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Abstract:

This paper explores the frequency of permanent shocks in divorce rates for 16 European countries during the period 1930 to 2006, by examining whether the divorce rate is a stationary series, exhibits a unit root, or is stationary around a process subject to structural breaks. A clear finding from this analysis is that not all shocks have transitory effects on the divorce rate. Results provide evidence of both stationarity around occasional shocks which have permanent effects, and of a unit root, where all shocks have a permanent effect on the divorce rate. All of the permanent shocks are positive, and almost all occurred in the 1970s. Supplemental analyses indicate that most of these shocks can be associated with the divorce law reforms that occurred throughout Europe at that time, suggesting an important role of those policies in the evolution of divorce rates.

Keywords: Divorce rate, unit root, structural break.

JEL: C12, C22, J12, J18, K36

1. Introduction

This paper aims to provide evidence on the frequency of persistent shocks in divorce rates, defined as the annual divorces per 1000 inhabitants. We analyse three possible scenarios (see Perron, 2006 for a review of the literature on structural breaks). First, shocks may have temporary effects on divorce rates. In this scenario, the divorce rate is basically stable; after a shock, such as divorce law reform, short-run effects on the divorce rate would be observed, but in the long-run, the divorce rate should return to its equilibrium level (see, for instance, the effects of unilateral reforms in Wolfers, 2006, for US and in González and Viitanen, 2009, for Europe). This would imply that the divorce rate is stationary. In the second scenario, occasional shocks may cause permanent changes in the equilibrium rate itself, but most shocks would only cause temporary movements of the divorce rate around the equilibrium level. We should expect that divorce would be stationary around a process that is subject to structural breaks. The third scenario consists of all shocks having permanent effects on the level of divorce. The divorce rate would be expected to exhibit a unit root since fluctuations are not transitory.

There is a large literature studying the effects of divorce on the socioeconomic outcomes of women and children. The possibility of divorce may increase female labour force participation, (Michael, 1985; Johnson and Skinner 1986; Peters, 1986; Parkman, 1992), but it can also affect the economic status of women and children (Jarvis and Jenkins, 1999; Bedard and Deschênes, 2005). At the same time, divorce may also have long-term negative effect on children (Seltzer, 1994; Amato, 2000; Gruber, 2004). These findings suggest that it is crucial to carefully consider the frequency of persistent shocks in divorce rates, since divorce can permanently impact on large segments of the population and on both economic and psychological well-being dimensions.

This paper contributes to the growing literature that evaluates whether shocks have permanent effects on social and economic variables. Using statistical techniques developed by Dickey and Fuller (1979), Nelson and Plosser (1982) argued that shocks have a permanent effect on the long-run level of most macroeconomic and financial aggregates, for example, real gross national product (GNP), nominal GNP, real per capita GNP, industrial production, employment, unemployment rate, GNP deflator, consumer prices, wages, and real wages among others. Some years later, Perron (1989) carried out tests of the unit-root hypothesis against the alternative hypothesis of trend stationarity with a break in the trend at the Great Crash of 1929, or at the 1973 oil-price shock. He used data from the Nelson-Plosser macroeconomic data series as well as a post-war quarterly real GNP series. Zivot and Andrews (1992) used the same data but considering an endogenous breaking point. Moreover, Ben-David and Papell (1997) examined the structure of post-war trade, testing for structural change in the import-GDP and export-GDP ratios for 48 countries. They tried to determine whether the evolution of trade

shares had followed a stable process during the post-war period or, alternatively, whether and when the process had changed. In the field of international economics, there is an extended literature on purchasing power parity (PPP) using unit root tests and considering structural changes (Papell 1997; O'Connell 1998; Murray and Papell 2002; Papell 2002). Recently, Davis and Weinstein (2002) examined the evolution of city growth in Japan by testing for the presence of a unit root while considering the Allied bombing of Japanese cities in WWII as a shock to relative city sizes. In the same way, Bosker et al. (2008) used unit root tests to analyze the evolution of the individual cities that make up the West-German city size distribution in the period 1925-1999. We add to this work by presenting evidence of the frequency of persistent shocks in divorce rates.

In our empirical analysis, we first apply standard unit root methods to the divorce rate for 16 European countries from 1930 to 2006. When using Augmented Dickey-Fuller (ADF) tests, the null hypothesis of a unit root in divorce rate can be rejected for five of the sixteen countries. Thus, the unit root scenario seems to better describe the experience of the European countries. For eleven of sixteen countries, these results suggest that any sudden shock has permanent effects. For the rest of countries, there is a tendency to return to a stable value; fluctuations are transitory (mean reversion).

Despite being widely used, the ADF tests suffer from an important drawback. It has been documented that the usual tests for a unit root are biased towards nonrejection of the null hypothesis of a unit root, due to a misspecification of the deterministic trend, Perron (1989). Thus, stationary fluctuations with a mean that exhibit a one-time permanent change in level may previously being identified as a unit-root process, Perron (1990). To examine this issue, we use Perron and Vogelsang's (1992) methodology for nontrending data to test for a unit root in a divorce rate series while allowing for a structural break in the mean level occurring at an unknown date. These tests provide evidence in favour of stationarity of divorce rates around a process that is subject to a structural break for seven of the sixteen countries. For those seven countries, only these one time shocks appear to have any permanent effects.

We further explore the existence of multiple structural changes in nontrending, stationary time series using the methodology developed by Bai and Perron (1998, 2003). These tests are applied to those countries for which the one-break unit root tests provide evidence of stationarity. Structural breaks are also assumed to occur at unknown dates. Our findings suggest that divorce rates may be characterized as being stationary around occasional shocks that have permanent effects. Results show that five of the countries with stationary mean have more than one break, while the rest of the countries have one break. Additionally, there is some clustering of the break dates, most of the breaks occurred during the 1970s, and of the magnitude of the impact of those breaks which achieves a peak in the 1970s, but is lower in previous and subsequent decades.

Finally, we present a possible explanation for the apparent shift in the mean. We relate it to major events that are known to have occurred and which may have caused the structural change in the behaviour of the divorce rate series. We focus on divorce-law reforms, since the date of those reforms seems to coincide with the break dates.[1] There is extensive literature examining changes in the divorce rates that focuses on the effects of changes in divorce laws. However, empirical evidence has not been conclusive, given that legal reforms that occurred since the 1970s in Europe and in US have been found to have a variety of permanent, transitory or no effect on divorce rates. Jacob (1988) explains that divorce-law reforms in U.S. made no difference to divorce rates. Peters (1986, 1992) used cross-sectional data and found that changes in divorce laws do not affect marital stability, and more recently a similar finding appears in a study of Gray (1998). These results were rebutted first by Allen (1992), who found a causal relation between the law regime and divorce rates, and another rebuttal was provided by Friedberg (1998), who presented a state-based panel analysis. She found that divorce-law reforms, which occurred from the 1970s onward, accounted for about one-sixth of the rise in the divorce rate during the 1970s and 1980s.[2] But, ultimately, the issue is not how large the effect is, but whether or not this effect is permanent, Smith (2002). Wolfers (2006) replicated Friedberg's work with a longer panel using data from the 1950s to the 1990s. This study investigated whether the unilateral reforms that occurred from the 1970s in the US had permanent or transitory effects on divorce rate by accounting for the dynamic effects of changes in divorce laws. He found that the unilateral system had a transitory effect on divorce rates that lasted after 15 years since the reform took place. Some years later, González and Viitanen (2009) extended Wolfers' analysis using European data, by including the analysis of no-fault and unilateral reforms that occurred from the 1970s. They also found a transitory response to unilateral reforms that lasted between 5 and 8 years after the reform, as well as a permanent effect of no-fault reforms on divorce rates. Based on this analysis, the reforms account for about 0.6 divorces per 1000 inhabitants of the increase in divorce rates in Europe from 1950 to 2003.

Our analysis is more interpretive; to determine whether a divorce law reform has had a permanent impact on divorce rate, we simply compare the timing of the reforms with the year in which a break is located using stationary series. Results show that the two dates coincide in most countries. Thus, we may conclude that the occasional shock may actually be a policy shock that had a permanent effect on the divorce rate. For those nonstationary divorce rate series, fluctuations that could produce a shock, such as divorce law reform, are also not transitory. This evidence is consistent with the literature that found an important role of divorce law reforms in explaining changes in divorce rates.

The remainder of the paper is organized as follows. Section 2 contains a description of the data used. Section 3 proceeds with the econometric specifications and the main results.

Section 4 contains a possible explanation for the shifts in divorce rate, and the final section offers concluding remarks about the findings.

2. Divorce Rate

The longitudinal data on divorce rates covers 16 European countries for the period 1930 to 2006. The data for the divorce rate is publicly available from United Nations Demographic Yearbooks.[3] These yearbooks contain regular data series of a comprehensive collection of international demographic statistics, comparable within and among themselves, prepared by the Statistical Office of the United Nations. We incorporate data for our sample from successive issues on Marriage and Divorce Statistics (1958, 1968, 1976, 1982, 1990), and from each Demographic Yearbook from 1990 to 2006. We have also utilized divorce rate data from Eurostat to complete our dataset which is also publicly available.[4]

The UN Demographic Yearbooks define divorce as the final legal dissolution of marriage, conferring on both parties involved the right to remarry as defined by the laws of each country. The divorce rate is measured as the absolute number of divorces reported to have occurred in the time period and within contemporary geographic boundaries, per 1000 persons estimated to be present in the area at the mid-point of the year in question, that is, the annual number of divorces per 1000 mid-year population. The divorce rate does provide a simple measure of the level of, and changes in, divorce. However, the rates might be affected by the marital status structure of the populations to which they relate. 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 utilised total divorce rates, defined as annual number of divorces per 1000 married population, but this analysis would have been less reliable due to the scarcity of data on total divorce rate, which is only available from, at the earliest, 1950, or in other cases even later. Thus, we favour the use of the divorce rate with a longer series, 77 observations available in almost all countries (see Table 1).[5] That also facilitates the comparison with previous studies on divorce rates. [6]

Figure 1 shows the temporal evolution of the divorce rate by country. Our sample begins in a transitional period in the history of divorce between both World Wars characterised by a relative stability in divorce rates. Overall, this stable divorce rate was interrupted by an acceleration of divorces during and after World War II. After that, the stable decade of the 1950s was characterised by a level of divorce rates slightly greater than that of the pre-war period. That was followed by the most rapid sustained growth in the divorce rate level across Europe in the 1970s. In subsequent decades, divorce rate stabilized. However, it is important to note that not all individual countries conform to the same pattern.

This quick glance at the divorce rate series seems to reveal the presence of at least a sudden change in the mean level of the series. That change occurs in the 1970s, it is so big and sudden compared to the variability exhibited over the rest of the sample period that we would expect that divorce rate would be stationary around that occasional highly persistent structural change. Nevertheless, this is not a conclusive analysis. In the subsequent sections, we provide evidence on the frequency of persistent shocks in divorce rates.

3. Methodology and Results

3.1. Unit Roots in Divorce

We first test for unit roots without accounting for structural changes. Formally, consider the following expression:

$$DR_t = \alpha + \rho DR_{t-1} + \varepsilon_t, \qquad (1)$$

where DR_t is the divorce rate, α and ρ are parameters and ε_t is the perturbation term. When $-1 < \rho < 1$, the divorce rate will be a stationary time series and any shock will dissipate over time.[7] Fluctuations are transitory. However, if $\rho = 1$, the divorce rate will be a nonstationary time series, and the stochastic process modelled by equation (1) will be a random walk with drift (Brockwell and Davis, 1991) which is referred to as a unit root process (see Banerjee et al., 1993; Hamilton, 1994; and Gujarati, 1995). In this case, any sudden shock would have permanent effects on the long-run level of the divorce rate.

To test for the presence of unit roots, where $\rho = 1$, we apply Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979, 1981). The ADF test for nontrending data is carried out by running the following regression:

$$\Delta DR_t = \alpha + \gamma DR_{t-1} + \sum_{i=1}^{k} \left(c_i \Delta DR_{t-1}\right) + \varepsilon_t, \qquad (2)$$

where $\Delta DR_t = DR_t - DR_{t-1}$, $\gamma = (\rho - 1)$, and k is the number of lags added to ensure that the residuals, ε_t, are Gaussian White Noises.[8] Following Ng and Perron (1995), we choose the optimal k using a 'general-to-specific procedure' based on the t-statistic. The null and alternative hypotheses are, respectively, $H_0 : \gamma = 0$, $H_A : \gamma < 0$. If γ is found to be equal to 0, then the divorce rate series follows a random walk. If, on the other hand, γ is found to be significantly smaller than 0, the divorce rate is stationary around α.

Table 2 reports a summary of the results of the individual country unit root tests. We find that the null hypothesis of a unit root in the divorce rate is not rejected for most of the

countries in the sample. In particular, for eleven of the sixteen countries, or 68.75%, unit root is not rejected at the 10% level. Our estimates indicate that the unit root scenario seems to better describe the experience of the European countries.[9] However, there is another possible perspective for several reasons. First, we detect that a considerable number of countries, five of sixteen countries, that have divorce rate fluctuations that are transitory. Second, the nonrejection of the unit root hypothesis may be because the standard ADF tests are biased, Perron (1989). Therefore, it is possible that what we identified as a unit root process could be better modelled as a stationary process around highly permanent shocks. We revisit this issue in subsection 3.2.

3.1.1. Robustness Checks: Panel Unit Root Test.

For completeness, we also test for a unit root in a balanced panel (excluding Germany, Greece and Italy) and in an unbalanced panel that includes all countries. We first use the test created by Levin et al. (2002) on the balanced panel. The null hypothesis that all series have a unit root, versus the alternative of all series are stationary, is tested using the same autoregressive parameter. We then run a less restrictive test developed by Im et al. (2003). This also allows us to test the null of a unit root in all series, versus the alternative that some of the series are stationary, with a potentially varying autoregressive parameter. To test for unit root in an unbalanced panel, we use a generalization of the Pesaran's CADF test, Pesaran (2007). It allows testing for unit roots in heterogenous panels with cross-section dependence. Pesaran's CADF eliminates the cross-dependence by augmenting the standard DF (or ADF) regressions with the cross section averages of lagged levels and with first-differences of the individual series. Like the test done by Im et al. (2003), Pesaran's CADF test is consistent under the alternative that only a fraction of the series is stationary.

Panel B of Table 2 shows the results of applying the aboved described panel unit root tests. Using the Levin–Lin–Chu test, we find that the null hypothesis of a unit root is not rejected even at the 10% level. In contrast, the Im–Pesaran–Shin test rejects the unit root null at the 5% level (it does not reject it at the 1% level), and Pesaran's test shows that when controlling for cross-sectional dependence, the null hypothesis is not rejected at the 5% level. Thus, not all countries conform to the same pattern, since these tests provide weaker evidence in favour of a unit root for all countries. The same fragility is observed when we test for unit root in an unbalanced panel; the null hypothesis is not rejected at the 1% level.

3.2. Unit Roots in the Presence of a One-time Structural Break

As mentioned above, in the presence of a structural break, the standard ADF tests are biased towards the nonrejection of the null hypothesis, Perron (1989). The estimator of the autoregressive parameter goes asymptotically to values close to 1 when the variable is generated

by a regime-wise stationary process in which the effect of a structural break is present. This is problematic since, in our finite divorce rate series, it is possible that the unit root tests are not able to reject the unit root null hypothesis in the presence of a structural break. In order to avoid this type of problem, we apply a unit root test suggested by Perron and Vogelsang (1992) which works correctly in a structural break framework, and is appropriate for nontrending data.[10]

We estimate additive outlier (AO) models, which allows for a sudden change in mean (crash model). The AO model is appropriate when the change is assumed to take effect instantaneously which seems to be the case for divorce rate.[11] This model is estimated by the following two expressions:

$$DR_t = \mu + \delta DU_t + \eta_t \qquad (3)$$

and

$$\eta_t = \sum_{i=0}^{k} \omega_i DTB_{t-i} + \rho \eta_{t-1} + \sum_{i=0}^{k} c_i \Delta \eta_{t-i} + \varepsilon_t \quad (4)$$

where η_t is the estimated residual from equation (3), *TB* is the break date, $DTB_t = 1$ if $t = TB + 1$, and is *0* otherwise, and $DU_t = 0$ if $t \leq TB$, and is *1* otherwise. Both equations are estimated in two stages by OLS for each break year $TB = k + 2,...,T - 1$, with T being the number of observations and *k* the truncation lag parameter.

The results of applying the AO-model to test for a unit root in divorce rates in the European countries under the null of unit root versus stationary around a possibly shifting mean under the alternative are also summarized in Table 2. Results do not substantially differ from the previous ones. At the 10% level, the unit root null hypothesis cannot be rejected in favour of a stationary divorce rate with a one-time break for 56.25% of the countries in our sample, or nine of sixteen countries.

Table 3 displays the results by country. The null hypothesis of a unit root is rejected for France and Germany at the 1% level, and for Denmark, Iceland, Netherlands, Sweden and United Kingdom at the 5% level. Results show that the structural breaks are all positive, which reflects the rise in the mean of the divorce rate among the European countries in the period considered. It is also observed that the timing of the breaks for those stationary series spans from the late 1960s to the late 1970s.

Results suggest that not all shocks have temporary effects on divorce, even though there is no single scenario for all countries. Our results do provide evidence in favour of both unit root processes and stationary processes subject to a structural break. For stationary countries, most shocks cause temporary movements of the divorce rate around the equilibrium level, but

occasionally shocks cause permanent changes in the equilibrium rate. It is important to note that by *permanent* what should be understood is that the change is still in effect given a sample of data, but not that the change will last forever. For nonstationary countries, there is no tendency to return to a stable value, since all shocks have permanent effect on the level of divorce.

3.2.1. Robustness Checks: Unit Roots in the Presence of Double Structural Break.

The previous analysis only captures the single most significant break in each divorce rate series. However, since variables rarely show just one break; rather, it is common for them to exhibit the presence of more than one break (Clemente et al. 1998), and given that by simply plotting the divorce rate it is observed that the stable divorce rate may be interrupted by another change in the mean during the 1940s, we also attempt to determine whether divorce rate series show double change in the mean.

For the nontrending case, we use the test developed by Clemente et al. (1998), who base their approach on Perron and Vogelsang (1992), but who allow for two breaks.[12] Formally, (3) and (4) change to:

$$DR_t = \mu + \delta_1 DU_{1t} + \delta_2 DU_{2t} + \eta_t, \qquad (5)$$

and

$$\eta_t = \sum_{i=0}^{k} \omega_{1i} DTB_{1t-i} + \sum_{i=0}^{k} \omega_{2i} DTB_{2t-i} + \rho\eta_{t-1} + \sum_{i=0}^{k} c_i \Delta\eta_{t-i} + \varepsilon_t \qquad (6)$$

where $DU_{jt} = 1$ if $t > TB_j \ (j = 1,2)$ and *0* otherwise. DTB_{jt} sets equal 1 if $t = TB_j + 1$, *0* otherwise, $(j = 1,2)$. TB_1 and TB_2 are the time periods when the mean is being modified. As Clemente et al. (1998), we suppose that $TB_j = \lambda_j T \ (j = 1,2)$, with $0 < \lambda_j < 1$ which implies that the test is not defined at the limits of the sample, and also that $\lambda_2 > \lambda_1$, which eliminates those cases where breaks occur in consecutive periods. To test for the unit root null hypothesis, equation (5) is first estimated by OLS to remove the deterministic part of the variable, and then, it is carried out the test by searching for the minimal pseudo t-ratio for the $\rho = 1$ hypothesis in equation (6) for all the break time combinations.

We would expect that allowing for the possibility of two endogenous break points would provide further evidence against the unit root hypothesis (Lumsdaine and Papell 1997; Ben-David et al. 2003; Maddala and Kim 2003). However, the percentage of unit root rejected at the 10% is lower than for the one break test, see Table 2. For ten of the sixteen countries, results suggest that any sudden shock has permanent effects. Table 4 reports results for each individual country. The structural breaks are all positive and significant. For Denmark, France,

Sweden and United Kingdom, results indicate that divorce may be characterized as being stationary around a mean which changes in the 1940s and in the 1970s. For two countries, Belgium and Switzerland, evidence suggests that introducing the possibility of two structural breaks results in the divorce rate series being identified as stationary around two breaks in the mean level in the 1970s and in the late 1980s. Intriguingly, in the case of Iceland, Germany and Netherlands, we conclude that these series are not stationary when allowing for double structural break, but the unit root null hypothesis can be rejected in favour of a stationary divorce rate with just one-time break. All in all, these findings seem to confirm that there is no a single scenario for all divorce rate series.

3.3. Multiple Structural Changes

Admittedly, there is no economic reason for restricting the analysis to one or two breaks. Using the methodology developed by Bai and Perron (1998, 2003) enables us to test for and estimate multiple structural changes once stationarity has been established for the case with no trending regressors. Following the Bai and Perron sequential procedure, it is first estimated the linear regression with only a constant as regressor:

$$DR_t = \mu + \delta DU_t + \eta_t \qquad (7)$$

where DR_t is the divorce rate, the observed independent variable, *TB* is the break date and $DU_t = 1$ if $t > TB$, and 0 otherwise. As above, the break dates are explicitly treated as unknown. The method of estimation considered is that based on the least-squares principle. The sup-F statistic is obtained by maximizing the difference between the restricted (without DU_t) and unrestricted sums of squared residuals over all potential break dates. When a break point is detected, the full sample is divided into two subsamples at the break point, and subsequently the test is carried out on each of the subsamples. This subdivision process continues until the test fails to reject the null hypothesis of no additional structural changes, or until the subsamples become too small. To determine the final breaks, we use the repartition method described in Bai (1997), estimating breaks one at a time.[13] We allow for heterogeneity and autocorrelation in the residuals. The method used is Andrews (1991) automatic bandwidth with AR(1) approximation and the quadratic kernel. We impose a trimming of 15%, hence each segment has at least 15 observations, and allow up to five breaks, Bai and Perron (1998, 2003).

Table 5 shows the significant break dates at the 5% level from the Bai and Perron tests for multiple structural changes. It also reports the mean divorce rates before the first break and after each subsequent break. For those countries in which the one-break unit root tests provide evidence of stationarity, it is observed that four of the seven countries (Denmark, France,

Germany and, the Netherlands) have one significant break at the 5% level; one country, Sweden, has one break; and two countries, Iceland and United Kingdom have three breaks.

The Netherlands and Germany are special cases since the unit root null is not rejected by the double-break tests, but it is rejected by the single-break tests. For the purpose of considering structural change, using Bai and Perron multiple structural tests, the number of breaks selected is only one, which coincides with the single-break test. We therefore will treat both Netherlands and Germany as stationary. In the case of Switzerland and Belgium, since these countries can be identified as stationary around two breaks, and given that the Bai and Perron method also determines two breaks, we will treat both countries as stationary around two structural breaks. Iceland will also be treated as stationary while recognizing that the unit root null is not rejected by the double-break tests and that there are differences in the breaks chosen. After repartition, the first break selected is 1945 which does not coincide with that chosen by the unit root tests in the presence of one structural break at 1966. Instead, it is closed to that determined by the unit root in the presence of double-structural break at 1943. The second break is not captured as the most significant break in any of the unit root tests used, but after the repartition procedure, the third break is chosen one year later than that detected by the unit root double-structural break test.

There are several remarkable aspects of these results. For all of the countries there have been determined at least one significant break. This determination provides strong evidence against the scenario in which all shocks have temporary effects on divorce. Our findings suggest that divorce may be characterized as being stationary around occasional persistent shocks. These occasional shocks cause persistent changes in the equilibrium rate itself, although most shocks cause temporary movements of divorce around the equilibrium level.

None of the sixteen significant breaks is negative, reflecting the increase in divorce in the period considered. Another interesting result is that most of the break dates are grouped. Nine of fifteen breaks are chosen during the 1970s, and three breaks occur in 1944 and 1945. This can be associated with major events that are known to have occurred, such as a particular government policy, a divorce law reform, economic crises, wars, regime shifts or other factors. We revisit this issue in the subsequent section.

In a final analysis, we applied the Bai and Perron procedure to the seven countries for which the unit root hypothesis is not rejected in either the single-break tests or the double-break tests. Although the assumptions for the Bai and Perron methodology are not satisfied and we cannot strictly speak of a change in the mean caused by a structural change, we consider the results exemplary of the pattern of divorce rates in those countries. As in the previous case, all breaks are positive and most of them are grouped around the 1970s. None of them has a large

number of breaks, only one of them has three breaks, but results do not provide evidence against unit root for them.

4. Explanation of Shifts in Divorce

Up to this point, we have focused on testing shock frequency for statistical reasons. However, since the previous analysis allows us to identify the times when possible structural breaks occur, we have valuable information for analyzing whether a structural break on a certain date can be associated with a particular event. In this section we present a possible explanation for the changes in mean apparent in the divorce rate series discussed in Section 3.

We suggest the following story: we consider that divorce law reforms could have caused the structural breaks in divorce rate series. Policy shocks are considered to be major events that may cause structural breaks (e.g. Piehl et al., 2003, looked at the Boston Gun Project and Rathinam and Raja, 2008, investigated public interest litigation in India). Using similar methods, researchers investigates the evolution of socioeconomic variables subject to public and legal interventions, (e.g. Mitchell, 1993; Papell et al., 2000 tracked changes in unemployment and Narayan et al., 2005 investigated crime rates).

For our story to apply, we begin by assuming that there is a stable divorce rate, and that the only divorces that occur are *efficient* divorces, Becker (1981), or those in which the total value of the couple when they are single is greater than the joint value of the marriage. It is then observed that the equilibrium level of the divorce rate moves to a new steady state at a higher level of divorce. How can divorce law reform produce this shift in the mean of the divorce rate? One possibility is that a decrease in the cost of divorce caused by a change in divorce law can lead to the total vale of the couple when they are single being greater than the joint value of the marriage. At the aggregate level, we would expect that the number of divorces, and so, the divorce rate, would increase to a higher level, as a consistently higher number of couples value the now less-expensive divorce over marriage.[14]

We also extend our story to a situation where divorce is assumed to be *inefficient* in that the compensation between the members of the couple is not feasible, while centring on the applicability of the Coase theorem to marital breakdown. Focusing on the shift from a mutual consent regime to a unilateral divorce, Becker (1981) argued that this kind of divorce law reform may not affect the probability of marriage breakdown, because it only affects property rights. In Coasian terms, 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. However, the change to a unilateral system transfers the right to divorce to the spouse most wanting a divorce. Under unilateral divorce, it is the party who wants to continue to be married who has to compensate the spouse who wishes to leave.

Therefore, when the reassignment of property rights between spouses is accompanied with transfers between them, we should observe a stable aggregate divorce rate. Nevertheless, the aggregate divorce rate will change when compensation is not possible. Previous research has been suggested several situations in which compensation is not possible. For example, those cases in which the transaction costs are quite high, the spouse who wishes to continue married may be unable to compensate his partner, and hence, an inefficiently high divorce rate may be observed under unilateral divorce, Allen (2002). Another example is the existence of children, because the involvement of children makes the negotiation process difficult and costly, Zelder (1993).

Of course such an explanation is interpretive in nature and a more extensive analysis is needed to fully account for the causal relationship between divorce law reforms and divorce rates, (e.g. Wolfers 2006; and González and Viitanen 2009). Nonetheless, the point made is enough for our purpose in that it shows how it is possible to have a significant change in structure which can cause a shift in mean in divorce rate series. To probe this further, we simply compare the timing of the reforms with the year in which a break is located for stationary series in order to observe whether they coincide. We first briefly review divorce law reforms that were passed in the period under consideration throughout Europe.

4.1 A Brief Review of Divorce Law Reforms

We can distinguish two main periods of divorce law reforms during the time from 1930 to 2006. The first one occurred in the interwar period, and mainly consisted in added fault grounds or added egregious behaviours that were acceptable reasons for requesting a divorce.[15] In England, in the year 1937, the grounds for divorce were explicitly extended beyond adultery, but the laws also incorporated a restriction in order to prevent hasty divorces. In 1938, there was also a divorce reform in Scotland, but like England, it was limited to extending fault grounds, Doroghi (1955). The law adopted in Germany and Austria in 1938 was more liberal, Phillips (1991). Divorce was permitted for fault and no-fault divorce after a period of separation. In contrast, two countries, France and Portugal, reformed their divorce laws to actually limit the grounds of divorce in 1938 and 1942, respectively, Phillips (1991).

The second wave of reforms swept Europe from the 1970s. The timing of the main reforms was summarized by González and Viitanen (2009), see Table 6. Divorce laws passed to three different systems: no-fault, unilateral, and separation. Under no-fault laws, a couple could divorce for any reason, normally the "irretrievable" breakdown of the marriage or "irreconcilable differences". This law did not attribute blame to either party, but mutual consent was usually necessary. Under the unilateral system, divorce required the consent of only one person, and did not specify a period of living apart; one could instigate a divorce without the

consent of their spouse. In the separation system, evidence that couple had lived apart for a specified period was needed as requisite for divorce on the request of either of spouse. Italy represented a special case since divorce was actually banned until 1970; in 1975, no-fault divorce was added to the legislation, following the trend that existed in other European countries.

Beginning in the 1970s and continuing in the 1980s, 6 countries passed no-fault divorce laws; 10 permitted divorce when a couple had lived apart for a specified period, allowing unilateral divorce where separation was considered to be proof of the irretrievable breakdown of the marriage. An additional 2 countries allowed this ground in 1993 and another one in 2000, and 2 countries recognized unilateral divorce, the right to divorce at the request of either spouse.

4.2 Structural Breaks and Divorce Law Reforms

To explain the apparent shift in mean of the divorce rate, we focus on comparing the timing of divorce laws and the timing of structural breaks, which are determined by using the Bai and Perron test. For illustrative purposes, Figure 2 plots the divorce rates, along with their changing means (dotted line) and the divorce law reforms (red lines), for all sixteen countries.

We first focus on the nine countries for which the Bai and Perron test is applicable, or those for which the unit root null can be rejected in favour of stationary process around occasional breaks. Of these nine, a total of seven, Belgium, Denmark, France, Germany, Netherlands, Sweden and United Kingdom, have a break that is located close to the time of the divorce law reforms that were passed beginning in the 1970s. For five of these countries, the structural break is located in the year in which the divorce law was reformed or one year later. A structural break is determined at a point more than one year later than the legal reform in the Germany and Belgium series. Sweden was a special case, as the break is found two years before the reform although the year of the reform, 1974, is included in the confidence interval at the 95%.

Additionally, three of the nine countries have structural breaks located in the mid-1940s, including Iceland, Sweden, and United Kingdom. Although these abrupt changes can be associated with the first wave of divorce law reforms, it is unclear whether this event caused the breaks, given of the interruption of the World War II.[16] The rest of the breaks are not found to the dates of any divorce law reforms.

Iceland and Switzerland present particular cases. The structural breaks chosen in the 1970s for both countries cannot be associated with a divorce law reform since Iceland and Switzerland did not introduce new divorce laws until 1993 and 2000, respectively. This result suggests that there have been other factors that can be associated with the breaks located in the 1970s. Although one can think that this does not confirm the divorce law hypothesis, we find

differences in the magnitude of the change. The change in the mean is greater for those countries that approved a divorce law reform, thus, we believe that this evidence goes in favour of the association between divorce law reforms and the structural breaks.

For the remaining seven countries, as explained above, we cannot strictly speak of a change in the mean, but it is comforting that the structural breaks are close to the divorce law reforms. A single break can be associated with a reform in five of the seven countries. There are also two breaks that coincide with the World War II, although that found in 1940 for the Austria series could have been due to the divorce law reform that was introduced in 1938. As exception, breaks in Italy and Norway do not coincide with main reforms. However, Italy approved minor changes to make divorce more accessible in the 1980s and 1990s, and in both decades structural breaks are located in 1986 and 1999, so both features appear to be related. The case of Norway is similar to that of Switzerland and Iceland, whose governments approved reform laws in the 1990s or even later. Thus, it is likely that our analysis is unable to detect breaks in these series due to the proximity of the end of the sample.

We also look at the distribution of all structural breaks to analyse whether a pattern in the evolution of divorce rate series exists across Europe. Results indicate that the major events that could have caused the structural breaks in the divorce rate series do have similar effects on divorce rate within specific periods, but that those effects vary over time. In Figure 3, we plot the change in each country's mean divorce rate after the estimation of the structural breaks obtained by using the Bai and Perron procedure. We observe that persistent changes have an inverted U-shaped; the size of the effect is lower in the 1940s, increases in the late 1960s, achieves a peak in the 1970s, and then decreases in the 1980s and 1990s.

5. Conclusions

The purpose of this paper is to provide evidence regarding the frequency of shocks that persisted in the divorce rates for sixteen European countries. In most of these countries, the evolution of divorce rate has sparked many worry among researchers and policy makers because of the high and persistent divorce rate that is observed from the 1970s, and its effects on women and children. A further attractive feature of our approach is that it can provide valuable information for determining whether a structural break on divorce rate can be associated with a special event.

The clear result of this analysis is that not all shocks have transitory effects on divorce rate. This result is robust to a range of alternative tests that are presented. We observe that there is no single scenario to identify the behaviour of the divorce rate. We find evidence of stationarity around a process that is subject to structural breaks, only a few occasional shocks have permanent effects, and of unit root, all shocks have permanent effect on divorce rate.

These findings can be interpreted in the context of evaluating the effects of divorce laws on divorce rates. In the literature, evidence is not conclusive, since divorce laws have been found to have permanent, transitory or no effect on divorce rate. In our case, the finding that the highly persistent changes can be associated with the major changes in divorce laws seems to be consistent with research that suggests an important impact of divorce law reforms on the evolution of divorce rates.

Endnotes

[1] Others determinants of divorce suggested in the literature are economic growth (South, 1985), price stability (Nunley, 2009), unemployment (Jensen and Smith, 1990), female labour force participation (Allen, 1998), public transfers, tax laws and welfare reforms (Bitler et al., 2004; Tjøtta and Vaage, 2008), property distribution within marriage (Gray, 1998), child support enforcement (Nixon 1997; Heim 2003), child custody (Halla, 2009), fertility behaviour (Svarer and Verner, 2008), religiosity (Vaaler et al., 2009), television (Chong and La Ferrara, 2009), among others.

[2] In the area of sociology (see Nakonezny et al., 1995; and Rodgers et al., 1999) and law and economics literature (see Brinig and Buckley, 1998 and Ellman and Lohr, 1998), mixed results have also been found. They have asserted for some decades that easier divorce laws have only a small effect on the divorce rates with the exception of Brinig and Buckley (1998) who provides the strongest evidence to date that no-fault divorce laws are associated with higher divorce levels.

[3] For Italy, Spain and Ireland, divorce was banned until 1970, 1981, and 1996, respectively. We do not include Spain and Ireland in our analysis since we do not have enough data to implement our methodology and results could be less reliable.

[4] To fill in the few gaps in the divorce rate series, we impute divorce rate using the available data points, plus a linear, a quadratic trend, and a mid-point. Results are quite robust.

[5] Significant differences using the divorce rate or the total divorce rate would not be expected since the pattern of the total divorce rate is similar to that of the divorce rate from 1950.

[6] Much of recent literature uses divorces per thoushand people as the main dependent variable in their studies, see Friedberg (1998), Wolfers (2006) and González and Viitanen (2009).

[7] A stochastic process is said to be stationary if its mean and variance are time-independent and if the covariance between any two periods depends only on the lag and not on the actual time at which the covariance is calculated.

[8] This means that ε_t has a zero mean and a constant variance that is uncorrelated with ε_s for $t \neq s$.

[9] We also ran ADF tests incorporating a trend and results are quite consistent.

[10] See others papers such as Banerjee, et al. (1992) and Zivot and Andrews (1992) in which the breakpoint selection is also endogenized.

[11] It is conceivable that shocks have very different short-run and long-run effects, which may induce a graduate change in the divorce rates. To tackle this and at least from a robustness perspective, we also estimated innovational outlier (IO) models where the structural change occurs gradually. Our results are

quite consistent, although some of the structural breaks are detected some years later than those determined by using the AO model.

[12] A similar extension is also provided by Lumsdaine and Papell (1997) for the case of trending series.

[13] For the countries in which the sequential procedure found no break since the $\sup F_T(1)$ test is not significant, we use the LWZ method which is a modified Schwarz criterion proposed by Liu et al. (1997) to determine the number of breaks, see Bai and Perron (1998, 2003) . For Portugal and United Kingdom, the number of breaks determined following the LWZ coincides with those determined using the Bayesian Information Criterion (BIC), Yao (1988). In the case of Greece, Italy and Switzerland, both the LWZ method and the $\sup F_T(l+1|l)$ with $l \geq 1$allow us to select for the same number of breaks, but the BIC criterion determines more than 2 breaks. The number of breaks selected by the LWZ does not coincide with those determined by the BIC and the $\sup F_T(l+1|l)$ in the cases of Austria (BIC and $\sup F_T(l+1|l)$: 3 breaks) and Sweden (BIC: 4 breaks and $\sup F_T(l+1|l)$: 0 breaks).

[14] It is important to note that this simple explanation omits other possible effects that a shift in the divorce law can have, such as changes in the pattern of divorce (bad matches may be dissolved earlier); differential selection into marriage which can change the population at risk of divorce, other changes in the marriage and remarriage market, such as an increase in the remarriage population, which can increase the population at risk of divorce and so on.

[15] Faults mostly consisted of adultery, desertion, and cruelty.

[16] Philips (1988) enumerates the main factors that could have produced the rise in the divorce rate in the 1940s such as the weakening of marriages under wartime conditions, the increase in war marriages, the separation imposed by the war and wartime adultery.

References

Allen, D. W., (1992). 'Marriage and divorce: Comment', American Economic Review, 82(3): 679–685.

Allen, D. W., (1998). 'No-fault divorce in Canada: Its cause and effect', Journal of Economic Behaviour & Organization, 37: 129–149.

Allen, D. W., (2002). 'The impact of legal reforms on marriage and divorce', in The Law and Economics of Marriage & Divorce, A. W. Dnes and R. Rowthorn, (eds.), Cambridge: Cambridge University Press.

Amato, P. R., (2000). 'The consequences of divorce for adults and children', Journal of Marriage and the Family, 62(4): 1269–1287.

Andrews, D. W. K., (1991). 'Heteroscedasticity and autocorrelation consistent covariance matrix estimation', Econometrica, 59: 817–858.

Bai, J., (1997). 'Estimating multiple breaks one at a time', Econometric Theory, 13: 315–352.

Bai, J., and P. Perron, (1998). 'Estimating and testing linear models with multiple structural changes', Econometrica, 66: 47–78.

Bai, J., and P. Perron, (2003). 'Computation and analysis of multiple structural change models', Journal of Applied Econometrics, 18: 1–22.

Banerjee, A., J. J. Dolado, J. W. Galbraith, and D. F. Hendry, (1993). Cointegration, Error Correction, and the Econometric Analysis of Non-stationary Data. Oxford: Oxford University Press.

Banerjee, A., R. L. Lumsdaine, and J. H. Stock, (1992). 'Recursive and sequential tests for a unit root: Theory and international evidence', Journal of Business & Economic Statistics, 10: 271–287.

Becker, G., (1981). A Treatise on the Family. Cambridge, MA: Harvard University Press.

Bedard, K., and O. Deschênes, (2005). 'Sex preferences, marital dissolution, and the economic status of women', *Journal of Human Resources,* 40(2): 411–434.

Ben-David, D., R. Lumsdaine, and D. H. Papell, (2003). 'Unit root, post-war slowdowns and long-run growth: Evidence from two structural breaks', Empirical Economics, 28(2): 303–319.
Ben-David, D., and D. H. Papell, (1997). 'International trade and structural change', Journal of International Economics, 43: 513–523.
Bitler, M. P., J. B. Gelbach, H. W. Hoynes, and M. Zavodny, (2004). 'The impact of welfare reform on marriage and divorce', Demography, 41(2): 213–236.
Bosker, E. M., S. Brakman, H. Garretsen, and M. Schramm, (2008). 'A century of shocks: The evolution of the German city size distribution 1925 – 1999**', Regional Science and Urban Economics, 38: 330–347.
Brinig, M. F., and F. H. Buckley, (1998). 'No-fault laws and at-fault people', International Review of Law and Economics, 18(3): 325–340.
Brockwell, P. J., and R. A. Davis, (1991). Time Series: Theory and Methods. New York: Springer-Verlag.
Chong, A., and E. La Ferrara, (2009). 'Television and divorce: Evidence from Brazilian novelas', Journal of the European Economic Association, 7: 458–468.
Clemente, J., A. Montañés, and M. Reyes, (1998). 'Testing for a unit root in variables with a double change in the mean', Economics Letters, 59: 175–182.
Davis, D. R., and D. E. Weinstein, (2002). 'Bones, bombs, and break points: The geography of economic activity', American Economic Review, 92(5): 1269–1289.
Dickey, D. A., and W. A. Fuller, (1979). 'Distributions of the Estimators for Autoregressive Time Series with a Unit Root', Journal of American Statistical Association, 74(366): 427–481.
Dickey, D. A., and W. A. Fuller, (1981). 'Likelihood ratio statistics for autoregressive time series with a unit root', Econometrica, 49(4): 1057–1072.
Doroghi, E., (1955). Grounds for Divorce in European Countries. New York: Research Division of the New School.
Ellman, I. M., and S. L. Lohr, (1998). 'Dissolving the relationship between divorce laws and divorce rates', International Review of Law and Economics, 18(3): 341–359.
Friedberg, L., (1998). 'Did unilateral divorce raise divorce rates? Evidence from panel data', American Economic Review, 88(3): 608–627.
González, L., and T. K. Viitanen, (2009). 'The effect of divorce laws on divorce rates in Europe', European Economic Review, 53: 127–138.
Gray, J. S., (1998). 'Divorce-law changes, household bargaining, and married women's labour supply', American Economic Review, 88: 628–642.
Gruber, J., (2004). 'Is making divorce easier bad for children? The long-run implications of unilateral divorce', Journal of Labor Economics, 22(4): 799–833.
Gujarati, D. N., (1995). Basic Econometrics. New York: McGraw-Hill, Inc.
Halla, M., (2009). 'The Effect of Joint Custody on Marriage and Divorce', IZA Discussion Paper 4314, Institute for the Study of Labour (IZA), Bonn, Germany.
Hamilton, J. D., (1994). Time Series Analysis. Princeton: Princeton University Press.
Heim, B. T., (2003). 'Does child support enforcement reduce divorce rates?', Journal of Human Resources, 37: 774–791.
Im, K. S., M. H. Pesaran, and Y. Shin, (2003). 'Testing for unit roots in heterogeneous panels', Journal of Econometrics, 115: 53–74.
Jacob, H., (1988). The Silent Revolution: The Transformation of Divorce Law in the United States. Chicago: University of Chicago Press.
Jarvis, S., and S. P. Jenkins, (1999). 'Marital splits and income changes: Evidence from the British Household Panel Survey', Population Studies, 53: 237–254.
Jensen, P., and N. Smith, (1990). 'Unemployment and marital dissolution', Journal of Population Economics, 3: 215–229.
Johnson, W. R., and J. Skinner, (1986). 'Labor supply and marital separation', American Economic Review, 76(3): 455–469.
Levin, A., C.-F. Lin, and C.-S. J. Chu, (2002). 'Unit root tests in panel data: Asymptotic and finite sample properties', Journal of Econometrics, 108: 1–24.
Liu et al (1997).
Lumsdaine, R. L., and D. H. Papell, (1997). 'Multiple trend breaks and the unit root hypothesis', Review of Economics and Statistics, 79(2): 212–218.
Maddala, G. S., and I. M. Kim, (2003). Unit Root, Cointegration and Structural Change. Fifth Edition. Cambridge: Cambridge University Press.
Michael, R. T., (1985). 'Consequences of the rise in female labor force participation rates: Questions and probes', Journal of Labor Economics, 3: s117–s146.

Mitchell, W. F., (1993). 'Testing for unit roots and persistence in OECD unemployment rates', Applied Economics, 25: 1489–1501.
Murray, C. J., and D. H. Papell, (2002). 'The purchasing power persistence paradigm', Journal of International Economics, 56: 1–19.
Nakonezny, P. A., R. D. Shull, and J. L. Rodgers, (1995). 'The effect of no-fault divorce law on the divorce rate across the 50 States and its relation to income, education and religiosity', Journal of Marriage and the Family, 57(2): 477–488.
Narayan, P. K., I. Nielsen, and R. Smyth, (2005). 'Is there a natural rate of crime?', Monash Economics Working Papers 18/05. Melbourne, AU: Monash University Department of Economics.
Nelson, C. R., and C. I. Plosser, (1982). 'Trends and random walks in macroeconomic time series: Some evidence and implications', Journal of Monetary Economics, 10: 139–162.
Ng, S., and P. Perron, (1995). 'Unit root tests in ARMA models with data dependent methods for the selection of the truncation lag', Journal of the American Statistical Association, 90: 268–281.
Nixon, L. A., (1997). 'The effect of child support enforcement on marital dissolution', Journal of Human Resources, 32: 159–181.
Nunley, J. M., (2009). 'Inflation and other aggregate determinants of the trend in US divorce rates since the 1960s', Applied Economics, DOI: 10.1080/00036840802112489.
O'Connell, P. G. J., (1998). 'The overvaluation of purchasing power parity', Journal of International Economics, 44: 1–19.
Papell, D. H., (1997). 'Searching for stationarity: Purchasing power parity under the current float', Journal of International Economics, 43: 313–332.
Papell, D. H., (2002). 'The great appreciation, the great depreciation, and the purchasing power parity hypothesis', Journal of International Economics, 57: 51–82.
Papell, D. H., C. Murray, and H. Ghiblawi, (2000). 'The structure of unemployment,' Review of Economics and Statistics, 82: 309–315.
Parkman, A. M., (1992). 'Unilateral divorce and the labor-force participation rate of married women, revisited', American Economic Review, 82(3): 671–678.
Peters, H. E., (1986). 'Marriage and divorce: Informational constraints and private contracting', American Economic Review, 76(3): 437–454.
Peters, H. E., (1992). 'Marriage and divorce: Reply', American Economic Review, 82(3): 687–693.
Perron, P., (1989). 'The great crash, The oil price shock and the unit root hypothesis', Econometrica, 57: 1361–1401.
Perron, P., (1990). 'Testing for a unit root in a time series with a changing mean', Journal of Business and Economic Statistics, 8: 153–162.
Perron, P., 2006. 'Dealing with Structural Breaks', in Palgrave Handbook of Econometrics, Vol. 1: Econometric Theory, K. Patterson and T.C. Mills (eds.), (pp. 278–352). Basingstoke, UK: Palgrave Macmillan.
Perron, P., and T. Vogelsang, (1992). 'Nonstationarity and level shifts with an application to purchasing power parity', Journal of Business and Economic Statistics, 10: 301–320.
Pesaran, M. H., (2007). 'A simple panel unit root test in the presence of cross-section dependence', Journal of Applied Econometrics, 22: 265–312.
Philips, R., (1988). Putting Asunder: A History of Divorce in Western Society. Cambridge: Cambridge University Press.
Philips, R. (1991). Untying the Knot: A Short History of Divorce. Cambridge: Cambridge University Press.
Piehl, A. M., S. J. Cooper, A. A. Braga, and D. M. Kennedy, (2003). 'Testing for structural breaks in the evaluation of programs', Review of Economics and Statistics, 85(3): 550–558.
Rathinam, F. X., and A.V. Raja, (2008). 'Regulatory failure and judicial intervention: Does public interest litigation help?', German Working Papers in Law and Economics, Vol. 2008, Article 14. Retrieved from http://www.bepress.com/gwp/default/vol2008/iss1/art14
Rodgers, J. L., P. A. Nakonezny, and R. D. Shull, (1999). 'Did no-fault divorce legislation matter? Definitely yes and sometimes no', Journal of Marriage and the Family, 61(3): 803–809.
Seltzer, J. A., (1994). 'Consequences of marital dissolution for children', Annual Review of. Sociology, 20: 235–266.
Smith, I., (2002). 'European divorce laws, divorce rates, and their consequences', in The Law and Economics of Marriage & Divorce, A. W. Dnes and R. Rowthorn, (eds.), Cambridge University Press, Cambridge.
South, S., (1985). 'Economic conditions and the divorce rate: A time-series analysis of post-war United States', Journal of Marriage and the Family, 47: 31–41.

Svarer, M., and M. Verner, (2008). 'Do children stabilize relationships in Denmark?', Journal of Population Economics, 21: 395–417.
Tjøtta, S., and K. Vaage, (2008). 'Public transfers and marital dissolution', Journal of Population Economics, 21: 419–437.
Vaaler, M. L., C. G. Ellison, and D. A. Powers, (2009). 'Religious influences on the risk of marital dissolution', Journal of Marriage and Family, 71(4): 917–934.
Wolfers, J., (2006). 'Did unilateral divorce laws raise divorce rates? A reconciliation and new results', American Economic Review, 96(5): 1802–1820.
Yao, Y.-C., (1988). 'Estimating the number of change-points via Schwarz' criterion', Statistics and Probability Letters, 6: 181–189.
Zelder, M., (1993). 'Inefficient dissolutions as a consequence of public goods: The case of no-fault Divorce', Journal of Legal Studies, 22: 503–520.
Zivot, E., and D. W. K. Andrews, (1992). 'Further evidence on the great crash, the oil price shock and the unit root hypothesis', Journal of Business and Economic Statistics, 10: 251–270.

Tables

Table 1. Descriptive statistics of the sample

Country	Mean	Stand. Dev.	Max.	Min.	Period	Years
Austria	1.47	0.68	2.56	0.09	1930-2006	77
Belgium	1.23	0.95	3.45	0.22	1930-2006	77
Denmark	1.95	0.74	2.95	0.65	1930-2006	77
Finland	1.51	0.83	2.89	0.31	1930-2006	77
France	1.17	0.63	2.50	0.28	1930-2006	77
Germany[1]	1.54	0.62	2.60	0.61	1947-2006	60
Greece	0.57	0.30	1.30	0.17	1958-2006	49
Iceland	1.22	0.64	2.18	0.24	1930-2006	77
Italy	0.45	0.20	0.80	0.19	1971-2006	36
Luxembourg	1.02	0.80	2.50	0.03	1930-2006	77
Netherlands	1.17	0.74	2.36	0.33	1930-2006	77
Norway	1.22	0.77	2.54	0.29	1930-2006	77
Portugal	0.56	0.66	2.30	0.04	1930-2006	77
Sweden	1.62	0.79	3.33	0.36	1930-2006	77
Switzerland	1.35	0.64	2.91	0.67	1930-2006	77
United Kingdom	1.51	1.15	3.08	0.08	1930-2006	77

Source: UN Demographic Yearbooks and Eurostat.

Note: [1]Germany includes the German Democratic Republic

Table 2. Results of unit root tests on divorce rates

A: Country specific tests	% Unit root rejected		
Significance level	Trend stationarity	Trend stationarity with one break	Trend stationarity with two breaks
1%	0.00%	12.50%	12.50%
5%	12.50%	43.75%	18.75%
10%	31.25%	43.75%	37.50%

B: Panel tests (p = 1)	Test-statistic (p-value)	
Statistic Type	Balanced panel[1]	Unbalanced panel[2]
Levin–Lin–Chu (2002)	-0.94662(0.1719)	
Im–Pesaran–Shin (2003)	-1.988 (0.023)	
Pesaran (2007)	-1.329 (0.092)	-1.861 (0.031)

Notes: The null hypothesis is in all cases the existence of a unit root in divorce rate. Following the suggestion in Ng and Perron (1995) we choose the optimal number of lagged growth rates to be included in the regression to control for autocorrelation using a 'general-to-specific procedure' based on the t-statistic. The maximum lag length to start off this procedure is set at 11. The panel test statistics are the t^*, the $W[\bar{t}]$, and the $Z[\bar{t}]$-statistic in case of the Levin–Lin–Chu, Im–Pesaran–Shin, and Pesaran test respectively.

[1] Excluding Germany, Greece and Italy.

[2] Including all countries.

Table 3. Results of unit root tests on divorce rates with one structural break test

Country	δ	$(\hat{\rho}-1)$	Structural Break Year
Austria	1.04865***	-0.167	1979
Belgium	1.80242***	-0.077	1996
Denmark	1.30622***	-0.283**	1972
Finland	1.47677***	-0.151	1975
France	1.17906***	-0.340***	1978
Germany	0.83457***	-0.333***	1976
Greece	0.51521***	-0.239	1996
Iceland	1.16039***	-0.333**	1966
Italy	0.32726***	-0.332	1993
Luxembourg	1.55066***	-0.252	1979
Netherlands	1.41294***	-0.328**	1974
Norway	1.47264***	-0.173	1982
Portugal	1.47106***	-0.134	1993
Sweden	1.42242***	-0.287**	1969
Switzerland	1.1428***	-0.291	1973
United Kingdom	2.16492***	-0.287**	1973

Notes: One-break test of Perron and Vogelsang (1992), AO model.
Structural break year dummy variable coefficient δ:
Significant at the *** 1% level; ** 5% level, * 10% level
$(\hat{\rho}-1)$: H_0: Unit root rejected at *** 1% level, ** 5% level, * 10% level

Table 4. Results of unit root tests on divorce rates, double structural break test

Country	δ_1	δ_2	$(\hat{\rho}-1)$	Year of 1st Break	Year of 2nd Break
Austria	1.03855***	0.82017***	-0.495	1940	1979
Belgium	1.14391***	1.06912***	-0.497*	1975	1989
Denmark	0.72623***	1.06978***	-0.559**	1943	1972
Finland	1.24115***	0.59594***	-0.274	1968	1990
France	0.35489***	1.0849***	-0.446*	1942	1978
Germany	0.47493***	0.47045***	-0.349	1969	1976
Greece	0.33292***	0.31033***	-0.564	1981	1996
Iceland	0.41527***	1.03548***	-0.62	1943	1969
Italy	0.1922***	0.25034***	-0.648	1984	1997
Luxembourg	1.41351***	0.46289***	-0.308	1979	1998
Netherlands	0.745***	0.78332***	-0.418	1969	1977
Norway	0.85443***	0.81167***	-0.307	1970	1982
Portugal	0.72414***	0.91664***	-0.407	1978	1993
Sweden	0.66193***	1.16103***	-0.715***	1946	1971
Switzerland	0.82341***	0.62***	-0.745***	1973	1989
United Kingdom	0.53848***	1.93239***	-0.501*	1948	1973

Notes: Two-break test of Clemente-Montañés-Reyes (1998), AO model.
Structural break year dummy variables coefficients δ_i:
Significant at: *** 1% level, ** 5% level, * 10% level
$(\hat{\rho}-1)$: H_0: Unit root, rejected at: *** 1% level, ** 5% level, * 10% level

Table 5. The Multiple Break Model

Country	Mean Divorce Rate Before Break	Mean Divorce Rate *Year*		
		TB_1	TB_2	TB_3
Austria[1]	0.29	1.33	2.15	
		1940	*1979*	
Belgium	0.52	1.69	2.83	
		1974	*1991*	
Denmark	1.31	2.67		
		1970		
Finland	0.80	1.99	2.62	
		1970	*1987*	
France	0.72	1.89		
		1976		
Germany	1.28	2.20		
		1979		
Greece[1]	0.39	0.68	1.03	
		1979	*1994*	
Iceland	0.40	0.72	0.95	1.85
		1945	*1957*	*1970*
Italy[1]	0.27	0.51	0.74	
		1986	*1999*	
Luxembourg	0.43	1.74	2.33	
		1976	*1995*	
Netherlands	0.54	1.96		
		1972		
Norway	0.37	0.72	1.65	2.29
		1944	*1973*	*1986*
Portugal[1]	0.11	0.88	1.88	
		1975	*1995*	
Sweden[1]	0.52	1.22	2.40	
		1944	*1971*	
Switzerland[1]	0.87	1.77	2.34	
		1975	*1991*	
United Kingdom[1]	0.15	0.73	2.43	2.84
		1945	*1971*	*1982*

Note: The entries in columns 3 to 5 are the mean divorce rates following the break, with the break date reported in italics.

[1]The $\sup F_T(1)$ test was not significant for any of these countries, thus, the sequential procedure found no break. However, the BIC and LWZ select more than one break, and the $F_T(2)$ and $F_T(l+1|l)$ with $l \geq 1$tests were all significant, overall, suggesting a model with more than one break. Thus, we use the LWZ method to determine the number of breaks.

Table 6. Divorce Law Reforms from 1970

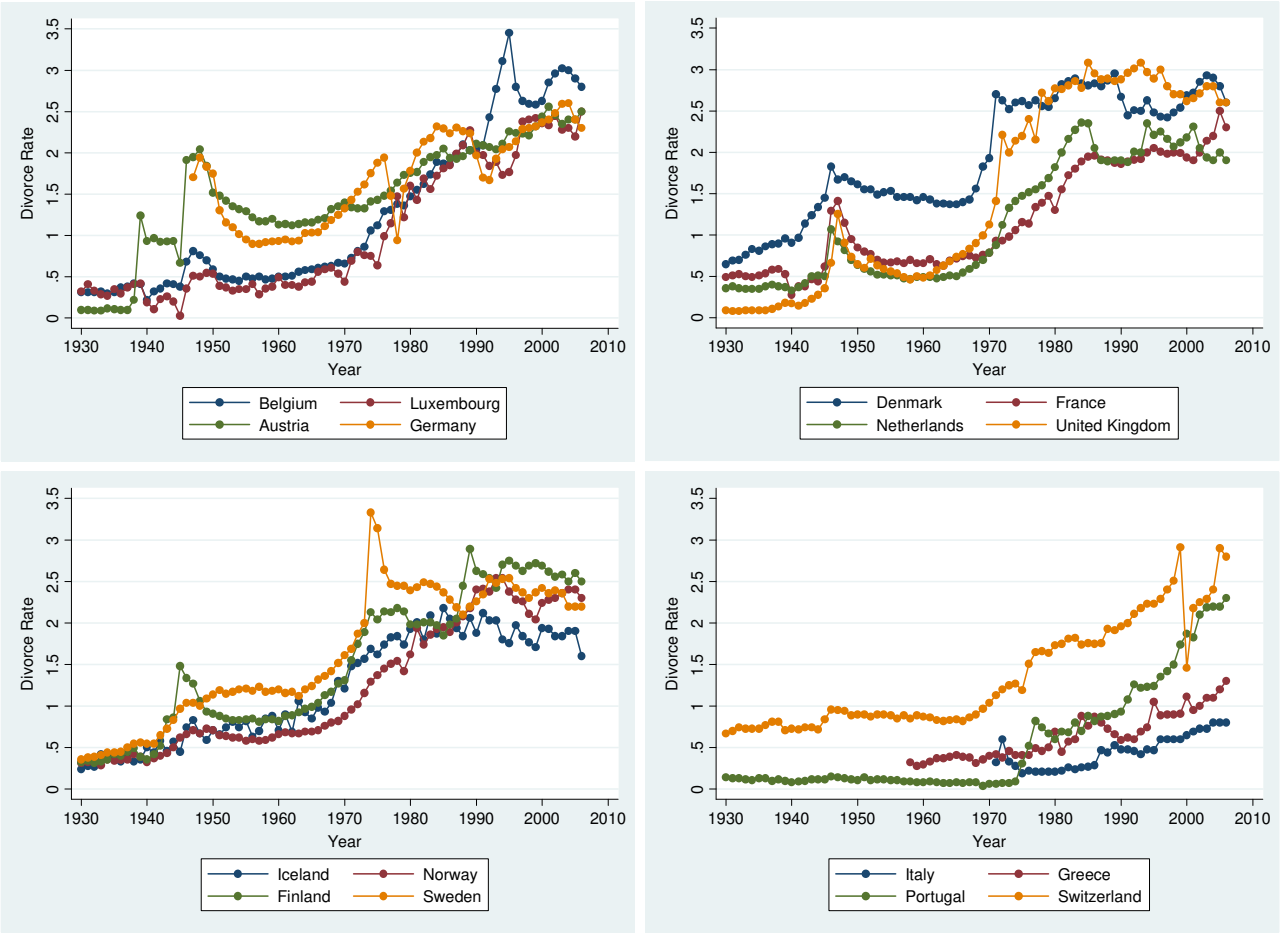
	No-fault	Unilateral, no fault
Country	Year	Year (Separation Period)
Austria	.	1978 (6)
Belgium	.	1975 (10), 1983 (5), 2000 (2)
Denmark	.	1970 (3), 1989 (2)
Finland	.	1988 (0)
France	1976	1976 (6)
Germany	.	1977 (3)
Greece	1979	1983 (4)
Iceland	.	1993 (2)
Italy	1975	None
Luxembourg	.	1979 (3)
Netherlands	1971	1971 (2)
Norway	.	1993 (2)
Portugal	1976	1976 (3)
Sweden	.	1974 (0)
Switzerland	.	2000 (4)
United Kingdom[1]	1971	1971 (5)

Source: González and Viitanen (2009).
Notes: Column 1 shows the year when no-fault grounds for divorce were introduced from the 1970s. No-fault grounds for a divorce include irretrievable breakdown, irreconcilable differences and/or incompatibility. Column 2 shows the year when unilateral, or non-explicit unilateral divorce was allowed from the 1970s. Unilateral divorce does not require mutual consent and can be granted at the request of either spouse. The dates correspond to the year when a certain reform was implemented, which is often the year after the legislation was passed. The length of the specified separation period in years is in parenthesis means that unilateral divorce was not introduced explicitly, but was in fact possible after a certain separation period, which served as proof of irretrievable breakdown of the marriage.

[1]The divorce law for Scotland post-dates that of England and Wales by five years.

Figures

Figure 1. Divorce Rate by country



Source: UN Demographic Yearbooks and Eurostat

Figure 2. Divorce Rates and their changing means

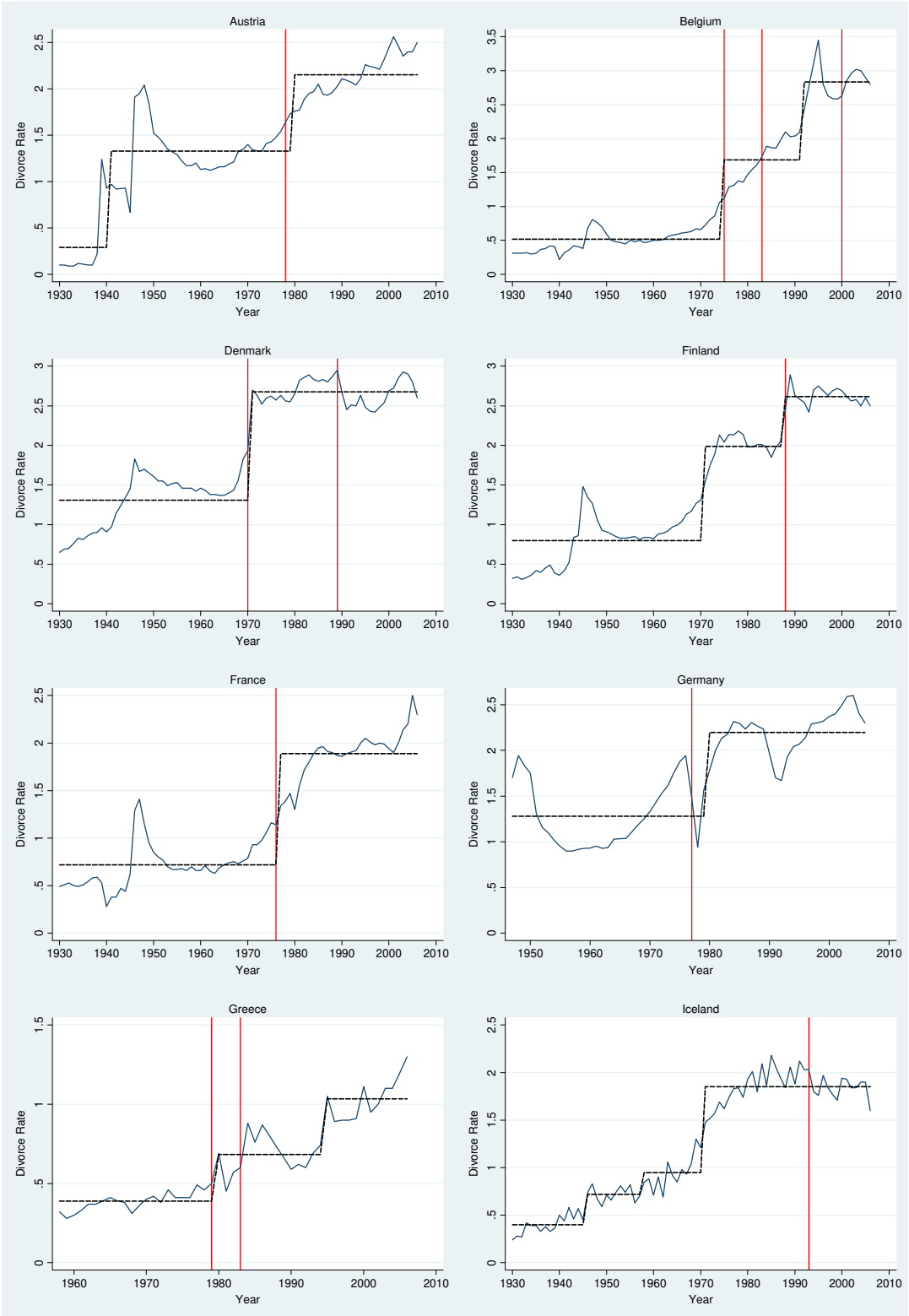


Figure 2. (continued)

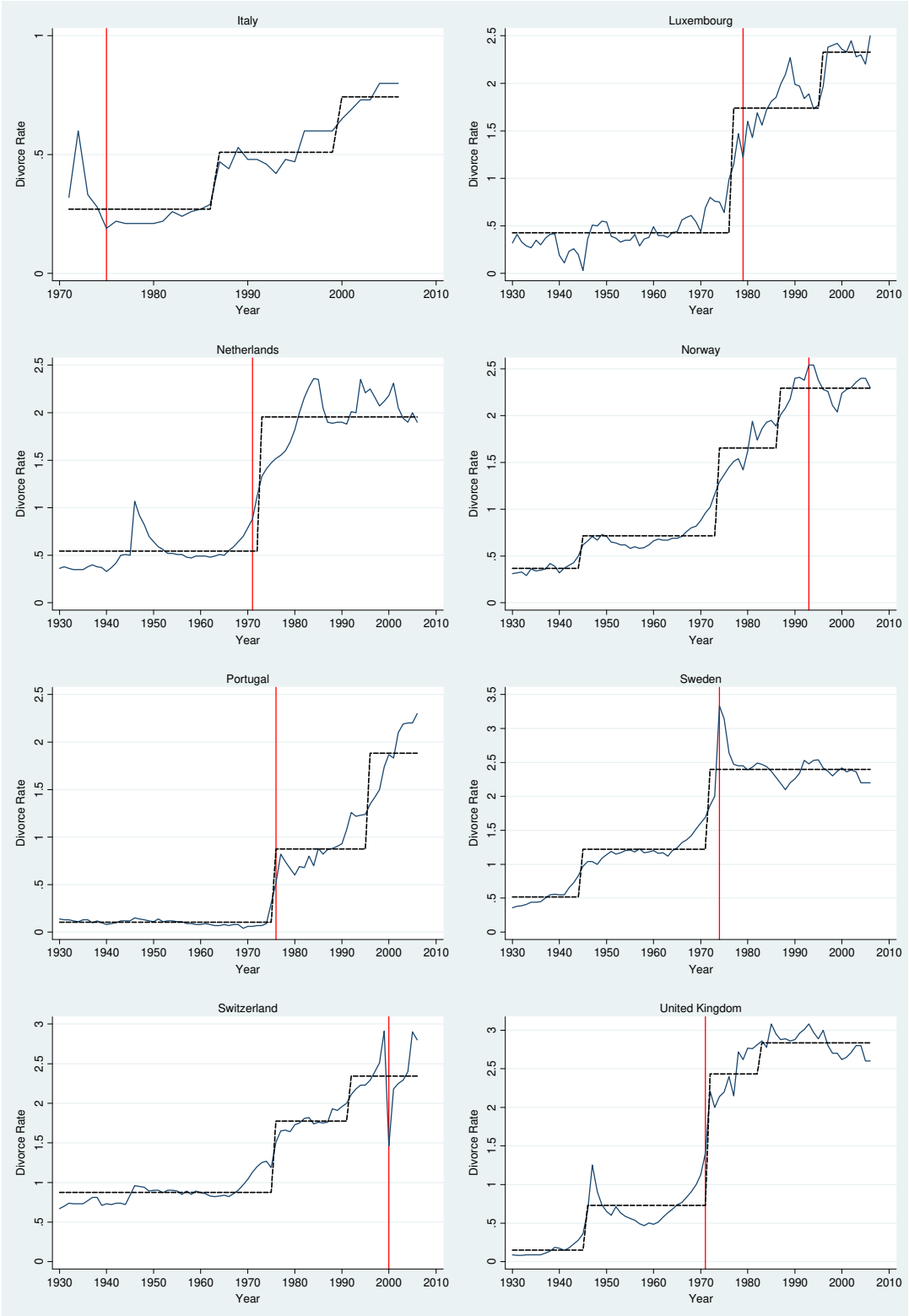
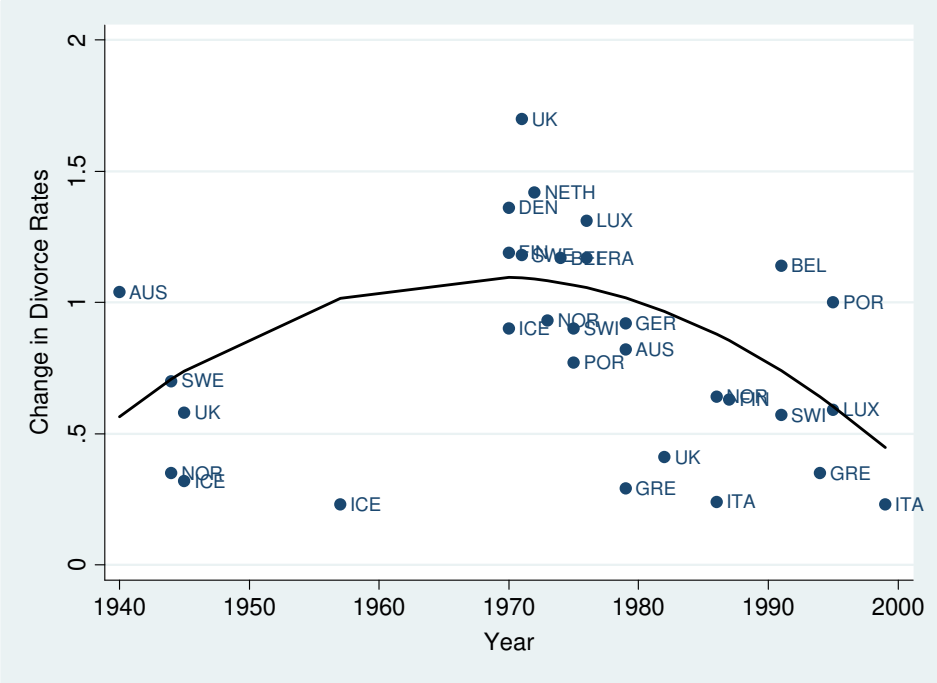


Figure 3. Change in the mean divorce rate (structural breaks detected) over time



Note: Curve fitted as $y = ax^2 + bx + c$