956–1998	6.4	8.1	3.7	Nevada	1967 (1973)	1956–1998	18.6	36.6	8.1
Arkansas	.	1956–1998	5.7	8.0	2.8	New Hampshire	1971	1956–1998	4.0	5.9	1.7
California	1970	1956–1990	4.6	6.1	2.9	New Jersey	.	1956–1998	2.4	3.9	0.7
Colorado	1972 (1971)	1956–1998	5.0	7.6	2.7	New Mexico	1933 (1973)	1956–1998	5.6	9.1	1.5
Connecticut	1973	1956–1998	2.8	4.6	1.0	New York	.	1956–1998	2.3	3.8	0.4
Delaware	1968 (.)	1956–1998	3.6	5.5	1.2	North Carolina	.	1956–1998	3.6	5.3	1.2
District of Columbia	.	1956–1998	3.5	7.3	1.4	North Dakota	1971	1956–1998	2.5	3.6	0.8
Florida	1971	1956–1998	5.9	7.4	3.8	Ohio	.	1956–1998	4.0	5.5	2.2
Georgia	1973	1956–1998	4.6	6.4	2.1	Oklahoma	1953(.)	1956–1998	6.6	8.2	4.6
Hawaii	1972 (1973)	1956–1998	3.7	5.3	1.2	Oregon	1971 (1973)	1956–1998	5.0	6.8	3.0
Idaho	1971	1956–1998	5.5	7.0	3.6	Pennsylvania	.	1956–1998	2.5	3.5	1.0
Illinois	.	1956–1998	3.5	4.6	1.8	Rhode Island	1975 (1976)	1956–1998	2.6	3.8	1.0
Indiana	1973	1956–1990	5.1	7.6	1.7	South Carolina	.	1956–1998	3.0	4.6	1.0
Iowa	1970	1956–1998	3.1	4.4	1.5	South Dakota	1985	1956–1998	2.8	4.2	0.9
Kansas	1969	1956–1998	4.2	5.8	2.2	Tennessee	.	1956–1998	5.1	6.9	2.4
Kentucky	1972	1956–1998	4.1	6.4	2.1	Texas	1970 (1974)	1956–1998	5.1	6.9	3.6
Louisiana	.	1971–1983	3.4	4.3	2.5	Utah	1987 (.)	1956–1998	4.1	5.4	1.5
Maine	1973	1956–1998	4.0	5.6	2.0	Vermont	.	1956–1998	3.3	5.3	1.2
Maryland	.	1956–1998	3.0	4.1	1.7	Virginia	.	1956–1998	3.4	4.8	1.7
Massachusetts	1975	1956–1998	2.3	3.7	1.1	Washington	1973	1956–1998	5.3	7.3	3.2
Michigan	1972	1956–1998	3.7	4.9	1.8	West Virginia	.	1956–1998	4.0	5.6	1.8
Minnesota	1974	1956–1998	2.7	4.0	1.1	Wisconsin	1978 (.)	1956–1998	2.6	3.9	0.9
Mississippi	.	1956–1998	4.2	5.8	2.3	Wyoming	1977	1956–1998	6.1	8.5	3.6
Missouri	.	1956–1998	4.3	5.7	2.6						

Note: Year of unilateral divorce is from Gruber (2004) and from Friedberg (1998) in parentheses.

Table 2. State convergence clubs

1956–1998		1956–1972		1973–1998	
Club	$\hat{\beta}_1$ (t-statistic)	Club	$\hat{\beta}_1$ (t-statistic)	Club	$\hat{\beta}_1$ (t-statistic)
1 [5]	-0.633 (-1.572)	1 [21]	0.223 (0.421)	1 [2]	-1.099 (-0.601)
2 [7]	-1.406 (-1.576)	2 [14]	0.324 (0.835)	2 [10]	-1.037 (-1.099)
3 [35]	-0.132 (-0.531)	3 [6]	-0.036 (-0.100)	3 [10]	-0.812 (-0.903)
		4 [4]	0.649 (0.496)	4 [10]	-0.882 (-0.778)
		5 [2]	-0.004 (-0.012)	5 [4]	-0.157 (-0.408)
				6 [10]	-1.229 (-1.566)

Notes: The numbers in brackets are the number of states. The corresponding t-statistic in the regression is constructed in the usual way by using HAC standard errors. At the 5% level, the null hypothesis of convergence is rejected if the t-statistic < -1.65. All the t-statistics reported are higher than -1.65, indicating that we cannot reject the null hypothesis at 5% in any case.

Table 3. States within clubs

State	Club (1956–1972)	Club (1973–1998)	Club (1956–1998)	State	Club (1956–1972)	Club (1973–1998)	Club (1956–1998)
Alabama	3	3	3	Montana	2	4	3
Alaska	4	3	3	Nebraska	1	1	3
Arizona	5	6	3	Nevada	5		3
Arkansas	4	6	3	New Hampshire	1	3	3
California				New Jersey	1	2	1
Colorado	4	6	3	New Mexico	2	3	3
Connecticut	2	2	3	New York	1	2	1
Delaware	2	4	3	North Carolina	1	5	2
District of Columbia	1	5	3	North Dakota	1	2	1
Florida	3	6	3	Ohio	2	3	3
Georgia	2	6	3	Oklahoma	4	3	3
Hawaii	2	6	3	Oregon	3	3	3
Idaho	2	6	3	Pennsylvania	1	2	2
Illinois	1	4	3	Rhode Island	2	1	2
Indiana				South Carolina	1	4	2
Iowa	1	2	3	South Dakota	1	3	2
Kansas	1	4	3	Tennessee	2	6	3
Kentucky	1	2	3	Texas	2	4	3
Louisiana				Utah	1	4	1
Maine	2	4	3	Vermont	1	4	2
Maryland	1	3	3	Virginia	2	6	3
Massachusetts	1	2	1	Washington	1	5	3
Michigan	1	4	3	West Virginia	3	5	3
Minnesota	1	2	3	Wisconsin	2	2	2
Mississippi	3	3	3	Wyoming			
Missouri	3	6	3				