The dimensions of divorce laws: waiting times, no-fault, and unilateral divorce laws*

Tongyai Iyavarakul† and Marjorie McElroy‡
Duke University

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Abstract

Was the steep rise in U.S. divorce rates from the late 1960's through the early 80's due to contemporaneous sweeping changes in state laws governing divorce? And if so, since divorce laws have changed little since then, what accounts for the decline and leveling off of divorce rates since the early 1980's? Among others, three successive AER articles attempted to determine whether unilateral divorce laws contributed to the early rise. From article to article the answers flip-floped between "yes" and "no" with the no's interpreted as corroborating the Coasean world in which the efficiency of a divorce is independent of the property rights to divorce, and the yes's interpreted as contradicting it. This paper broadens the discussion and integrates (i) the direct effects of the multiple dimensions of divorce law changes on the divorce rate for a given stock of married couples combined with (ii) the indirect effects of divorce law changes on the stock of quality of successive cohorts of married couples and thereby on the divorce rates.

Using state panel data, this paper uses a unified framework to explain the variation in divorce rates within states over time. First for existing marriages, we explain the increase in divorce rates as the result of changes in three dimensions of divorce laws: (i) the serial decrease in waiting times that serve as sufficient grounds for divorce, (ii) the switch by some states from fault to no-fault grounds for divorce, and (iii) the switch from mutual consent to unilateral (property) rights to divorce. In this interval of time, every state changed at least one of these dimensions of their divorce laws and all of these changes would serve to increase divorce rates for a given average quality of marriages. In addition, these new laws seemed to have decreased the value of marriage per se (Rasul, 2006). Hence, successive cohorts of married couples were more and

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†Corresponding author. Email: ti4@duke.edu
‡Email: mcelroy@econ.duke.edu

more positively selected into marriage – an effect that, other things equal, would reduce divorce rates. In a section of this paper that is currently incomplete, we integrate this countervailing force into the model to see if changes in divorce laws can account for the observed serial increase in divorce rates, followed by a drop in divorce rates and then a tapering off to a new current steady state level (that is higher than the rates in the 1960's and earlier).

We model divorce costs under fault regimes as the cheaper of two options, waiting separate and apart for the legally mandated minimal length of time, or proving fault in court. Similarly, for no-fault regimes, the cost of divorcing is the cheaper of waiting separately and apart for the legally mandated period of time, or the cost of getting a no-fault divorce. This model yields a straightforward measure of the seemingly-complicated, successive, state-specific liberalizations of grounds for divorce. This model also leads to a nonlinear econometric specification that fully accounts for the state-specific changes in waiting times as well as the passage of no-fault laws and of unilateral divorce laws.

Our study has four advantages over earlier studies. First, we integrate the separate effects of three dimensions of divorce laws on existing marriages, namely waiting times that are sufficient grounds for divorce, whether grounds for divorce are fault or no-fault and whether (property) rights to divorce require mutual consent or belong unilaterally to each spouse. Secondly, we account for the indirect effect of legal changes on the quality of the stock of marriages over time. Third, we allow for correlated structure in the state-specific error terms as did Gold (2006). Lastly, following Gold (2006) we mark the beginning of legal changes with implementation dates, not passage dates.

In preliminary work that neglects the effects of divorce law liberalization on the average quality of the stock of marriages, we find that two types of legal changes effect divorce rates: reducing waiting times adopting either mutual consent or unilateral no-fault laws. We find that a switch from a no-fault mutual consent to a no-fault unilateral divorce law does not significantly change the divorce rate. The fault equivalent waiting time is approximately equal to 0.5 years in the no-fault states (either mutual or unilateral) and 2 years in the fault states. A reduction in the waiting period in the fault states, say, from 2 to 1 year, significantly increases the divorce rate by 0.175 per 1,000 population. No-fault property settlement law has however no significant impact on the divorce rates. What remains is to integrate these results with the indirect effects of legal changes that serially increased the match quality of the average marriage.

JEL Classification: D1, J12, J18, K36
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1 Introduction

In 1969, Governor Ronald Reagan of California signed the Family Law Act that allowed for a law that has become known as the no-fault unilateral divorce law. In essence, the act has replaced the traditional fault grounds for divorce such as adultery, cruelty, and desertion by irreconcilable difference between the spouses. In addition, it also allows one spouse to file for divorce without the mutual consent of the other. The law was originally enacted as a mean to restore the sanctity of the law since many unhappy couples are willing to pay a high price to end the doomed marriages, even if ones must commit perjury in court. In the United States before 1950, the so-called fault era of divorce law since divorces were granted only on fault grounds, perjury was almost foreseen in the family court. According to an interesting remark by Judge Henry Fenn in 1911, 'there is probably no tribunal in the country in which perjury is more rife than in the Divorce Court, which has been known in some quarters as the playground of perjurers'. In New York, where divorce at that time was practically limited to adultery, the following adultery charade, as was vividly retold by Friedman (2000), was common in the court. The plaintiff, typically the wife, would present to the court photographs of her husband taken in bed with another woman, who was hired by the couples' lawyer to fabricate an evidence of adultery. In California before 1969, where cruelty was a popular ground, the court scenario was captured by Justice Stanley Mosk of the California Supreme Court as follows:

> Every day, in every superior court in the state, the same melancholy charade was played: the 'innocent' spouse, generally the wife, would take the stand and, to the accompanying cacophony of sobbing and nose-blowing, testify under the deft guidance of an attorney to the spousal conduct that she deemed 'cruel'.

Many states followed California and liberalized their divorce laws in the 1970s in one way or another. Some states, such as Colorado, immediately allowed for grounds such as incompatibility in the marriages, irreconcilable differences, and irretrievable breakdown (hereafter referred to as an III ground) and unilateral divorce at the same time. Some, such as Delaware, only allowed for an III ground but retained the mutual consent requirement of both spouses to file for divorce. And some, such as Virginia, chose not to pass any new grounds for divorce but instead reduced the time the couples were required to separate in order to file for divorce on living separate and apart ground. As shown in Figure, the divorce rates at the national level markedly increased during the early 1970s, reached their peak in the early 1980s, the time after which an urge to relax the divorce laws finally subsided, and started to decline aftewards.

There continue to be a heating debate whether the rise is due to the change in the divorce laws. But what laws, if any, actually attribute to the increase in the divorce rates? It is important to emphasize the distinction between a *unilateral divorce law*, which switches the property rights to divorce from the spouse who wants to keep to the one who wants to dissolve the marriage, and a *no-fault divorce law*, which lays out the ground for divorce that directly affects the cost of getting a divorce. The laws in most states also make clear whether both or only one is allowed. Consider for example from the state of Nevada, where both an III ground and a unilateral divorce are allowed:

> §125:010 Divorce from the bonds of matrimony may be obtained for any of the

> following causes: No Fault: 1. When the husband and wife have lived separate and apart for 1 year without cohabitation the court may, in its discretion, grant an absolute decree of divorce at the suit of either party. 2. Incompatibility. Fault: 1. Insanity existing for 2 years prior to the commencement of the action. Upon this cause of action the court, before granting a divorce, shall require corroborative evidence of the insanity of the defendant at that time.
>
> §125:120 In any action when it appears to the court that grounds for divorce exist, the court in its discretion may grand a divorce to either party.

This is in contrast with the state of South Dakota, where a mutual consent is required:

> §25-4-17.2 The court may not render a judgment decreeing the legal separation or divorce of the parties on the grounds of irreconcilable differences without the consent of both parties unless one party has not made a general appearance.

These laws not only differ in their legal definitions, but also in the economic implication of their effects. No-fault divorce laws tend to decrease the cost of filing for a divorce since ones no longer need to prove faults and hence are likely to increase the divorce rates. The effect of unilateral divorce law is however more controversial. Becker (1981), in his explanation based on the Coase theorem, argues that the law merely changed the property rights and the law should not affect the divorce outcome absent the transaction cost of resource allocations between the spouses. The Becker conjecture is further elaborated by Peters (1986) who develops a compensation scheme to show how the divorce outcome is the same under the mutual consent and the unilateral divorce law. In another important theoretical contribution, Clark (1999), using a Scitovsky compensation criterion, shows that a unilateral divorce law may increase, decrease, or have no effect on the divorce rates even when the transaction cost of realloacting the resources between the spouses is minimal.

The effect of unilateral divorce law therefore remains an empirical question and tends to be inconclusive. Some studies such as Peters (1986) find that the law has no effect on the divorce rates while others such as Friedberg (1998) and Wolfers (2006) find that the law significantly increases the divorce rates. In this paper, we identify three methodological issues that contribute to the possibly erronous findings in these studies: the omitted bias in studies that treat the unilateral and no-fault divorce laws as synonymous, the measuremet error in the law from different interpretation of the law, and failure to take into account the autocorrelated structure of the error terms in the estimation. The challenge is whether or when living separate and apart ground becomes a no-fault ground because even though this ground is widely regarded as a no-fault law *de jure* since couples are allowed to divorce without having to establish fault grounds, one may cast doubt on whether such law is a no-fault law *de facto* since those who are eager to get a divorce may choose to prove or fabricate evidence to prove faults rather than wait especially when the required waiting period is too long.

2 Literature Review

To our knowledge, most empirical studies on the effect of divorce laws, with the exception of Gold (2008) and Horowitz (2006), treat unilateral divorce law and no-fault divorce law as synonymous. The effects of these laws can be very different from the theoretical perspective since the former law defines the *rights to get a divorce* while the latter law lays out the *ground for divorce*.

The effect of unilateral divorce law from a theoretical perspective was first discussed by Becker (1981) in his *Treatise on the Family*. The argument, based on a version of Coase theorem of property rights, follows that the change from a mutual consent divorce to a unilateral divorce is merely a change of the rights to divorce from the spouse who wants to stay in the marriage to the one who wants to divorce. Absent the transaction cost in the bargaining process between spouses, this should not affect the efficiency of the marriage and hence the divorce outcome. Whether a couple decides to get a divorce will depend on the *total* gain from divorce rather than the gain of each spouse before the bargaining takes place since the gainer can always compensate the loser to agree to the outcome. A more elaborate transfer scheme is shown in Peters (1986) based on this argument.

Another significant theoretical contribution to the subject is in Clark (1999). Using Scitovsky compensation criterion, he shows that the effect of unilateral divorce law may be uncertain even when the cost in the bargaining process is minimal. In essence, the effect of these laws depend on the shape of the utility possibility frontiers of the spouses before and after the divorce and the allocation of the resources in each scenario. In the case when the two frontiers never cross, the implication is similar to Becker's since the divorce outcome is determined by the total gain alone. However, a comparison of the effects of mutual consent and unilateral divorce law becomes uncertain when the frontiers cross. In this situation, both the initial and the post divorce allocations are important. If the allocations are on the outer frontier of the union of the utility possibility sets from marriage and divorce, then it is possible that a change from a mutual consent divorce to a unilateral divorce will increase the divorce rates. Conversely, if the initial allocations are inside the union of the utility possibility sets, then divorce rates in a mutual consent regime may be *higher* than those in a unilteral regime.

The Coase-Becker argument is further elaborated in Peters (1986), who develops a compensation scheme for husband and wife and shows that the divorce outcome only depends on the combined resources of the spouses. Using cross-sectional data on women from the Current Population Survey in 1979, she found no difference in divorce rates between women living in unilateral versus mutual consent states. Allen (1992) reexamined Peters' results by controlling for geographical heterogeneity in divorce propensities and found a significant impact of the law. Using an ordinary least squares method, Friedberg (1998) proposed to resolve this dispute by regressing state panel data of divorce rates during 1970-1985 on a dummy variable of unilateral divorce law that is one if the state adopts this law at that time and zero otherwise. State and time fixed effects are included in the regression to control for differences across states over the national level and differences over time. Moreover, a state-specific linear and quadratic time trends were included to control for other unobserved heterogeneity at the state level. The results, which are robust to different legal classifications, show that unilateral divorce significantly increases divorce rates and that this change is permanent. Wolfers (2006) replicated Friedberg's results, expanded the range of the analyzed data to 1956-1988, and modified Friedberg's model to capture the dynamic effect of the law by including a set of dummy variables that indicate how long the law has been in effect. He finds that unilateral divorce law significantly increases the divorce rates, but in contrast to Friedberg, finds that the effect of the law lasts for less than ten years.

The model used by Friedberg (1998) and Wolfers (2006) is a differences-in-differences model in spirit and the estimation technique is an ordinary least squares. However, if the error terms are autocorrelated over time, and this problem is ignored in the estimation process, and as Bertrand et al. (2004) showed, the standard errors are likely to be underestimated. Moreover, these studies do not specifically address the difference between the effect of a no-fault divorce law (whether mutual consent or unilateral) versus a fault divorce law and the difference between the effect of a unilateral no-fault law versus a mutual consent divorce law. As most states tend to make a regime switch from a fault divorce regime to a unilateral no-fault divorce regime, any significant impact of these laws on an increase in the divorce rates in studies that make no distinction between these laws may be attributed to either a decrease in the cost of divorce via the no-fault law or a significant bargaining cost between spouses that increases the divorce rates via the unilateral law. Horowitz (2006), using an ordinary least squares method, replicated the results in Wolfers (2006) and included another set of dummy variables for no-fault divorce laws à la Wolfers using data from Gruber (2004) and found that the increase in the divorce rates is explained by the inclusion of some types of no-fault divorce laws such as incompatibility or living separate and apart as permissible grounds for divorce rather than unilateral divorce law. The problem that may arise in this study is due to the fact that all states that allow for a living separate and apart ground, regardless of the length of the required time, belong to the definition of a no-fault state in Gruber (2004). For example, Rhodes Island, a state that as early as 1893 allowed for a divorce when couples can prove that they have been living apart for 10 years, is classified as a no-fault state as of that period. In a more recent study, Gold (2008) reviewed the historical data of divorce law reforms in all states, expanded the range of the data in the analysis to 1940-2005, and used the year in which the law was in effect rather than the year in which the law was passed to construct divorce law variables. Effects of separation ground and III ground on the divorce rates are studied separately and the estimation technique allows for a first order autocorrelated structure of the error term. In contrast to the previous findings, none of the laws appear to have a significant impact on the change in the divorce rates. The results in Gold (2008) may however be subject to the same definition problem of the living separate and apart ground as we previously argue. A reduction in the separation time to a new level that is still high, e.g. from 10 to 8 years, may have no impact on the divorce rates since couples may find a cheaper alternative to divorce by fabricating evidence of faults and filing for a divorce on these grounds. A model that analyzes the effect of a reduction in the waiting period using a binary variable that merely indicates whether living separate and apart is permissible as a ground for divorce can therefore be faulty.

3 Data

One of the most common sources in the difference in the findings of the effect of divorce laws on divorce rates is the data. While the data on the divorce rates used in most studies is often reliable and consistent across studies, such is not the case for historical data on divorce laws. In our study, we consider that a state s has a unilateral divorce law at time t if one of the spouses is allowed to file a divorce based on an III ground during January and June of year t or during July and December of year $t-1$. Note that we consider the year that the law is in effect rather than the year that the law is passed since any change in the divorce rates that is due to the law is likely to be observed only after the law has been in effect for some periods. In fact, in states where there exists a considerable gap between the time that the law is passed and the time that the law is in effect, the divorce rates are most likely declining during that period since most couples will want to take advantage of the law that provides divorce at a lower cost. Note also that we consider an III ground a necessary condition for a unilateral divorce. This is due to the fact that many states define living separate and apart as living apart in two different addresses as well as the absence of any sexual intercourse during that period. We therefore regard living separate and apart as a ground that requires a mutual consent in our study since the disagreed party can always petition to the court that they engage in sexual intercourse during the separation period, a claim that is very hard to disprove.

The main sources of the required separation period that is sufficient for a couple to file for a divorce on living separate and apart ground are Vlosky and Monroe (2002) and DiFonzo (1997). In states that do not explicitly allow living separate and apart as a ground for divorce, we adopt a common law rule that a very long separation period (e.g. eight or more years) is a sufficient ground for a divorce. In fact, there exists a very fine distinction between *desertion*, when one party wilfully leaves the other, and *separation*, when the decision to live apart is often consensual. For example, in Cagle v. Cagle 193 Ga. 34 (17 S.E. 2d 75), the Supreme Court of Georgia defined desertion as 'the voluntary separation of one of the married parties from the other, or the voluntary refusal to renew

State	Separation		III	Unilateral	State	Separation		III	Unilateral
	Length	Year				Length	Year		
Alaska			1963	1963	North Dakota			1971	1971
Alabama	5	1915	1972	1972	Nebraska			1972	1972
	2	1947			New Hamshire	3	1938	1972	1972
Arkansas	3	1937				2	1957		
	1.5	1991			New Jersey	1.5	1971	1972	1972
Arizona	5	1931	1974	1974	New Mexico			1933	1933
California			1970	1970	Nevada	5	1931	1967	1967
Colorado			1972	1972		3	1939		
Connecticut	1.5	1973	1973	1973		1	1967		
DC	5	1935			New York	1	1966		
	1	1965				2	1966		
Delaware	2	1957	1974		Ohio	2	1974	1990	1990
	1.5	1968				1	1982		
Florida			1972	1972	Oklahoma			1953	1953
Georgia			1973	1973	Oregon			1972	1972
Hawaii	2	1965	1974	1974	Pennsylvania	2	1988	1981	1988
	3	1967			Rhode Island	10	1893	1975	1975
	2	1970				3	1975		
Iowa			1971	1971	South Carolina	3	1969	1969	
Idaho	5	1945	1971	1971		1	1979		
Illinois	2	1984	1984		South Dakota			1985	
Indiana			1974	1974	Tennessee	2	1977	1977	1977
Kansas			1970	1970	Texas	2		1970	1970
Kentucky	5	1850	1972	1972		10	1925		
Louisiana	7	1916				7	1953		
	4	1932				3	1967		
	2	1960			Utah	2	1943	1987	1987
	1	1979				3	1965		
	0.5	1991			Virginia	3	1960		
Massachusetts			1976	1976		2	1970		
Maryland	5	1939				1	1975		
	3	1947			Vermont	3	1941		
	1.5	1961				2	1971		
	0.5	1983				0.5	1972		
Maine			1974	1974	Washington	8	1917	1973	1973
Michigan			1972	1972		5	1921		
Minnesota		1935	1974	1974		2	1965		
Missouri			1974	1974	Wisconsin	5	1866	1978	1978
Mississippi			1977			1	1977		
Montana			1976	1976	West Virginia	1	1969	1978	1978
North Carolina	10	1907				2	1969		
	5	1921			Wyoming	2	1939	1977	1977
	2	1933							
	1	1965							

Table 1: Divorce laws in the United States, 1850 - 1995. The length of the separation requirement is in years. Sources of separation requirement are DiFonzo (1997), and Vlosky and Monroe (2002). Sources of III grounds and unilateral divorce are Gold (2008), andEllman and Lohr (1998).The required waiting time for the state of New York in 1966 and West Virginia in 1969 seem to be in conflict in DiFonzo (2 years) and Vlosky and Monroe (1 year). We decide to use DiFonzo's data since he provides a specific primary source of this information in both states, while Vlosky and Monroe do not. Further clarifications of this dispute are needed and left for future research. Many states also appear to allow for an III ground despite the popular belief that California was the pioneer of this law.

Waiting time	No. of observations	Waiting time	No. of observations.
0.5	23	4	4
1	144	5	139
1.5	77	7	11
2	233	10	19
3	148	Not specified	1,095

Table 2: The length of separation time that is a sufficient ground for divorce. Number of observations are state-year observations from 51 states during 1959-1988.

a suspended cohabitation, without justification either in the consent or the wrongful conduct of the other' while 'a separation by mutual consent of the parties does not constitute desertion'. Spouses who both want a divorce may therefore live apart for a long enough period and file for a divorce on desertion ground even when the state does not explicitly allow living apart as a ground for divorce.

4 A Least Cost Model of Choosing Grounds for Divorce

In this section, we develop a model that allows us to estimate the effect of various divorce laws on the divorce rate. While some grounds such as incompatibility and irreconcilable differences in the marriage are clearly no-fault grounds, it is difficult to decide if living separate and apart for a specified length of time should be included as a no-fault ground. Although a waiting period is widely regarded as a no-fault law *de jure* since couples are allowed to divorce without having to establish fault grounds such as adultery or cruelty, one may cast doubt on whether such law is a no-fault law *de facto* since those who are eager to get a divorce may choose to prove or fabricate evidence to prove faults rather than wait especially when the required waiting period is too long. It is therefore often difficult to decide if or when waiting period is truly a no-fault ground. The model developed in this section aims to overcome this difficulty by estimating the *de facto* no-fault waiting time such that couples no longer choose to prove fault grounds if the required waiting period is less than or equal to this threshold.

Let a couple i differ from others in their (total) benefit (B_i) and cost (C_i) of the divorce. Both the benefit and the cost can be expressed as a sum of the deterministic part that is similar for all marriages, and a stochastic part that is couple-spebcific, i.e.

$$\begin{aligned} B_i &= B + \eta_i \\ C_i &= C + \nu_i, \end{aligned}$$

where B and C are the deterministic part and η_i and ν_i are the stochastic parts of the benefit and

		No-fault grounds	
		No	Yes
Unilateral	No	Regime 1 (1,035)	Regime 2 (104)
	Yes	–	Regime 3 (544)

Figure 1: Regime of divorce laws. Numbers in the parenthesis indicate the number of state-year observations from 51 states during 1959-1988 that belong to each regime.

cost, respectively. Cost is comprehensive including financial costs, time costs, and psychic costs. Couples residing in a state that adopts regime r can choose to divorce either by filing for a divorce and paying c_r, or choosing to wait for a state mandated waiting period (w) before getting divorced. If they wait by living separate and apart, their cost equals $c(w)$, where $c(\cdot)$ is a continuous function that is increasing in w. The cost associated with any state divorce law can be fully specified by indicating the grounds for divorce, the property rights to divorce, and the waiting period sufficient for divorce. Let state s at time t be classified into one of the three mutual exclusive and exhaustive regimes as shown in Figure 1.The columns indicate whether fault grounds are required or whether no-fault grounds, which include grounds such as incompatibility in the marriage, irretrievable breakdown, and irreconcilable differences, are permitted. Some states allow both no-fault as well as fault grounds. In these states, no-fault grounds are almost always used (reference). Hence, we classify such states as no-fault. The rows indicate whether a unilateral divorce is permitted. Note that we define a unilateral divorce law such that all unilateral divorces must be filed on an no-fault ground for the reason explained earlier. Regime 1 is the fault regime in which couples filing for divorce must prove faults and pay the cost equal to c_1. Regime 2 is the III mutual consent regime in which couples are required to file for a divorce based on any of the III ground and both spouses must agree to the divorce. We conjecture that $c_2 \leq c_1$, that is, the cost of filing for a divorce in this regime is lower than that in the state where a fault ground must be established since, say, adultery and cruelty are harder to prove in practice than incompatibility and that adultery and cruelty can always be cited in the court as an evidence of incompatibility in the marriage. The last regime is the no-fault unilateral regime in which either party can file for a divorce based on any of the no-fault ground and pays the cost equal to c_3. In general, it follows from the Coase theorem that $c_3 \leq c_2$, with strict inequality when a significant transaction cost is incurred during the rebargaining process between the spouses.

Couples optimize by getting a divorce if and only if the benefit exceeds the cost of divorce, and choosing the cheapest cost of divorce available. For simplicity, we assume that there is no migratory divorce. Hence, couple i divorces if and only if

$$\nu_i - \eta_i < B - \min\left\{c_r, c(w)\right\}, r \in \{1, 2, 3\}.$$

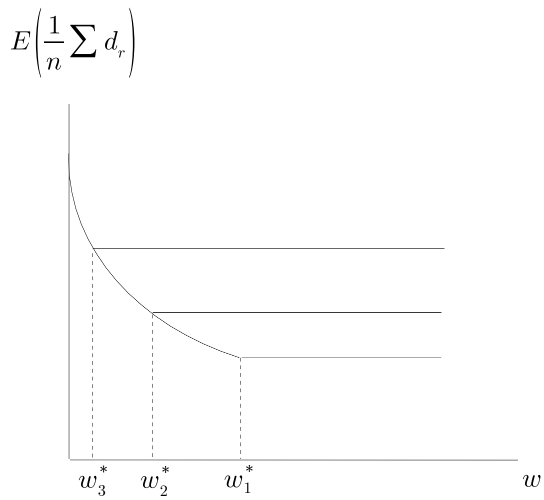

Figure 2: The effect of waiting time on the expected divorce rates in different regimes.

Note from previously that we make use of the Coase theorem so that the divorce outcome depends on the total resources left after the divorce rather than the resource allocated to each individual. Let the difference in the stochastic parts $\nu_i - \eta_i$ follow a well defined probability distribution function $\mathcal{F}$, and d_i be a binary variable that is equal to one if couple i divorces and zero otherwise, the (expected) average divorces in an economy with n marriages in state that is in regime r is given by

$$\mathsf{E}\left(\frac{1}{n}\sum_{i=1}^{n} d_{ir}\right) = \mathcal{F}\left(B - \min\left\{c_r, c(w)\right\}\right). \tag{1}$$

Let w_r^* be the fault equivalent waiting period such that $c_r = c(w_r^*)$, then for $w > w_r^*$, the divorce rate is equal to $\mathcal{F}(B - c_r)$, which is independent of the waiting time. For $w < w_r^*$, the divorce rate is equal to $\mathcal{F}(B - c(w))$, which is decreasing in w since $\mathcal{F}(\cdot)$ and $c(\cdot)$ are increasing functions. From the previous conjecture that $c_3 \leq c_2 \leq c_1$, the divorce rate as a function of the waiting time w can therefore be illustrated as in Figure 2.

5 Estimating the Divorce Spline

Our econometric specification makes extensive use of the spline function defined by

$$g(w_{st}; \beta, w_r^*) = \beta_0 + \beta_1 w_{st} + \beta_{2r}(w_{st} - w_r^*)\mathcal{I}(w_{st} > w_r^*),$$

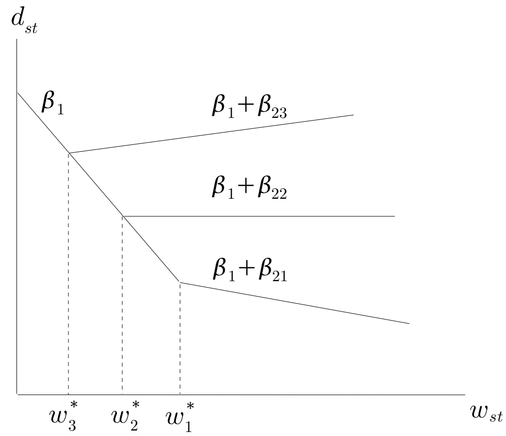

Figure 3: A graphical illustration of the spline linear function $g(w_{st}; \beta, w_r^*)$.

where state s at time t belongs to one of the $r \in \{1, 2, 3\}$ regime, w_{st} is the required waiting time in state s at time t that is sufficient to get a divorce, and w_r^* is the fault equivalent waiting period in regime r that is a parameter to be estimated in the model. When w_{st} is less than w_r^*, the effect of the waiting time on the divorce rate is a linear function with intercept β_0 and slope β_1. When w_{st} exceeds w^*, the slope changes from β_1 to $\beta_1 + \beta_2$; the parameter β_2 measures the difference between the slopes of the two segments and both lines intersect at w_r^*. Note that (**??**) provides an estimating equation that can be used to verify some testable implications in (1); that is, for $\beta_0 > 0$, $\beta_1 < 0$, $\beta_1 + \beta_{2r} = 0$, and $w_r^* > 0$, the spline function $g(w_{st}; \beta, w_r^*)$ resembles the shape of (1). A graphical illustration of the spline linear function $g(w_{st}; \beta, w_r^*)$ is shown in Figure 3. In this figure, we illustrate the case when $c_3 \leq c_2 \leq c_1$ and $\beta_1 + \beta_{23} > 0$, $\beta_1 + \beta_{22} = 0$, and $\beta_1 + \beta_{21} < 0$.

A general econometric specification to estimate (1) using panel data on divorce rates is given by

$$d_{st} = \sum_{r \in \{1,2,3\}} g(w_{st}; \beta_r, w_r^*) \mathcal{I}(r) + \Delta_{st} + \epsilon_{st}, \tag{2}$$

where d_{st} is the divorce rate (defined as the number of divorces per 1,000 population) in state s at time t, $\mathcal{I}(r)$ is equal to one if state s at time t belongs to the r regime, Δ_{st} captures the state fixed effect, time fixed effect, and state linear and quadratic time trend similar to the specification in Friedberg (1998) and Wolfers (2006), and ϵ_{st} are mean-zero error terms assumed to be correlated across time t within the state s, but uncorrelated across different states. The estimation of (2) is complicated by the fact that the break points are unknown. Hence, (2) becomes a non-linear function that is not differentiable at the (unknown) break points, w_r^*, so that gradient based optimization techniques do not apply. To estimate this equation, we follow Muggeo (2003) by linearizing the nonlinear part $g(w_{st}; \beta, w_r^*)$. Using a first-order Taylor expansion around a candidate value,

$w_r^{*(0)}$, yields

$$(w_{st} - w_r^*)\mathcal{I}(w_{st} > w_r^*) \approx (w_{st} - w_r^{*(0)})\mathcal{I}(w_{st} > w_r^{*(0)}) - (w_r^* - w_r^{*(0)})\mathcal{I}(w_{st} > w_r^{*(0)}). \quad (3)$$

where $(-1)\mathcal{I}(w_{st} > w_r^{*(0)})$ is the first order derivative of $(w_{st} - w_r^*)\mathcal{I}(w_{st} > w_r^*)$ evaluated at $w_r^{*(0)}$. Substitute (3) into $g(w_{st}; \beta, w_r^*)$ to get

$$g(w_{st}; \beta_r, w_r^*) = \beta_0 + \beta_1 w_{st} + \beta_{2r}(w_{st} - w_r^{*(0)})\mathcal{I}(w_{st} > w_r^{*(0)}) - \beta_{2r}(w_r^* - w_r^{*(0)})\mathcal{I}(w_{st} > w_r^{*(0)}) \quad (4)$$

for $r = 1, 2, 3$. The function in (4) can be reparameterized by

$$g(w_{st}; \beta_r, \delta_r, w_r^*) = \beta_0 + \beta_1 w_{st} + \beta_{2r}(w_{st} - w_r^{*(0)})\mathcal{I}(w_{st} > w_r^{*(0)}) - \delta_r \mathcal{I}(w_{st} > w_r^{*(0)}), \quad (5)$$

where w_{st}, $(w_{st} - w_r^{*(0)})\mathcal{I}(w_{st} > w_r^{*(0)})$, and $\mathcal{I}(w_{st} > w_r^{*(0)})$ are the variables observed in the data given $w_r^{*(0)}$, and β_1, β_2, and δ_r are the corresponding coefficients to be estimated respectively. Note from (4) and (5) that $\delta_r = \beta_{2r}(w_r^* - w_r^{*(0)})$ and hence for $\beta_2 \neq 0$, the necessary condition for the convergence of $w_r^{*(0)}$ such that $w_r^{*(0)}$ is close to the true value w_r^* requires that δ_r is close to zero. Substitute (5) into (2) gives

$$\begin{aligned} d_{st} = {} & \beta_0 + \beta_1 w_{st} + \sum_r [\beta_{2r}(w_{st} - w_r^{*(0)})\mathcal{I}(w_{st} > w_r^{*(0)}) - \\ & \delta_r \mathcal{I}(w_{st} > w_r^{*(0)})]\mathcal{I}(r) + \Delta_{st} + \epsilon_{st}, \end{aligned} \quad (6)$$

which is linear in the parameter and hence standard linear regression technique applies. The estimation of the fault equivalent waiting period follows from (4) and (5) that

$$\hat{w}_r^* = \frac{\hat{\delta}_r}{\hat{\beta}_{2r}} + w_r^{*(0)}. \quad (7)$$

The standard error of $\hat{w}^*$ can be computed using the delta method, i.e.

$$\mathsf{s.d.}(\hat{w}_r^*) = \left(\frac{\mathsf{var}(\hat{\delta}_r) + \mathsf{var}(\hat{\beta}_{2r})\left(\hat{\delta}_r / \hat{\beta}_{2r}\right)^2 + 2\left(\hat{\delta} / \hat{\beta}_{2r}\right)\mathsf{cov}\left(\hat{\delta}_r, \hat{\beta}_{2r}\right)}{\hat{\beta}_{2r}^2} \right)^{\frac{1}{2}}.$$

Since we observe only nine (eight actual waiting period and one set at a very long period, e.g. eight years) values of the state-time waiting period w_{st}, we estimate (6) at each $w_r^{*(0)}$ equal to each of the value of w_{st} as shown in Table 2 and pick the one that gives the highest fitting criterion. Note that $\mathcal{I}(w_{st} > w_r^{*(0)})$ is the same for any $w_r^{*(0)}$ that falls within the interval between two observed values of w_{st}, e.g. $\mathcal{I}(w_{st} > 1.2) = \mathcal{I}(w_{st} > 1.3)$ since both 1.2 and 1.3 fall within the same interval

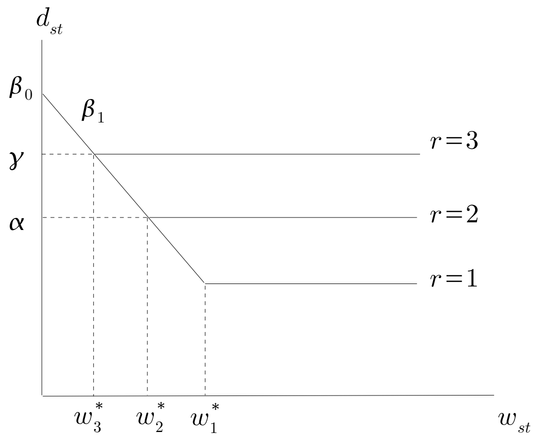

Figure 4: A graphical illustration of $g(w_{st}; \beta, w^*)$ such that $\beta_1 + \beta_{2r} = 0$ as used in Specification 9.

defined by the observed waiting time 1 and 1.5 in the data. Hence, any $w_r^{*(0)} \in (1, 1.5]$ will give the same fitting criterion (although with different intercepts).

In what follows, we assume that the divorce rate is completely independent of the waiting period when $w_{st} > w_r^*$, i.e. $\beta_1 + \beta_{2r} = 0$. This restriction can be imposed on the estimation of (6) so that the restricted version becomes

$$\begin{aligned} d_{st} &= \{\beta_0 + \beta_1 \sum_r \{w_{st} - (w_{st} - w_r^{*(0)})\mathcal{I}(w_{st} > w_r^{*(0)})\}\mathcal{I}(r) - \\ &\quad \sum_r \delta_r \mathcal{I}(w_{st} > w_r^{*(0)})\mathcal{I}(r) + \Delta_{st} + \epsilon_{st}, \end{aligned} \tag{8}$$

The grid search procedure may generally be computationally burdensome since there are nine values for each of $w_r^{*(0)}$. Alternatively, if we also assume that $c_3, c_2 \leq c_1$, then we may estimate (8) using the following specification

$$\begin{aligned} d_{st} &= \{\beta_0 + \beta_1 [w_{st} - (w_{st} - w_1^{*(0)})\mathcal{I}(w_{st} > w_1^{*(0)})] - \\ &\quad \delta_1 \mathcal{I}(w_{st} > w_1^{*(0)})\mathcal{I}(1) + \alpha III_{st} + \gamma U_{st} + \Delta_{st} + \epsilon_{st}, \end{aligned} \tag{9}$$

where III_{st} is a binary variable that is equal to one if some form of III is in effect in state s in June or after in year t, and U_{st} is a binary variable analogous to I_{st}. In this specification, we use the observations from regime 1 to identify all the βs and $w_1^{*(0)}$, the observations such that $w_{st} > w_1^*$ from the second regime to identify α, and the observations such that $w_{st} > w_1^*$ from the third regime to identify γ. Both $\hat{w}_2^*$ and $\hat{w}_3^*$ can be calculated as a function of $\hat{\beta}_0$, $\hat{\beta}_1$, $\hat{\alpha}$, and $\hat{\gamma}$, i.e.

$$\hat{w}_2^* = \frac{\hat{\alpha} - \hat{\beta}_0^*}{\hat{\beta}_1^*}$$
$$\hat{w}_3^* = \frac{\hat{\gamma} - \hat{\beta}_0^*}{\hat{\beta}_1^*}.$$

The effect of a switch from Regime 1 (a fault regime when couples previously chose to prove fault) to Regime 2 (a no-fault regime that allows for a no-fault ground but requires a mutual consent of both spouses) without changing any waiting time is

$$\mathsf{E}(d_{st}|r = 1, w_{st} > w_1^*) - \mathsf{E}(d_{st}|r = 2, w_{st} > w_2^*) = \alpha - (\beta_0 + \beta_1 w_{st}).$$

Similarly, the effect of a switch from Regime 1 (a fault regime when couples previously chose to prove fault) to Regime 3 (a no-fault regime that allows for both a no-fault ground and a unilateral divorce) without changing any waiting time is

$$\mathsf{E}(d_{st}|r = 1, w_{st} > w_1^*) - \mathsf{E}(d_{st}|r = 3, w_{st} > w_3^*) = \gamma - (\beta_0 + \beta_1 w_{st}).$$

Therefore, the change in the divorce rates that is due to a switch from a mutual consent to a unilateral divorce, holding the cost of divorce constant is

$$\mathsf{E}(d_{st}|r = 3, w_{st} > \max\{w_2^*, w_3^*\}) - \mathsf{E}(d_{st}|r = 2, w_{st} > \max\{w_2^*, w_3^*\}) = \gamma - \alpha.$$

The specification in (9) is however less efficient compared to (8) since not all observations are included in the estimation process (no w_{st} to the left of what would be w_2^* should be used to identify α and no w_{st} to the left of what would be w_3^* should be used to identify γ). It however carries less computational burden because one only needs to directly estimate the fault equivalent waiting time in the first regime as compared to a three dimensional grid search as in specification (6).

6 Results

The columns of Table 3 show the estimated parameters conditional on four candidate values for $w_1^{*(0)}$, the fault equivalent waiting time $w_1^{*(0)} = 1, 1.5, 2, 3$. To identify α, and γ we use observations from Regimes 2 and 3. These observations need to be to the right of the kink point for thier respective regimes. Since $w_3^* \leq w_2^* \leq w_1^*$, this means the observations must be at least as big as the candidante $w_1^{*(0)}$. To keep the number of observations the same for each candidate value, we

Parameter	Estimates at $w_1^{*(0)}$ equal to			
	1	1.5	2	3
β_0	3.0902*	3.3846*	3.4271*	3.3270*
	(0.2504)	(0.1453)	(0.1145)	(0.1024)
β_1	0.2192	-0.1050	-0.1593*	-0.0785*
	(0.2708)	(0.1098)	(0.5562)	(0.0323)
δ_1	0.2034*	0.1133	-0.0029	-0.0228
	(0.0664)	(0.0587)	(0.4912)	(0.0511)
α	3.3257*	3.3336*	3.3305*	3.3340*
	(0.1018)	(0.1018)	(0.1018)	(0.1020)
γ	3.2162*	3.2269*	3.2235*	3.2259*
	(0.0614)	(0.0615)	(0.0616)	(0.0622)
$w_2^* = \frac{\alpha-\beta_0}{\beta_1}$	1.0744	0.4857	0.6064	-0.0892
$w_3^* = \frac{\gamma-\beta_0}{\beta_1}$	0.5748	1.5019	1.2781	1.2879
$\alpha - (\beta_0 + \beta_1 w_1^*)$	0.0163	0.1065	0.2220	0.2425
$\gamma - (\beta_0 + \beta_1 w_1^*)$	-0.0932	-0.0002	0.1150	0.1344
$\gamma - \alpha$	-0.1095	-0.1067	-0.1070	-0.1081
	(0.2586)	(0.2711)	(0.2697)	(0.2660)
χ^2	264973.87	264747.37	265285.44	264655.32
N	1444	1444	1444	1444

Table 3: Estimation results for specification (9) at selected values of $w_1^{*(0)}$. $\hat{\Delta}_{st}$ are all significant at 95% level of confidence. Standard errors are in parenthesis. Estimates that are significant at 95% level of confidence are marked by an asterisk *. The standard errors of some estimators are still to be computed.

need the observations to be to the right of the biggest candiate value. Hence for Regimes 2 and 3, we retain only those observations with w_{st} greater than 3 years, the largest $w_1^{*(0)}$.

The second last row of Table 3 gives the corresponding χ^2 measures of fit. Our GLS estmates coresspond to those for the largest χ^2.[1]The value $w_1^{*(0)} = 2$ yields the highest χ^2 with corresponding parameter estimates in the second last column. The estimated signs ($\beta_1 < 0$) and relative sizes of the parameters ($\alpha \geq \gamma$ and $\hat{w}_3^* \leq \hat{w}_2^* \leq \hat{w}_1^*$) are consistent with our model. If couples can instantly divorce, i.e. the required waiting time is dropped to zero, the expected divorce rate in any regimes is about 3.4 per one thousand population. This is about 0.4 times the peak national divorce rate of 8.7 per one thousand attained in 1980. In Regime 1 (fault), a one-year increase in the waiting period, where the fault equivalent waiting time is between 1.5 and 2, will significantly reduce the divorce rate by an estimated 0.16 per one thousand population. Likewise, for waiting times greater than w_3^* , a switch from Regime 2 (no-fault, mutual consent) to Regime 3 (no-fault, unilateral), which is a measure of the effect of unilateral divorce holding other costs constant, does not appear to significantly change the divorce rates. This result is in accord with the prediction of the Becker-Coase theorem. The estimates of w_2^* and w_3^* is approximately 0.6 and 1.3 years, respectively. This suggests that divorce laws that reduce the waiting time to lower than 1.5 years tend to have an impact on the divorce rates similar to those that allow for a no-fault ground. The standard errors of these estimates still remain to be calculated.

We next estimate the specification in (6) using all state-time observations from 51 states during 1956-1989. To lessen the computational burden of a three-dimensional grid search, we take advantage of the previous result by assuming that $w_2^* = w_3^*$ and performing a grid search over a pair of w_1^* and $w_2^* = w_3^*$ only. The maximum χ^2 is at $\hat{w}_1^* = 2$ and $\hat{w}_2^* = \hat{w}_3^* = 0.5$, which are closed to the estimation results from specification (9). The estimates of other parameters are shown in Table 4 in the first column titled the cost model and are remarkably close to the previous results. In particular, the expected divorce rate in any regimes is about 3.4 per one thousand population when the waiting period is zero. An increase in one year waiting period in Regime 1 provided that the new waiting time is less than or equal to 2 also significantly reduces the divorce rate by approximately 0.18 per one thousand population. We also perform a specification test between our non-linear specification of our cost model and two different spefications á la Friedberg (1998) and Wolfers (2006). In column 3 in Table 4, we add in a dummy variable F_{st} that is equal to 1 if unilateral divorce law is in effect in state s at time t into our specification in (6) . Similarly, in column 4 in Table 4, we add in a set of dummy variables W_{kst} that is equal to 1 if unilateral divorce law has been in effect for at least k years in state s at time t for $k = 2, 4, 6, 8, 10, 12, 14$. In both columns, we find that our nonlinear specification of the cost model tends to outperform both Friedberg and

[1]It is straightforward to show that the χ^2as a fucntion of $w_1^{*(0)}$is a step function in which the risers are located at observed values of wst and the flats are the intervals between observations, each closed on left and open on the right. Hence, in our search over candiate values for $w_1^{*(0)}$, we need only search over observed waiting times.

Specification	(1)	(2)	(3)
β_0	3.3790*	3.3809*	3.3769*
	(0.1145)	(0.1150)	(0.1116)
β_1	-0.1768*	-0.1757*	-0.1722*
	(0.0537)	(0.0538)	(0.0528)
δ_1	-0.0696	-0.0666	-0.0615
	(0.0452)	(0.0454)	(0.0456)
$\delta_2 = \delta_3$	0.0700	0.0236	0.0758
	(0.0829)	(0.0949)	(0.0816)
Friedberg dummy	-	-0.0585	-
		(0.0634)	
Wolfers dummies (χ^2)	-	-	11.5300
			[0.1736]
$\beta_1 = \delta_1 = \delta_2 = \delta_3 = 0$ (χ^2)	31.4300*	21.1800*	27.1500*
	[0.0000]	[0.0001]	[0.0000]
χ^2	254597.20	253014.69	279502.84
N	1631	1631	1631

Table 4: Estimation results for specification (6) at $w_1^{*(0)} = 2$ and $w_2^{*(0)}, w_3^{*(0)} = 0.5$, the best estimates with an imposed restriction that $3 > w_1^* > w_2^* = w_3^*$. $\hat{\Delta}_{st}$ are all significant at 95% level of confidence. Standard errors are in parenthesis. p-values are in bracket. Estimates that are significant at 95% level of confidence are marked by an asterisk *. The standard errors of some parameters are still to be computed. Specification (1) corresponds to equation (8) imposing the restriction that $w_2^* = w_3^*$. Specification (2) adds a dummy for unilateral divorce law à la Friedberg (1998) into specification (1). And specification (3) adds a set of dummies for unilateral divorce law à la Wolfers (2006) into specification (1). All dummies are coded using our according to Table 1.

Wolfers specifications. In particular, the joint hypothesis that the parameters that define the spline (except for the intercept) are all equal to zero are rejected at a high level of confidence. On the contrary, we cannot reject the hypothesis that the Friedberg's dummy and the Wolfers' dummies are zero when the waiting time is incorporated into the model. Our estimates for the parameters of the spline are also fairly stable in all three specifications.

7 Concluding Remarks

In this paper, we study the effect of no-fault divorce law, unilateral divorce law, and waiting time to get a divorce on the divorce rates in 51 states in the United States during 1956-1989. The Coase theorem states that absent the transaction cost of reallocating resources between the spouses, the change from a mutual consent law to a unilateral law should not affect the divorce rates since it merely switches the rights to divorce from the spouse who wants to keep the marriage to the one who wants to dissolve it. The actual effect however has remained an empirical question and studies that find that the law has no effect support the theorem while those that find a positive significant effect argue otherwise that the transaction cost is not negligible. We identify three methodological issues that contribute to the possibly erronous findings in these studies: the omitted bias in studies that treat the unilateral and no-fault divorce laws as synonymous, the measuremet error in the law from different interpretation of the law, and failure to take into account the autocorrelated structure of the error terms in the estimation. In our model, we propose a spline linear model with the unknown threshold that captures the effect of the waiting time on the divorce rates in three regimes: the fault regime where no fault ground such as irreconcilable differences between the spouses is allow, the no-fault mutual consent regime where a type of no-fault ground exists but requires the consents of both spouses to file for a divorce, and the no-fault unilateral regime where one spouse is allowed to file for divorce based on a no-fault ground.

We estimate that the fault equivalent waiting period, i.e. the waiting time that the couple is indifferent between waiting before filing for a divorce based on living separate and apart ground and immediately filing for a divorce based on a fault ground to be 2 years. The no-fault equivalent waiting period, i.e. the waiting time the couple is indifferent between waiting and filing for a divorce based on a no-fault ground to be 0.5 years. A switch from a fault to a no-fault mutual consent regime significantly increases the divorce rate by about 0.2 per one thousand population. An increase in one year waiting period provided that the new waiting time is less than or equal to 2 also significantly reduces the divorce rate by approximately 0.18 per one thousand population. However, a switch from a no-fault mutual consent regime to a no-fault unilateral regime does not appear to significantly increase the divorce rates, which confirms the theoretical prediction of the Coase theorem.

It should be noted that our findings are preliminary, and we expect to complete a three-dimensional grid search and calculate the standard errors of some parameters in the near future.

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