The Effect of Same-Sex Marriage Laws on Different-Sex Marriage: Evidence From the Netherlands

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Abstract It has long been argued that the legalization of same-sex marriage would have a negative impact on marriage. In this article, I examine how different-sex marriage in the Netherlands was affected by the enactment of two laws: a 1998 law that provided all couples with an institution almost identical to marriage (a "registered partnership") and a 2001 law that legalized same-sex marriage for the first time in the world. I first construct a synthetic control for the Netherlands using OECD data for the period 1988–2005 and find that neither law had significant effects on either the overall or different-sex marriage rate. I next construct a unique individual-level data set covering the period 1995–2005 by combining the Dutch Labor Force Survey and official municipal records. The estimates from a discrete-time hazard model with unobserved heterogeneity for the first-marriage decision confirm the findings in the aggregate analysis. The effects of the two laws are heterogeneous, with presumably more-liberal individuals (as defined by their residence or ethnicity) marrying less after passage of both laws and potentially more-conservative individuals marrying more after passage of each law.

Keywords: Same-sex marriage, Synthetic control, Discrete-time hazard model

Introduction

Economists have long been interested in the effects of various policies on marriage behavior. Some policies studied are aimed directly at the marriage contract, such as no-fault divorce laws (Allen et al. 2006; Rasul 2006) or minimum age requirements (Blank et al. 2009). Others alter the monetary incentives associated with marriage, such as welfare reforms (Bitler et al. 2004), income taxes (Alm and Whittington 1999), blood test requirements (Buckles et al. 2011), or a reduction in the cost of premarital sex (Goldin and Katz 2002). The common theme is that each of these policies altered the value of marriage relative to alternative arrangements. In this article, I study a new policy that could affect the value of marriage: the legalization of same-sex marriage.

The argument that opening the institution of marriage to same-sex couples would affect the value of marriage was used to justify amendments to state constitutions, such as Proposition 8 in California and the U.S. federal Defense of Marriage Act (DOMA), laws meant to protect the federal or state governments from having to recognize a same-sex marriage performed elsewhere.[2] However, the effect of same-sex marriage on the institution of marriage is theoretically ambiguous. On the one hand, the legalization of same-sex marriage could reduce the incentives to marry if it changes social norms toward alternative family forms (Kurtz 2004b). On the other hand, it could lead to more different-sex marriages by reigniting the interest in marriage, by reducing the pressure on government and employers to provide marriage-like benefits to cohabiting couples, or by pushing different-sex couples to reclaim the institution of

[2] By the end of 2008, the U.S. Congress and 40 states had enacted such acts (Stateline.org 2009), with 30 states having constitutional amendments that specifically defined marriage as the union between a man and a woman.

marriage (Rauch 2004; Safire 2003).

The empirical evidence on the effect of same-sex marriage on the institution of marriage is limited and consists mostly of case studies (e.g., Eskridge and Spedale 2006) or graphical analyses of aggregate data.[3] To date, only two studies have attempted to address the issue of causality between same-sex unions and different-sex marriage. Using data on U.S. states between 2000 and 2006, Graham and Barr (2008) rejected the hypothesis that an increase in unmarried same-sex couples Granger-causes more different-sex unmarried couples. While addressing causality, the authors acknowledged that they could not determine whether same-sex marriage would cause fewer different-sex marriages. Using U.S. state-level data, Langbein and Yost (2009) estimated difference-in-difference models and found no statistically significant effects on marriage, divorce, abortion, and out-of-wedlock births in states allowing same-sex marriage or civil unions. One concern is that these findings could be caused by time-varying factors that are correlated with both the introduction of same-sex marriage and the outcomes analyzed, such as trends in social norms.

In this article, I study the effects of same-sex marriage on different-sex marriage in the Netherlands. There are several reasons for choosing this setting. To begin, the Netherlands offers the longest time-series of same-sex marriages, being the first country (in 2001) to legalize same-sex marriage. Second, the Dutch legislature introduced in 1998 the concept of "registered partnership," an institution that is identical to marriage in almost every respect and is, unlike the Scandinavian registered partnership, also open to different-sex couples. This offers the unique

[3] See Kurtz (2004a,b,c, 2006a,b) for interpretations of the aggregate data as showing a negative effect of same-sex marriage laws on marriage and family formation, and see Badgett (2004a,b, 2009) for interpretations of no effect.

opportunity to distinguish between a change in the marriage rate and a change in the rate of union formalization, and also for a partial distinction between the effects of same-sex marriage versus granting same-sex couples the same rights and benefits through an alternative institution. Finally, the argument that legalizing same-sex marriage would affect the institution of marriage was also used in the Netherlands.[4]

I first conduct my analysis at the aggregate level. Using data on the 16 OECD member countries that did not enact same-sex marriage or registered partnership laws by 2005 and the synthetic control method developed by Abadie and Gardeazabal (2003) and Abadie et al. (2010), I construct a counterfactual for the Dutch marriage rate in the absence of the two laws. (As mentioned earlier, I refer to a 1998 law that provided all couples with an institution almost identical to marriage (registered partnership) and also a 2001 law that legalized same-sex marriage for the first time in the world.) This method, unlike previous approaches using aggregate data, takes into account both observed and unobserved determinants of the marriage rate. Regardless of whether I focus on all marriages or only different-sex marriages, a comparison of the Dutch marriage rate to the synthetic marriage rate shows an insignificant increase after the registered partnership law, followed by an insignificant decrease after the same-sex marriage law. I then turn to a unique and highly confidential individual-level data set that includes demographic characteristics as well as information on marriage spanning the period 1995–2005 for approximately 10 % of the Dutch population, which I use to estimate a discrete-time duration model for the age at first marriage of young Dutch. As in the aggregate data, the

[4] In personal correspondence with the author, Boris Dittrich, former member and floor leader of the Dutch Parliament, mentioned the use of these arguments during the debate on the same-sex marriage law in the Netherlands.

results from specifications with unobserved heterogeneity suggest an increase in the marriage rate after the introduction of registered partnership and a generally insignificant decline after the same-sex marriage law.

Even if the average effect of the two laws is insignificant, responses across various groups in the population may differ. In particular, I find different effects in samples stratified by region of residence and by ethnicity, two potential indicators of religiosity and conservative views. Individuals living in more-conservative municipalities (the Dutch "Bible Belt") and those from more-conservative ethnicities (Turks, Moroccans, and other non-Western immigrants) have tended to marry significantly more after passage of each of the two laws, consistent with them reclaiming the institution of marriage. In contrast, individuals residing in the more-liberal four largest cities[5] have tended to marry significantly less after passage of each law, which is consistent either with an acceleration in the deinstitutionalization of marriage or with them learning about the availability of an alternative institution.

My findings indicate that neither the legalization of same-sex marriage nor the introduction of registered partnership have had significant negative effects on the Dutch different-sex marriage rate in the aggregate. However, my findings have several limitations. First, I can only estimate the short-term effects of the two laws, given how recently they were enacted. Second, the short-term effect of the same-sex marriage law cannot be separately identified from the longer-term effect of the registered partnership law because of the close timing of the two laws. However, to the extent that these two effects are of the same sign, my results suggest that both are statistically insignificant. Finally, any extrapolation of these results to a different context would need to take into account the social and institutional differences with the Netherlands.

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[5] In order: Amsterdam, Rotterdam, The Hague and Utrecht.

Despite these limitations, this article makes an important contribution to our understanding of marriage behavior and to the same-sex marriage debate by providing the first causal estimates of the short-term effects of same-sex marriage laws on different-sex marriage.

Conceptual Framework

In the standard economic marriage model (Becker 1973, 1974), individuals choose between being in a relationship (which can only take the form of marriage) or not. This model can be extended to include alternative family forms, such as cohabitation or registered partnerships. Any policy or societal change that reduces the benefits of marriage relative to these alternatives would presumably lead to fewer couples marrying.

It is theoretically ambiguous how different-sex couples might change their marriage behavior following the legalization of same-sex registered partnership and of same-sex marriage. On the one hand, the past few decades brought about a "deinstitutionalization of marriage" (Cherlin 2004). This trend is characterized by changing social norms toward an increased acceptance of nontraditional family forms, leading to a declining marriage rate. The introduction of same-sex registered partnership and of same-sex marriage could accelerate the change in social norms and thus the decline in different-sex marriage (Kurtz 2004b).[6] Individuals with different degrees of conservatism or religiousness might respond in potentially different ways to the changing social norms as previous research found a strong relationship between religiosity (or conservatism) and marriage attitudes and behavior (Allgood et al. 2008; Mahoney 2010; Village et al. 2010). In addition, because registered partnership is available to all couples in the Netherlands, different-sex couples have yet another choice of family form that may reduce their incentives to marry.

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[6] Cherlin (2004) specifically mentioned same-sex marriage as an indicator of changing social norms.

It is also possible that the legalization of same-sex registered partnership and of same-sex marriage increases the different-sex marriage rate. The legalization of same-sex marriage can be interpreted an institutionalization of same-sex relationships (Lauer and Yodanis 2010) that could reignite different-sex couples' interest in marriage (Cahill 2004; Mello 2004; Safire 2003). In addition, granting same-sex couples marriage-like benefits, either via marriage or registered partnership, could reduce the pressure on governments and employers to provide cohabiting couples rights similar to those of married couples. This, in turn, could slow the decline in the relative value of marriage (Rauch 2004). Finally, Akerlof and Kranton's (2000) identity theory suggests that some individuals might perceive marriage as an exclusive institution to which only certain couples (specifically, different-sex) have access. The introduction of same-sex registered partnership might make marriage a "purer" institution, but the opening of marriage to same-sex couples could lead to a loss of identity. In response, some different-sex couples could enhance certain behaviors related to marriage (e.g., choosing a religious wedding ceremony) or "act out" (marry more) in order to "reclaim the institution of marriage."

Finally, these theoretical models suggest that any effect of same-sex marriage or registered partnership laws should be observed on new marriages, and particularly first marriages, because most of the marriage-specific social and economic costs are already sunk in existing marriages.[7]

The Dutch Legal Environment

The road to same-sex marriage in the Netherlands was long and bumpy.[8] As early as 1991, Dutch

[7] They also suggest that it might be misleading to examine divorces in the aftermath of same-sex marriage laws. If there is a decline in different-sex marriage, then only couples who have relatively strong reasons to marry would choose to do so, thus reducing the divorce rate.

[8] The presentation in this section draws extensively on Merin (2002) and Curry-Sumner (2006).

gay rights organizations suggested the creation of a symbolic registry that could potentially evolve into an alternative to the marriage registry and to which municipalities would participate voluntarily. More than 100 of the 650 Dutch municipalities decided to participate within the first year. In response, the government set up a committee of legal advisers (the First Kortmann Committee) to inquire into the effects and the desirability of the legal recognition of same-sex couples. The committee recommended a Danish-style partnership, and a bill to that effect was introduced in Parliament in 1993 but was held up because of the 1994 elections. The new governing coalition, which did not include Christian Democrats (the largest party opposing same-sex marriage), suggested a registered partnership open to both same-sex and different-sex couples to avoid discrimination on sexual orientation (Merin 2002). As a result, registered partnership was designed to be an almost perfect substitute to marriage. Waaldijk (2004) compared the rights and obligations from both contracts and found only three differences for different-sex couples. First, the paternity of a child born in different-sex marriage is automatically assigned to the man, but paternity in a registered partnership must be explicitly claimed by the man, although this is rather a formality. Second, although both contracts can be terminated in court, registered partnerships can also be dissolved at the civil registry by mutual agreement.[9] Finally, couples in registered partnerships cannot engage in international adoptions, although this does not prevent one partner from adopting a child as a single individual and the

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[9] Starting from 2001, married couples can change their marriage to a registered partnership. van Huis (2005) reported that more than 90 % of these changes are followed within 12 months by partnership dissolution by mutual agreement, a procedure called “flash divorce.” This is a cheaper alternative to divorce when the parties agree on the division of property. Therefore, I consider only new partnerships in the empirical analysis.

other partner subsequently adopting the child as the partner of the adoptive parent.

There was still an argument that same-sex couples faced discrimination given that they could not marry, and a motion to this effect was introduced in 1996, leading the government to appoint a new panel of experts (the Second Kortmann Committee) to analyze the issue. In the meantime, the registered partnership bill was signed into law and became effective on January 1, 1998.

The Second Kortmann Committee report, released in October 1997, recommended the legalization of same-sex marriage while dismissing the arguments against it, particularly the issue of a possible negative effect on different-sex marriage: “The argument that a large part of the population would no longer be able to identify with marriage if it were opened up applies to an ever diminishing part of society. They can continue to identify with a marriage in church” (Kortmann Commissie 1997, p. 22, author’s translation). The 1998 elections kept the same coalition in power, and an agreement was reached on the introduction of a same-sex marriage bill during that term. That bill was introduced in Parliament in 2000, was approved in September by the lower chamber and in December by the upper chamber, and became effective on April 1, 2001 (Merin 2002).

In conclusion, both same-sex and different-sex couples have been allowed to form registered partnerships since 1998, and same-sex couples have been allowed to marry since 2001. For the purpose of this article, the uncertainty in the timing of the laws makes them exogenous to marriage decisions because individuals could not perfectly anticipate the enactment date of each law and marriages would already be planned by the time the laws were announced.

Aggregate-Level Analysis

Empirical Strategy

Because the two laws apply to all Dutch residents, there is no control group in the Netherlands that provides the counterfactual marriage behavior of Dutch residents in the absence of the laws. At the same time, using a different country as a counterfactual can be problematic because of differences in attitudes toward marriage.[10] In the absence of an obvious control group, Abadie and Gardeazabal (2003) and Abadie et al. (2010) suggested creating a synthetic control: a weighted average of potential "donor" countries such that the averages of the synthetic marriage rate and its determinant variables closely match the corresponding numbers for the Netherlands during the "pre-intervention period" (before the enactment of the registered partnership law).[11]

Specifically, let **X** be a vector of marriage determinants, *m* be the marriage rate, subscript 1 represent the Netherlands, and subscript 0 represent the set of donor countries; $\mathbf{Z}_1 = \left(\bar{\mathbf{X}}_1', \bar{m}_1\right)'$ and $\mathbf{Z}_0 = \left(\bar{\mathbf{X}}_0', \bar{\mathbf{m}}_0\right)'$, where the overbar represents means over the pre-intervention period. The synthetic control is the set of weights that minimize the weighted distance between the pre-intervention averages for the Netherlands and for synthetic Netherlands:

$$\mathbf{W}^*\left(\mathbf{V}\right) = \arg\min \sqrt{\left(\mathbf{Z}_1 - \mathbf{Z}_0\mathbf{W}\right)' \mathbf{V}\left(\mathbf{Z}_1 - \mathbf{Z}_0\mathbf{W}\right)},$$

where **V** is a diagonal matrix of variable loadings. Similar to Abadie et al. (2010), the matrix **V** is chosen so as to minimize the mean squared error in the pre-intervention period:

$$\mathbf{V}^* = \arg\min \sqrt{\left[\mathbf{m}_1 - \mathbf{m}_0\mathbf{W}^*\left(\mathbf{V}\right)\right]'\left[\mathbf{m}_1 - \mathbf{m}_0\mathbf{W}^*\left(\mathbf{V}\right)\right]}.$$

To summarize, the synthetic control is constructed by assigning a set of data-driven

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[10] Belgium is an obvious choice for a control country, but Belgium enacted a registered partnership law in 2000 and a same-sex marriage law in 2003.

[11] Other cross-country studies using the synthetic control method include Billmeier and Nannicini (2013), Cavallo et al. (2010), Lee (2011), and Nannicini and Billmeier (2011).

weights to potential donor countries such that the weighted average of their marriage rates and of their determinant variables closely match the corresponding averages in the Netherlands during the pre-intervention period. These weights are the result of a two-step optimization. In the first step, each variable is assigned a loading, and the country weights are calculated as a function of these loadings to minimize the weighted distance between the synthetic control and the Netherlands. In the second step, the variable loadings are chosen so that the synthetic marriage rate matches the actual marriage rate as closely as possible, and the two steps are repeated until convergence is reached. By using both the determinants of the marriage rate and the pre-intervention marriage rate itself, the synthetic control method takes into account both the observable and the unobservable determinants of the dependent variable, and produces an appropriate counterfactual for the evolution of the marriage rate in the absence of the two laws. See Online Resource 1 for more details.

Data

The list of potential donors includes the 16 OECD member countries that did not enact a registered partnership or same-sex marriage law until 2005 and for which data was available: Australia, Austria, Czech Republic, Greece, Hungary, Ireland, Italy, Japan, Korea, New Zealand, Poland, Portugal, Switzerland, Turkey, the United Kingdom, and the United States.[12] Despite the likely differences between these countries and the Netherlands with respect to the rights offered to unmarried couples, this is arguably the set of countries that are most comparable to the

[12] The Civil Union Act in New Zealand came into effect on April 26, 2005, and the Civil Partnership Act came into effect in the United Kingdom in December 2005.

Netherlands.[13]

The pre-intervention period includes the years 1988–1997. Marriage is measured as the crude marriage rate, defined as the total number of marriages per 1,000 inhabitants.[14] The variables included in the vector of determinants **X** can be classified into three groups. The first group of variables describes the number of people at risk of marriage and the probability that they will meet, or the thickness of the marriage market: the fraction of the population in the 25–44 age group, the fraction of the population living in urban areas, the sex ratio, and the life expectancy of both men and women. The second set of variables characterizes the attractiveness of individuals in the marriage market: the share of girls in total enrollment in secondary and in tertiary education, and total fertility rate. The variables in the third group, the unemployment rate of both men and women in the 25–34 age group and the GDP per capita, describe business cycle fluctuations. Finally, I use the annual growth rate of the marriage rate and the fraction of respondents who agreed with the statement "Marriage is an out-dated institution" in the World Values Survey to account for the long-term trend in the attitude toward the institution of marriage.[15] A list of the data sources for each country is provided in Online Resource 1, Table

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[13] The results are robust to restricting the set of donors to countries presumably more similar to the Netherlands, such as the European OECD member countries.

[14] The ideal measure would use only the population at risk — that is, single individuals legally allowed to marry — but this is not commonly reported by statistical agencies. Figure S1 in Online Resource 1 shows that both measures follow similar patterns in the Netherlands, with smaller relative increases and larger relative declines in the "correct" marriage rate.

[15] The results are robust to the inclusion of additional variables, such as the fraction of the population in the 20–39 age group, the crude birth rate, the share of girls total enrollment in

S1.

The first two columns of Table 1 list the averages of each variable for the Netherlands and for the group of potential donors (the unweighted average) for the period 1988–1997. The relatively large differences for certain variables suggest that the unweighted average of the potential donors might not be an appropriate control group.

Results

The means of all variables for the synthetic control are listed in column 3 of Table 1.[16] In general, they are much closer to the corresponding values for the Netherlands (column 1) than the unweighted averages of potential donors (column 2). Indeed, the largest relative difference between columns 1 and 3 is almost one-half of the largest relative difference between columns 1 and 2. Finally, column 4 lists the loadings rescaled to sum up to 1 and shows that the variables with the largest contribution are mostly related to women and fertility.

In addition to the overall marriage rate, it is interesting to look at the different-sex marriage rate because the arguments in the earlier section on the conceptual framework refer to the behavior of different-sex couples. It could also be argued that what should matter is the rate of unions (i.e., marriages and registered partnerships) rather than just marriages because some different-sex couples might choose registered partnership over marriage if they are perceived as near-perfect substitutes. Note that these three measures of union formation are the same prior to

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primary education, the labor force participation rate of men and women in the 25–34 age group, the inflation rate, and the GDP growth rate.

[16] The weights of each donor country in the synthetic control are listed in Table S2, Online Resource 1. Four countries (in order of their contribution: Austria, Italy, Switzerland, and Australia) account for more than 90 % of the synthetic control.

1998 and that the counterfactual in each case is the same: what the marriage rate would have been in the absence of the two laws.

Figure 1 plots the overall marriage rate in the Netherlands and synthetic Netherlands; Fig. 2 plots the different-sex marriage rate (panel a) and different-sex union rate (panel b) against the same synthetic rate. As expected, the actual rates are relatively close to the synthetic marriage rate between 1988 and 1997, the period used to construct the synthetic control. After the introduction of registered partnership, the three rates are all higher than the synthetic marriage rate, but they all fall below the synthetic rate at some point after 2001, the year in which same-sex marriage was legalized.

To determine the statistical significance of the actual-synthetic difference after 1998, I conduct permutation experiments (Abadie et al. 2010) in which the Netherlands is assigned to the donor pool, one of the donors is considered "treated," and a synthetic control for this new "treated" group is constructed. I restrict the analysis to the donors with a reasonably close fit in the pre-intervention period as measured by mean square prediction errors (MSPE).[17] Figure 3 plots the gaps between the actual and the synthetic rates for the Netherlands (the dark lines) and for the donors with MSPE at most five times (panel a) or twice (panel b) as large as the Netherlands (the gray lines). The gap for the Netherlands is always within the range produced by the permutation tests. In other words, if a random country were picked from this restricted donor pool, the chance of finding an actual-synthetic gap in the post-1998 marriage rate comparable to the one in the Netherlands is 10 % (corresponding to the 10 solid lines in panel a) or 12.57 % (corresponding to the eight solid lines in panel b), levels similar to common statistical tests.

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[17] The mean squared prediction error is the mean squared error of the synthetic marriage rate relative to the actual marriage rate during the pre-intervention period: $MSPE = 1/T_0 \sum_{t=1}^{T_0} \left(m_{1t}^* - m_{1t} \right)^2$.

Therefore, we can conclude that the evolution of the Dutch marriage rate, whether overall or for different-sex couples only, is not statistically different after the enactment of each law from its evolution in the absence of the Dutch laws.[18]

The particular setup of the two laws makes it impossible to separate the long-term effects of the registered partnership law (beyond the first three years) from the short-term effects of the same-sex marriage law. However, if these two laws have an effect on the institution of marriage, it is likely that they act in the same direction (see the section on the conceptual framework). In this case, the results in this section suggest that each of the two effects is insignificant.

Individual-Level Analysis

Empirical Strategy

The individual-level analysis mirrors the aggregate analysis by estimating the effect of the two laws on the probability of marriage. In particular, I confine the analysis to never-married individuals and thus to first marriages because previously married individuals are likely to attribute a value to marriage that might not be influenced by changes in its definition.[19] The baseline specification is

$$P\left(m_{is}=1\middle|m_{is-1}=0\right)=h\left(\mathbf{X}_{is}RP_{s},RPSM_{s};\theta_{i}\right),\qquad(1)$$

where m_{is} is an indicator for individual i marrying during year s, and $\mathbf{X}_{is}$ is a vector of observable and potentially time-varying characteristics. The main variables of interest are RP_s, a dummy variable for the period following the registered partnership law (1998–2000), and $RPSM_s$ for the period following the same-sex marriage law (2001–2005). This model has the structure of a

[18] Online Resource 1 details a second type of test that confirms this conclusion.

[19] This is not restrictive: Fig. S3 shows that the variation in the total number of marriages is driven by the variation in the number of first marriages.

discrete-time duration model with first marriage as the event, $h(\cdot)$ as the hazard function, and age at first marriage as duration. Formally, let T_i be the random variable representing the age at first marriage age of individual i, t be the age of individual i in year s, and a_i be the last observed age of the individual, all measured in full years at the end of year s. As in several other studies (e.g., Nickell 1979; Ham and Rea 1987), the hazard function $h(\cdot)$ is assumed to have the following logit form:

$$h\left(\mathbf{X}_{is}, RP_s, RPSM_s; \theta_i\right) = P\left(T_i = t \middle| T_i \geq t\right) = h_i\left(t;\theta_i\right) = \frac{1}{1+\exp\left\{-y_i\left(t;\theta_i\right)\right\}}, \quad (2)$$

where

$$y_i\left(t;\theta_i\right) = \theta_i + \mathbf{X}'_{is}\beta + RP_s\lambda_1 + RPSM_s\lambda_2 + s\lambda_3 + \gamma\left(t\right), \quad (3)$$

s represents a linear trend; θ_i captures the unobserved characteristics of the individual and follows a discrete distribution with two mass points, $\overline{\theta}_1$ and $\overline{\theta}_2$ (Heckman and Singer 1984); and $\gamma(\cdot)$ represents duration dependence, the common way age influences the probability of marriage for any given person.[20]

The two coefficients of interest, λ_1 and λ_2, capture the effects of each law on the age-

[20] The most flexible form of duration dependence, a step function, leads to identification problems when unobserved heterogeneity is also modeled nonparametrically (Narendranathan and Stewart 1993). Eberwein et al. (2002) argued that the actual functional form does not influence the results as long as it is flexible. Based on their suggestion, I add higher-order terms in ln(t), $t = age - 17$, until they become insignificant. This procedure yields a fourth-order polynomial, which produces almost identical estimates to a specification with a full set of age dummy variables in a model without unobserved heterogeneity (available upon request).

specific conditional probability in the corresponding period as compared with the period before 1998, measured as deviations from the long-term trend in the marriage rate.[21] The identifying assumption is that the two laws have only *level* effects (i.e., they do not change the trend in the marriage rate), and thus the marriage behavior before 1998 is an appropriate counterfactual for the marriage behavior in the absence of the two laws after the long-term trend is taken into account.[22] This assumption is inherently untestable, but two arguments can be made to support it. First, as discussed later, the data cover a relatively short period (1995–2005), thus making a change in the long-term trend in the marriage rate less likely. Second, if the pre-1998 marriage behavior is an appropriate counterfactual for the post-1998 marriage behavior, then the actual pre-1998 marriage rate and the synthetic post-1998 marriage rate (as constructed in the preceding section) should be similar. This is confirmed by Fig. S4 in Online Resource 1, which shows that the 1998–2000 and 2001–2005 synthetic marriage rates are almost parallel to the pre-1998 marriage rate.

Finally, the likelihood function for a sample of N individuals is

$$L = \prod_{i=1}^{N} \left[P\left(T_i = a_i\right) \right]^{\delta_i} \left[P\left(T_i > a_i\right) \right]^{1-\delta_i},$$

where δ_i equals 1 if person i is observed to marry and 0 otherwise, a_i is the last observed age of

[21] An effect on the propensity to marry at every age during a particular period leads to an effect on the marriage rate in that particular period. To facilitate the comparison with the results in the section on aggregate-level analysis, I will loosely interpret the coefficients in Eq. (3) as effects on the marriage rate for the rest of the discussion.

[22] A more flexible approach with a nonlinear trend or with different slopes in each period would overfit the variation in the marriage rate over such a short period.

the individual, and

$$P\left(T_i = a_i\right) = \sum_{k=1}^{2} \left\{ \pi_k h_i\left(a_i;\overline{\theta}_k\right) \prod_{t=18}^{a_i-1} \left[1 - h_i\left(t;\overline{\theta}_k\right)\right] \right\},$$

$$P\left(T_i > a_i\right) = \sum_{k=1}^{2} \left\{ \pi_k \prod_{t=18}^{a_i} \left[1 - h_i\left(t;\overline{\theta}_k\right)\right] \right\}.$$

A random sample of never-married individuals (a stock sample) oversamples individuals who prefer to marry late and produces biased estimates, a situation known as the "initial conditions problem." Therefore, the likelihood function should be maximized in a flow sample of individuals (i.e., a sample of individuals who become at risk of marriage during the sample period).

Data

I construct the data using 10 waves (1996–2005) of the restricted version of the Dutch Labor Force Survey (*Enquête Beroepsbevolking*, *EBB*) and the January 2006 snapshot of the confidential Dutch Municipal Records (*Gemeentelijke Basis Administratie*, *GBA*). The EBB is an annual cross-sectional survey of the population aged 15 years and older. It includes information on educational attainment, ethnicity, and other demographic and labor market characteristics at the time of the interview, as well as a unique identification number that can be used to match individuals to other data sets maintained by Statistics Netherlands. The combined 10 waves of the survey contain almost 950,000 individuals, approximately 6 % of the average Dutch population between 1995 and 2005. To increase the probability that the highest educational level reported does not change over the sample period, I keep from the EBB only those individuals at least age 20 during the interview year.[23] Using the unique identification number, these individuals are matched to their marriage and residence history for the entire 1995–2005 period provided in the GBA.[24] The resulting longitudinal data set includes information on ethnicity, marital status, and residence over the entire period, as well as educational attainment and school enrollment at the time of the EBB interview. Finally, the data is augmented with the yearly unemployment rate at the regional level.[25]

As in the aggregate-level analysis, the control variables measure the attractiveness of an individual on the marriage market (five-year age cohort, education, and ethnicity), the thickness of the market (location of residence, level of urbanization, and ethnicity), business cycle fluctuations (regional unemployment rate), and the trend in the view on the institution of marriage (linear trend). Time is measured in calendar years because of how certain variables (such as the regional unemployment rate) are measured. Moreover, the strong seasonal pattern in

[23] About 15 % of the sample was still enrolled in school at the time of the survey (approximately 9 % full-time and 6 % part-time). A small fraction of these individuals were enrolled in a lower level than their highest level completed (e.g., persons with a college degree in science enrolled in professional business courses). In these cases, I used the highest of the two levels. A complete picture of the Dutch education system is shown in Fig. S7, Online Resource 1.

[24] For example, the marital status and residence of a person interviewed for the EBB in 2004 at age 24 is observed from age 15 (in 1995) until age 25 (in 2005). However, this person can marry only after she turns age 18 (in 1998).

[25] The Netherlands is divided into 12 provinces: Drenthe, Flevoland, Friesland, Gelderland, Groningen, Limburg, Noord-Brabant, Noord-Holland, Overijssel, Utrecht, Zeeland, and Zuid-Holland.

marriages within a calendar year suggests that marriage decisions are commonly based on the calendar year (see Figure S5 in Online Resource 1). Age is measured in full years at the end of the calendar year (so that individuals who turn age 18 during the year are included in the sample), residence is measured at the beginning of the year (under the assumption that most marriage decisions are made in advance), and the regional unemployment rate is measured as the calendar-year average.

This data set has three limitations. First, there is no difference in the recording of same-sex and different-sex marriages. Second, I have no information on individuals not interviewed for the EBB, particularly the spouses of individuals in the sample. Finally, the coding of addresses changed over time and has been aggregated at the street-number level since 2003. As a result, identifying the spouse of all individuals is virtually impossible, and I am unable to distinguish between same-sex marriages and different-sex marriages. This induces a small upward bias in the estimate of the different-sex marriage rate after 2001.[26]

As discussed earlier, the empirical analysis requires a flow sample. However, the sample cannot be restricted only to individuals who turn age 18 between 1995 and 2005 because of the increasingly high average age at first marriage in the Netherlands (from 29.6 for men and 27.4 for women in 1995 to 32.4 and 29.7 in 2005, respectively). Instead, I include all individuals who are first observed at an age such that the probability of having never married is close to 1. Based on the aggregate distribution of Dutch marriages by age, this yields the intervals 18–24 for men and 18–22 for women, which account for about 10 % of first marriages between 1995 and 2005,

[26] Same-sex marriages represent less than 2 % of all marriages over the period 2001–2005.

respectively.[27]

I conduct the analysis separately by gender because women tend to marry earlier than men and are more likely to marry previously married opposite-sex partners. This also implies that there is no one-to-one relationship between marriages in the sample of men and in the sample of women. The final sample includes 70,718 men and 53,883 women, for which descriptive statistics are listed in Table 2.[28]

Compared with the numbers in Table 1, the average person in the sample is younger than the average person in the population, with an average age at first marriage around 27 years for men and 25 years for women. Consequently, only 26.29 % of men and 33.30 % of women married during the sample period (see also the Kaplan-Meier estimates in Online Resource 1, Fig. S6). The distribution of education is skewed toward higher levels of education, mostly professional degrees, but with relatively more male university graduates, consistent with the shares of girls in secondary and tertiary education in Table 1. Approximately 83 % of the sample are natives and almost 8 % are Western immigrants from Europe (except Turkey), North America, Oceania, Japan, and Indonesia. Immigrants from potentially more-conservative areas such as the predominantly Muslim Turkey and Morocco, or from Aruba and Suriname, account

[27] Although a relatively small number of the individuals in the flow sample married by the end of the sample period, the coefficients of interest measure the variation in the marriage propensity of individuals of the same age before and after the enactment of each law.

[28] All the statistics and the subsequent analysis use sample weights. These weights are constructed by rescaling the weights provided in the EBB to represent the probability of interview relative to the entire sample of 10 waves, assuming that the population structure does not change significantly during the study period.

for about 6 % of both men and women. The fraction of the sample living in an urban area when first observed is slightly lower than in the population. One explanation is that single people tend to move to cities, where the marriage markets are thicker, but (married) couples tend to move out of the cities, where housing is cheaper (Gautier et al. 2010).

The individual-level data allow me to exploit the geographic heterogeneity with respect to attitudes toward marriage. One area of interest is the group of the four largest cities (Amsterdam, The Hague, Rotterdam, and Utrecht), which have relatively low rates of fertility, marriage, and church attendance, but high rates of divorce and nonmarital birth. A second area is the so-called Dutch Bible Belt (*De Bijbelgordel*), a group of municipalities with relatively high rates of church participation and fertility and low rates of cohabitation, divorce, and nonmarital births (de Jong 2003; Sobotka and Adigüzel, 2002). I include in the Bible Belt the municipalities where the four conservative Christian parties participating in the 1998 election to the lower chamber of the Dutch Parliament obtained more than 20 % of the votes.[29] The 32 municipalities in the Bible Belt are listed in Table S3, and the two areas of interest are highlighted on the map in Fig S8 of Online Resource 1.

As expected, a significantly larger fraction of individuals in the Bible Belt marry compared with the sample average (43.13 % of men and 52.44 % of women, compared with 26.29 % and 33.30 %, respectively), while the opposite holds for the individuals in the four

[29] Based on data from the Dutch Electoral Council (*de Kiesraad*). The four parties are the Reformatory Political Federation (*Reformatorische Politieke Federatie, RPF*), the Reformed Political Party (*Staatkundig Gereformeerde Partij, SGP*), the Reformed Political League (*Gereformeerd Politiek Verbond, GPV*) and the Catholic Political Party (*Katholiek Politieke Partij, KPP*). They obtained 5.17 % of the votes at the national level and won 8 of 150 seats.

largest cities (20.99 % and 24.64 %, respectively). Similarly, marriages contracted in the Bible Belt represent a disproportionately high fraction in the total number of marriages (almost 7 %). These statistics confirm that the four largest cities are some of the more-liberal areas in the Netherlands, while the Bible Belt municipalities include the more-conservative areas. In the rest of the analysis, I include indicators for residence in one of these two areas among the control variables.

Results

I first estimate a model without unobserved heterogeneity. The estimation results are listed in columns 1 and 3 of Table 3. I then estimate the model with unobserved heterogeneity, shown in columns 2 and 4. Note that only coefficient ratios can be compared across specifications because changing the distribution of unobserved heterogeneity changes the variance normalization of coefficients in logit models (Mroz and Zayats 2008; Nicoletti and Rondinelli 2010).

As expected, the decline in the marriage rate is attributed to the two laws in models that do not control for unobserved heterogeneity (columns 1 and 3).[30] The estimates show a drop in the marriage probability in each of the two periods for both men and women. After the unobserved heterogeneity is taken into account (columns 2 and 4), the estimates suggest that there is no

[30] Suppose that there are two types of individuals: type-A individuals, who want to marry young; and type-B individuals, who want to marry late. Over time, individuals who marry will exit the sample, and these will predominantly be type-A individuals. As a result, the sample will include an increasingly disproportionate number of type-B individuals at any age. Because type-B individuals are less likely to marry at any age than are type-A individuals, age-specific marriage rates will decrease over time. If unobserved heterogeneity is ignored, this decline is then incorrectly attributed to the two laws.

negative change in the marriage behavior of individuals after the enactment of each law, with the exception of young women after the same-sex marriage law. Even in the latter case, the decline in the marriage probability relative to the long-term trend is less than one-half than in models that do not control for unobserved heterogeneity. The first-marriage behavior of young Dutch should be expected to be more volatile than in the aggregate analysis, particularly for women. If most of the variation in the number of marriages is due to first marriages, the relative change in the first-marriage rate will be larger because the denominator is smaller (only never-married individuals). Still, young women seem to be more responsive than men to changes in their environment, with larger relative increases and declines in their marriage hazard relative to the long-term trend.[31]

In other results worth noting, most of the patterns in the explanatory variables do not change with the inclusion of unobserved heterogeneity. Not surprisingly, the estimates indicate a negative long-term trend in the marriage rate and a negative effect of economic downturns via the unemployment rate. The relationship between education and marriage varies by sex, being almost an inverted-U shape for men, consistent with male hypogamy (men "marrying down"), and an almost linearly decreasing relationship for women, consistent with female hypergamy (women "marrying up").[32] Finally, the estimates suggest that certain groups have higher or lower propensities to marry irrespective of gender. For instance, immigrants from Turkey and Morocco

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[31] The difference in the estimates is entirely driven by the oldest cohort of women (21 and 22 years old in 1995). After these observations are excluded, all the results are qualitatively similar for both men and women.

[32] In both cases, the omitted category is "senior vocational," an intermediate level between "general secondary" and "higher professional."

or from other non-Western countries as well as individuals residing in the Bible Belt are more likely to marry than natives. On the other hand, immigrants from a Western country or from Suriname and Aruba are less likely to marry, as are individuals living in urban areas, especially in the four largest cities. These patterns suggest that the marriage behavior of these groups could be affected differently by the two laws.

Heterogeneous Effects

To take into account the geographic differences in marriage behavior, I modify the hazard function in Eq. (3) as follows:

$$y_i\left(t;\theta_i\right) = \theta_i + \mathbf{X}'_{is}\beta + \gamma\left(t\right) + \sum_j \left(RP_s D_{is}^j \lambda_1^j + RPSM_s D_{is}^j \lambda_2^j + s D_{is}^j \lambda_3^j\right), \qquad (4)$$

where *j* represents one of the three regions defined earlier (Dutch Bible Belt, four largest cities, rest of the Netherlands), D_{is}^j is a dummy variable for individual *i* residing in region *j* at the beginning of year *s*, and the other variables are the same as before. In this specification, λ_1^j represents the change in the propensity to marry after the enactment of the registered partnership law among individuals living in regions *j* relative to the period 1995–1997 in that same region, and λ_2^j measures the corresponding effect for the same-sex marriage law. Finally, λ_3^j measures the long-term trend in the age-specific marriage rate in region *j*.

The results are listed in Table 4 and indicate that individuals in the Bible Belt have the highest baseline tendency to marry and the slowest-declining long-term trend among the three groups, while people in the four largest cities have the lowest baseline marriage probability and the fastest-declining long-term trend. The response to the two laws is also markedly different across the three regions. The marriage rate increases in the Bible Belt after the registered partnership law and then even more after the same-sex marriage law. For example, the increase in the marriage rate of men after the legalization of same-sex marriage is about 9 times the year-to-year variation in their marriage rate over the sample period. In contrast, individuals in the four largest cities marry less after the registered partnership law and even less after the same-sex marriage law. The decline in their marriage rate after the same-sex marriage law is about twice as large as the yearly decline in their marriage rate. Finally, individuals living in the rest of the country marry more after the registered partnership law and then return to their long-term trend after the same-sex marriage law, similar to the overall results I present in the preceding section.

Next, I study the marriage behavior of individuals of different ethnicities.[33] The hazard function has the same form as in Eq. (4), where *j* now represents one of the five ethnic groups (Dutch natives, Western immigrants, Surinamese/Arubans, Turks/Moroccans, other non-Western immigrants) and D_i^j is a dummy variable for individual *i* being of ethnicity *j*. The coefficients of interest have a similar interpretation as before but with respect to ethnicity *j*.

Table 5 presents the results. Relatively more-conservative men (Turks/Morrocans, Surinamese/Arubans, and other non-Western immigrants) marry more after the registered partnership law and then at least as much after the same-sex marriage law. For instance, the marriage rate of Turkish and Moroccan men increases by approximately 3.5 times the yearly variation in their marriage rate over the sample period after the legalization of same-sex marriage. The marriage behavior of Dutch natives and Western immigrants, on the other hand,

[33] Table S4 in Online Resource 1 shows various measures of religiosity for individuals of different ethnicities extracted from the World Values Survey and from the Longitudinal Internet Studies for the Social sciences. The table shows that Turks, Moroccan, Arubans, Surinamese, and individuals of non-Western descent are on average more conservative than native Dutch or individuals of Western descent.

tends to be similar to that of the overall population, with a marriage rate around or higher than its long-term trend after the registered partnership law and then falling after the same-sex marriage law. For example, the marriage rate of Western immigrant men falls by almost the same amount as the yearly decline in their marriage rate after the same-sex marriage law. For women, all immigrant ethnic groups experience an increase in their marriage hazard after the registered partnership law and decline slightly after the same-sex marriage law while remaining above the long-term trend. Finally, native Dutch women show a pattern similar to the overall results.

These results indicate significant variation in the response to the two laws. The presumably conservative individuals residing in the Bible Belt or of non-Western ethnicities seem to be affected by each law and have marriage probabilities significantly above their long-term trend in each period, consistent with them "reclaiming the institution of marriage" along the lines of Akerlof and Kranton's (2000) identity theory. Presumably liberal individuals, such as those living in the four largest cities, marry less after the introduction of each law (although this effect is not always statistically significant), consistent either with an acceleration in the deinstitutionalization of marriage or with them learning about the availability of an alternative institution.[34]

Conclusions

This article contributes to the same-sex marriage debate by providing the first causal estimates to the question of whether opening the institution of marriage to same-sex couples would have negative consequences on the institution of marriage, particularly for different-sex couples. I focus on the Netherlands, the first country to legalize same-sex marriage (in 2001). Overall, I do

[34] Boele-Woelki et al. (2007) reported case studies of cohabiting couples entering registered partnership after being informed of its existence and its similarity to marriage.

not find evidence of negative effects from the legalization of same-sex marriage or from the introduction of registered partnership. However, the response to the two laws varies across regions and ethnicities, with potentially more-conservative individuals marrying statistically significantly more after each law and presumably more-liberal individuals marrying increasingly less (although not always statistically significant) after passage of each of the two laws. These patterns provide suggestive evidence in support of some of the theories of marriage behavior presented earlier.

There are three caveats to the present study. First, any analysis to date can provide information only on the short-term effects of the two laws because of their recent enactment. Second, it is practically impossible to separate the short-term effect of the same-sex marriage law from the longer-term effect of the registered partnership law because of the timing of the two laws. Because the two effects plausibly have the same sign, my results suggest that both are statistically insignificant. Finally, any extrapolation of the results needs to take into account the social and institutional differences between other countries and the Netherlands. Despite these limitations, I believe my analysis makes an important contribution to our understanding of marriage behavior and to the same-sex marriage debate.

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Table 1 Descriptive statistics and loadings for the variables used in the synthetic control method

	Mean, 1988–1997			Variable Loading
	Netherlands	Potential Donors	Synthetic Netherlands	
	(1)	(2)	(3)	(4)
Crude Marriage Rate	5.83	6.45	5.91	
Population, Age 25–44 (%)	32.32	29.57	30.37	0.000
Urban Population (%)	70.87	69.08	70.44	0.034
Sex Ratio	0.99	0.97	0.97	0.000
Life Expectancy, Men (years)	74.26	71.58	73.49	0.012
Life Expectancy, Women (years)	80.21	78.13	79.88	0.000
Girls Share in Secondary Education (%)	47.54	48.58	47.64	0.250
Girls Share in Tertiary Education (%)	46.56	47.99	46.44	0.239
Fertility Rate	1.57	1.75	1.57	0.281
Unemployment Rate, Men Aged 25–34 (%)	5.67	6.98	5.74	0.036
Unemployment Rate, Women Aged 25–34 (%)	8.17	8.94	8.34	0.039
GDP per Capita	19,583.48	15,017.01	20,315.45	0.017
View on the Marriage Institution	21.20	13.53	14.73	0.000
Growth Rate of Marriage Rate	–0.01	–0.01	–0.01	0.092

Notes: Columns 1–3 show the mean of the corresponding variables over the period 1988–1997, with the exception of the marriage views variable, which is averaged over 1988–2000 for the donor countries. Column 2 includes simple averages of the countries in the donor group, and column 3 includes weighted averages using the weights produced by the synthetic control method. Column 4 lists variable loadings (the diagonal elements of matrix **V**), rescaled to sum to 1.

Table 2 Summary statistics

	Men (%)	Women (%)
First Marriages		
%	26.29	33.30
Average age (years)	27.37	25.25
	(2.97)	(2.96)
Censored Observations		
%	73.71	66.70
Average age (years)	28.19	26.96
	(3.70)	(3.23)
Birth Cohort		
1970–1974	41.04	23.79
1975–1979	39.54	51.19
1980–1984	18.43	23.79
1985–1989	0.99	1.23
Education		
Primary education	4.24	3.03
Secondary vocational	16.83	12.95
General secondary	6.83	7.10
Senior vocational	39.88	39.85
Higher professional	23.16	28.39
College	9.05	8.67
Ethnicity		
Natives	83.11	82.85
Western immigrants	7.71	7.80
Turks/Moroccans	3.21	3.43
Surinamese/Arubans	3.01	3.26
Other non-Western immigrants	2.97	2.66
Residence in Urban Area at Entry Into Sample	62.86	63.79
Four Largest Cities		
Residence at entry into sample	10.23	10.55
Percentage of total marriages	12.11	12.03
Percentage of residents marrying	20.99	24.64
Bible Belt		
Residence at entry into sample	4.35	4.35
Percentage of total marriages	6.93	6.66
Percentage of residents marrying	43.13	52.44
Number of Individuals	70,717	53,799

Notes: Never-married individuals aged 18–22 (men) or 18–24 (women) in 1995 or who turned age 18 between 1996 and 2005. All statistics are weighted using sample weights.

Table 3 Discrete-time duration model for age at first marriage

	Men (N = 70,717)		Women (N = 53,799)	
	(1)	(2)	(3)	(4)
Period 1 (1998–2000)	–0.016	0.032	–0.038**	0.054**
	(0.012)	(0.014)	(0.013)	(0.014)
Period 2 (2001–2005)	–0.048**	0.002	–0.180**	–0.078**
	(0.018)	(0.019)	(0.018)	(0.020)
Linear Trend (1995 = 0)	–0.039**	–0.040**	–0.028**	–0.028**
	(0.003)	(0.003)	(0.003)	(0.004)
Education (omitted category: Senior vocational)				
Primary education	–0.264**	–0.121**	0.009	0.532**
	(0.011)	(0.018)	(0.012)	(0.022)
Secondary vocational	–0.060**	0.037**	0.092**	0.379**
	(0.006)	(0.009)	(0.007)	(0.011)
General secondary	–0.348**	–0.509**	–0.272**	–0.427**
	(0.010)	(0.013)	(0.009)	(0.013)
Higher professional	–0.166**	–0.333**	–0.395**	–0.688**
	(0.006)	(0.008)	(0.006)	(0.008)
University	–0.171**	–0.393**	–0.642**	–1.096**
	(0.008)	(0.011)	(0.010)	(0.013)
Ethnicity (omitted category: Natives)				
Western immigrants	–0.148**	–0.165**	–0.192**	–0.161**
	(0.009)	(0.012)	(0.009)	(0.013)
Turks/Moroccans	1.278**	2.312**	1.616**	2.867**
	(0.010)	(0.017)	(0.010)	(0.018)
Surinamese/Arubans	–0.145**	–0.069**	–0.321**	–0.152**
	(0.014)	(0.021)	(0.016)	(0.024)
Other non-Western	0.144**	0.238**	–0.005	0.177**
	(0.014)	(0.019)	(0.016)	(0.023)
Unemployment Rate	–0.027**	–0.027**	–0.017**	–0.016**
	(0.002)	(0.002)	(0.002)	(0.002)
Urban Indicator	–0.154**	–0.178**	–0.227**	–0.311**
	(0.005)	(0.006)	(0.005)	(0.007)
Bible Belt	0.767**	1.106**	0.705**	1.080**
	(0.009)	(0.013)	(0.009)	(0.014)
Four Largest Cities	–0.236**	–0.361**	–0.259**	–0.355**
	(0.007)	(0.009)	(0.007)	(0.010)
Unobserved Heterogeneity	No	Yes	No	Yes
Log-Likelihood / 1,000	–983.130	–978.405	–872.522	–863.108

Notes: Sample of never-married individuals aged 18–24 (men) or 18–22 (women) in 1995 or who turned age 18 between 1996 and 2005. All specifications include five-year birth cohort dummy variables and a fourth-degree polynomial in ln(age – 17) and are weighted using sample weights. The unobserved heterogeneity term is drawn from a discrete distribution with two mass points.

**p < .01

Table 4 Discrete-time duration model for age at first marriage, by location

	Bible Belt	Four Largest Cities	Rest of the Netherlands
	(1)	(2)	(3)
Men (N = 70,717, Log-Likelihood / 1,000 = –978.205)			
Main effect	1.041**	–0.130**	–
	(0.023)	(0.022)	
Period 1 (1998–2000)	0.250**	–0.101**	0.080**
	(0.024)	(0.029)	(0.014)
Period 2 (2001–2005)	0.308**	–0.114**	0.034
	(0.025)	(0.043)	(0.020)
Linear trend (1995 = 0)	–0.033**	–0.055**	–0.040**
	(0.005)	(0.006)	(0.003)
Women (N = 53,799, Log-Likelihood / 1,000 = –862.592)			
Main effect	1.086**	0.004	–
	(0.023)	(0.022)	
Period 1 (1998–2000)	0.388**	–0.037	0.085**
	(0.026)	(0.030)	(0.015)
Period 2 (2001–2005)	0.440**	–0.359**	–0.030
	(0.028)	(0.046)	(0.021)
Linear trend (1995 = 0)	–0.051**	–0.051**	–0.027**
	(0.005)	(0.006)	(0.004)

Notes: Discrete-time duration model with unobserved heterogeneity for age at first marriage using a sample of never-married individuals aged 18–24 (men) or 18–22 (women) in 1995 or who turned age 18 between 1996 and 2005. All specifications include a fourth-degree polynomial in ln(*age* – 17); the regional unemployment rate; and dummy variables for five-year birth cohort, ethnicity, education and residence in an urban area. All specifications are weighted using sample weights. The unobserved heterogeneity term is drawn from a discrete distribution with two mass points.

**$p < .01$

Table 5 Discrete-time duration model for age at first marriage, by ethnicity

	Natives	Western Immigrants	Turks/ Moroccans	Surinamese/ Arubans	Other Non-Western
	(1)	(2)	(3)	(4)	(5)
Men (*N* = 70,717, Log-Likelihood / 1,000 = –977.941)					
Main effect	—	–0.040	2.648**	0.373**	0.151**
		(0.029)	(0.028)	(0.046)	(0.051)
Period 1 (1998–2000)	–0.018	0.133**	0.446**	0.418**	0.346**
	(0.014)	(0.038)	(0.040)	(0.062)	(0.065)
Period 2 (2001–2005)	–0.054**	–0.047	0.621**	0.671**	0.292**
	(0.020)	(0.059)	(0.067)	(0.096)	(0.097)
Linear trend (1995 = 0)	–0.025**	–0.056**	–0.185**	–0.194**	–0.063**
	(0.003)	(0.008)	(0.010)	(0.013)	(0.012)
Women (*N* = 53,799, Log-Likelihood / 1,000 = –861.873)					
Main effect	—	0.087**	3.131**	0.976**	0.886**
		(0.030)	(0.028)	(0.042)	(0.045)
Period 1 (1998–2000)	–0.003	0.281**	0.461**	0.237**	0.091
	(0.015)	(0.040)	(0.040)	(0.062)	(0.064)
Period 2 (2001–2005)	–0.141**	0.275**	0.247**	0.226	–0.267
	(0.021)	(0.061)	(0.071)	(0.103)	(0.107)
Linear trend (1995 = 0)	–0.007	–0.108**	–0.128**	–0.260**	–0.133**
	(0.004)	(0.008)	(0.010)	(0.014)	(0.014)

Notes: Discrete-time duration model with unobserved heterogeneity for age at first marriage using a sample of never-married individuals aged 18–24 (men) or 18–22 (women) in 1995 or who turned age 18 between 1996 and 2005. All specifications include a fourth-degree polynomial in ln(*age* – 17); the regional unemployment rate; and dummy variables for five-year birth cohort, ethnicity, education and residence in an urban area. All specifications are weighted using sample weights. The unobserved heterogeneity term is drawn from a discrete distribution with two mass points.
**$p < .01$

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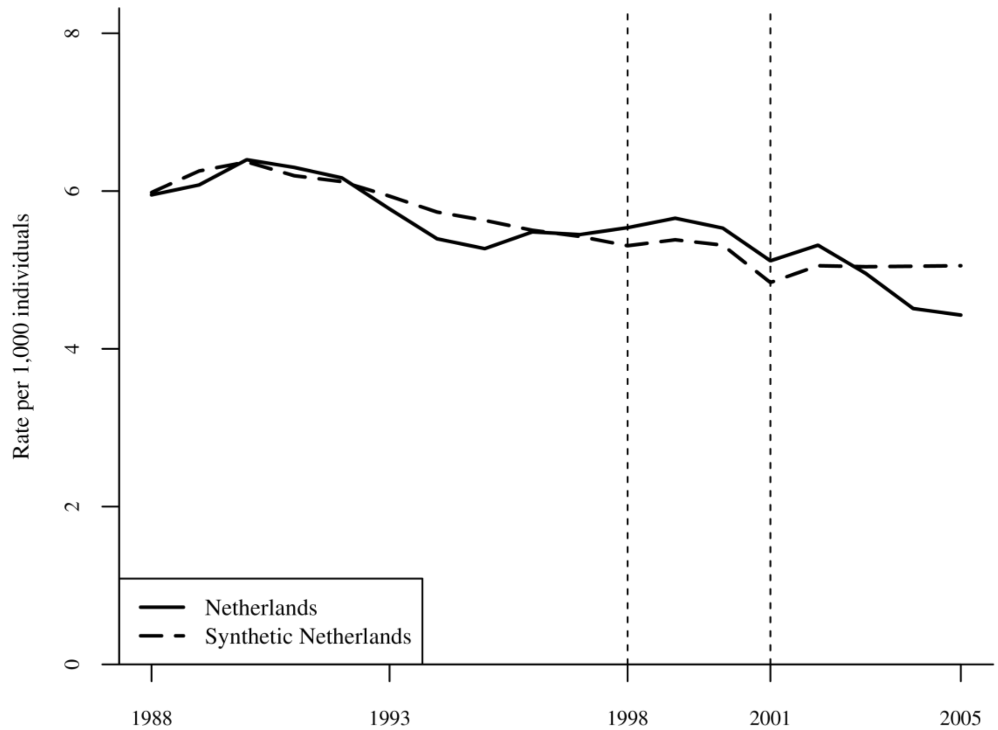
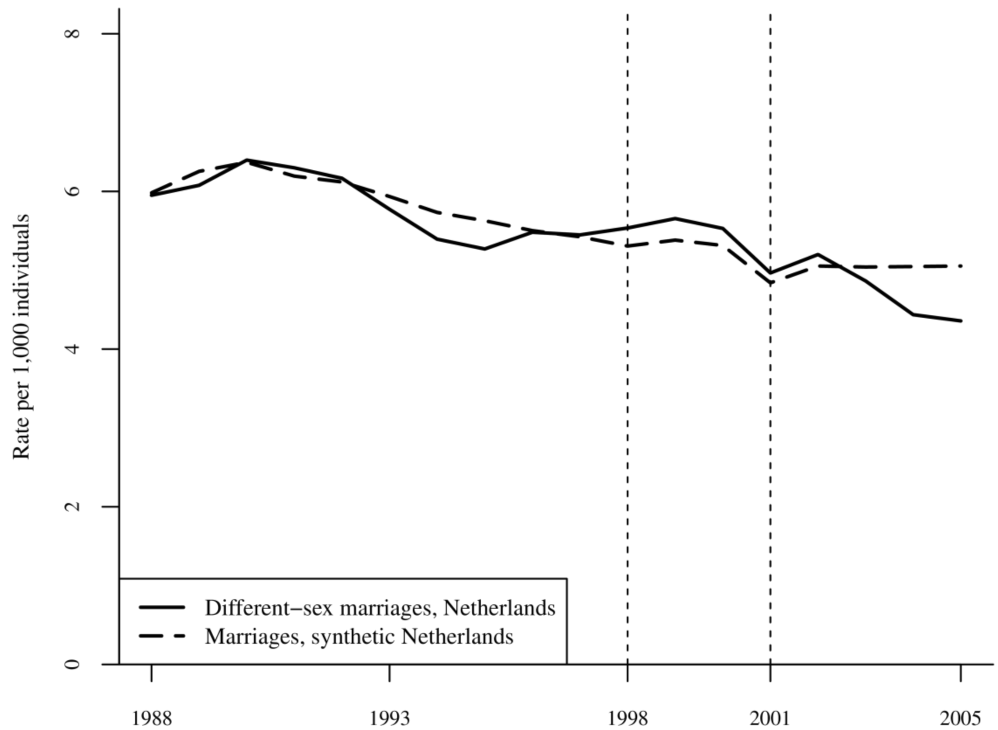
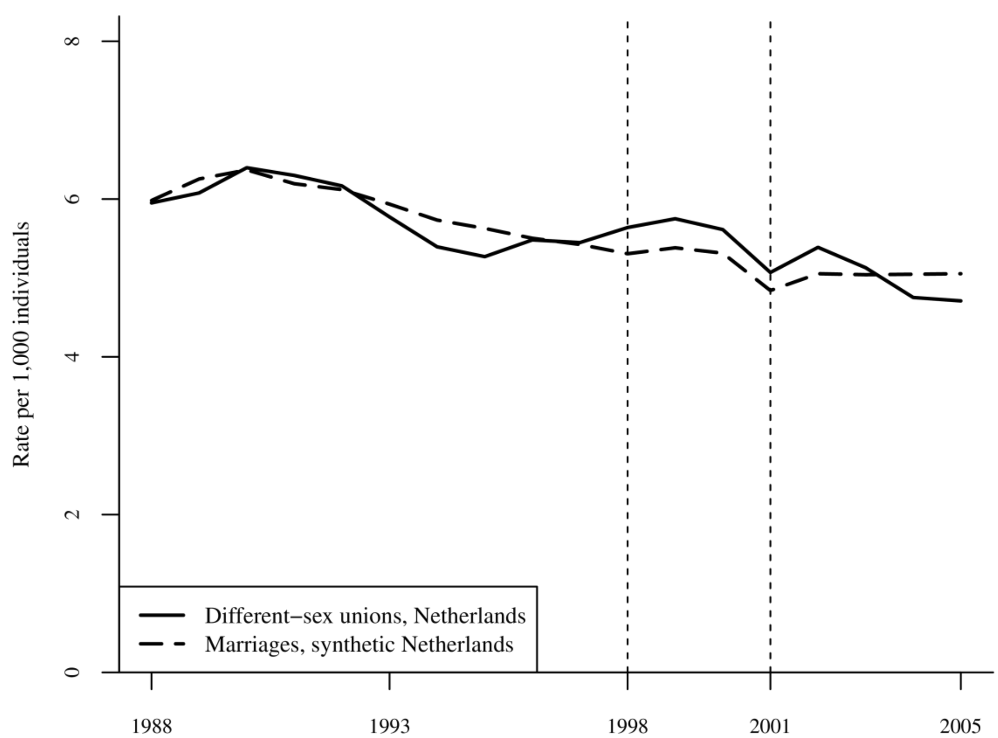


Fig. 1 Evolution of marriage rate in the Netherlands and in the synthetic control

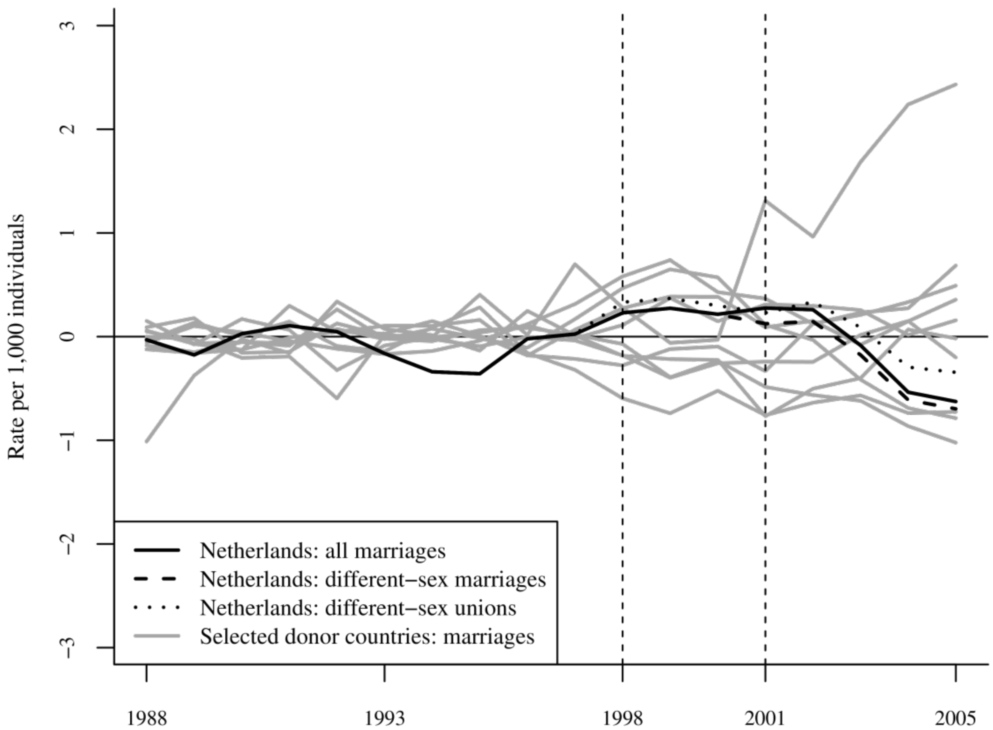


(a) Different-sex marriage rate

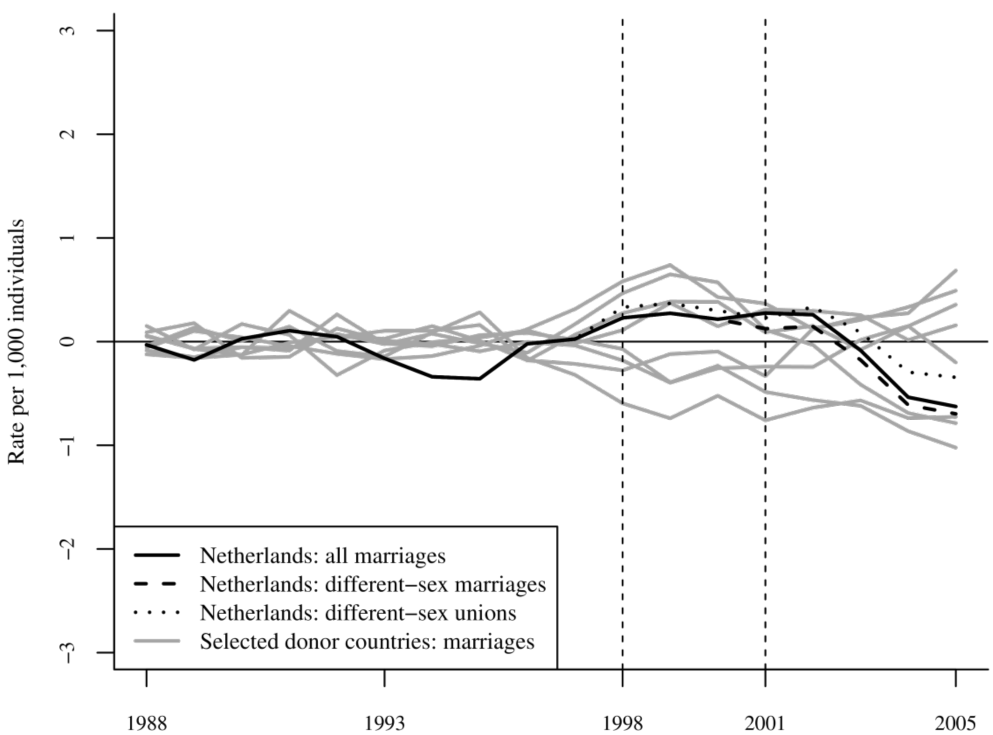


(b) Different-sex unions rate

Fig. 2 Alternative measures of different-sex union formation



(a) At most five times the MSPE of the Netherlands



(b) At most two times the MSPE of the Netherlands

Fig. 3 Comparison of actual-synthetic marriage rate differences

Online Resource 1

The Effect of Same-Sex Marriage Laws on Different-Sex Marriage: Evidence From the Netherlands

Mircea Trandafir

A1. The synthetic control method

As in Abadie et al. (2010), let subscript 1 indicate the Netherlands and $\mathbf{W} = (w_2, \dots, w_{J+1})$ be the vector of weights assigned to the J potential donor countries. Without any restrictions on the weights, a sufficiently large number of potential donor countries and of determinant variables will lead to a synthetic control that matches perfectly the evolution of the marriage rate in the Netherlands prior to the introduction of the two laws. However, weights outside the [0,1] interval are difficult to interpret and imply out-of-sample inference. Hence, the weights are restricted to lie in the unit interval ($0 \leq w_j \leq 1$ for all j) and to sum up to one ($\sum_{j=2}^{J+1} w_j = 1$), which results in a synthetic control that will likely not match perfectly the trend in the marriage rate before the two laws.

For the synthetic control, the marriage rate $\mathbf{m}_1^*$ and its determinants $\mathbf{X}_1^*$ are calculated as weighted averages of the corresponding variables in the donor countries:

$$m_{1t}^* = \sum_{j=2}^{J+1} w_j m_{jt} \qquad \qquad \mathbf{X}_{1t}^* = \sum_{j=2}^{J+1} w_j \mathbf{X}_{jt}$$

Let T_0 be the number of available periods before 1998 and let the vector $\mathbf{K} = (k_1, \dots, k_{T_0})$ define a linear combination of the pre-1998 marriage rates for any country i:

$$\overline{m}_i^K = \sum_{t=1}^{T_0} k_t m_{it}.$$

Now consider M such linear combinations for the Netherlands: $\bar{m}_1^{K_1}, \dots, \bar{m}_1^{K_M}$, and define $\mathbf{Z}_1 = \left(\mathbf{X}_1', \bar{m}_1^{K_1}, \dots, \bar{m}_1^{K_M}\right)'$ as the vector obtained by combining the determinants of the marriage rate prior to 1998 and these M linear combinations of the pre-1998 marriage rate in the Netherlands. Next, consider the matrix $\mathbf{Z}_0$ constructed by combining similar vectors for the J potential donors, such that the j-th column of $\mathbf{Z}_0$ is $\left(\mathbf{X}_j', \bar{m}_j^{K_1}, \dots, \bar{m}_j^{K_M}\right)'$, where $\mathbf{X}_j$ is the set of determinants of the marriage rate prior to 1998 in country j.

In principle, the linear combinations $(K_1, \dots, K_M)$ are arbitrary. In practice, Abadie et al. (2010) suggest choosing $M = 1$ and $k_t = \frac{1}{T_0}$, which produce average marriage rates over the period before the intervention:

$$\bar{m}_i = \frac{1}{T_0} \sum_{t=1}^{T_0} m_{it}.$$

The vector of data for the Netherlands becomes $\mathbf{Z}_1 = (\mathbf{X}_1', \bar{m}_1)'$ and the corresponding matrix $\mathbf{Z}_0$ for the donor countries has columns of the form $\left(\mathbf{X}_j', \bar{m}_j\right)'$ for the j-th donor country.

Given this structure of the $\mathbf{Z}$ matrices, let $\mathbf{V}$ be a diagonal matrix of loadings corresponding to all the variables (both the determinants $\mathbf{X}$ and the marriage rate m). The optimal set of weights is the one that minimizes the weighted distance between $\mathbf{Z}_1$ and $\mathbf{Z}_0$:

$$\mathbf{W}^*(\mathbf{V}) = \operatorname{argmin} \sqrt{(\mathbf{Z}_1 - \mathbf{Z}_0\mathbf{W})'\mathbf{V}(\mathbf{Z}_1 - \mathbf{Z}_0\mathbf{W})}.$$

The matrix $\mathbf{V}$ can be arbitrary, but a natural choice is the one that minimizes the mean squared error of the marriage rate in the synthetic control relative to the actual marriage rate in the Netherlands (Abadie et al., 2010):

$$\mathbf{V}^* = \operatorname{argmin} \sqrt{[\mathbf{m}_1 - \mathbf{m}_0\mathbf{W}^*(\mathbf{V})]'[\mathbf{m}_1 - \mathbf{m}_0\mathbf{W}^*(\mathbf{V})]},$$

where $\mathbf{m}_1$ is the $(T_0 \times 1)$ vector containing the marriage rate in the Netherlands and $\mathbf{m}_0$ is the $(T_0 \times J)$ matrix of marriage rates of the potential donors in the pre-intervention period. This ensures that the marriage rate in the synthetic control constructed using the resulting weights $\mathbf{W}^*(\mathbf{V}^*)$ is the best match to the marriage rate in the Netherlands in the period before 1998.

Abadie et al. (2010) suggest two ways to gauge the statistical significance of the actual-synthetic difference in the post-intervention period. The first is the type of permutation tests conducted in section 4.3. The second is to use the ratio of post- to pre-intervention $MSPE$ for the full sample of donors. Appendix Figure A2 plots the distribution of this ratio when the post-intervention is 1998–2000, after the introduction of registered partnership (panel a) or 2001–2005, after the legalization of same-sex marriage (panel b). In both cases, the pre-intervention period is 1988–1997. The Netherlands finds itself in the middle of the distribution in both graphs. The interpretation of these graphs is that if the intervention, registered partnership law or same-sex marriage law, were assigned randomly to a country in the sample, the probability of observing a pre-post relative difference in the marriage rate at least as large as in the Netherlands would be approximately 35%, corresponding to 6 countries (5 donors and the Netherlands) out of 16 having a $MSPE$ ratio as high as the Netherlands, both in the case of the registered partnership law and in the case of the same-sex marriage law. In the case of the different-sex marriage rate, the probability is the same, 35%, while in the case of different-sex unions, the probability is 23% for the period 1998–2000 and 41% for the period 2001–2005. If the post-intervention period is the entire 1998–2005, the probability is approximately 41% for all three measures. These probabilities are higher than the standard significance levels used in statistical tests, suggesting once again that the evolution of the Dutch marriage rate (overall or only different-sex) after the enactment of the two laws was not statistically different from its evolution in their absence.

Table S1: Data sources, aggregate analysis

	Marriage rate[1]	Pop. 25-44	Urban pop.	Sex ratio[2]	Age at first marriage[3]	Life expect.	Share of girls in education	Fertility rate	Unemp. rate	GDP per capita[4]	Marriage views[5]
Netherlands	CBS	E	WDI	WDI	E	OECD	WBES	OECD	OECD	OECD	WVS
Australia	ABS	ABS	WDI	WDI	ABS	OECD	WBES	OECD	OECD	OECD	WVS
Austria	E	E	WDI	WDI	E	OECD	WBES	OECD	OECD	OECD	WVS
Czech Republic	E	E	WDI	WDI	E	OECD	WBES	OECD	OECD	OECD	WVS
Greece	E	E	WDI	WDI	E	OECD	WBES	OECD	OECD	OECD	WVS
Hungary	E	E	WDI	WDI	E	OECD	WBES	OECD	OECD	OECD	WVS
Ireland	E, CSO	E	WDI	WDI	E	OECD	WBES	OECD	OECD	OECD	WVS
Italy	E	E	WDI	WDI	E	OECD	WBES	OECD	OECD	OECD	WVS
Japan	MH, JS	JSB	WDI	WDI	MH	OECD	WBES	OECD	OECD	OECD	WVS
Korea	KNS	KNS	WDI	WDI	KNS	OECD	WBES	OECD	OECD	OECD	WVS
New Zealand	SNZ	SNZ	WDI	WDI	SNZ	OECD	WBES	OECD	OECD	OECD	WVS
Poland	E	E	WDI	WDI	E	OECD	WBES	OECD	OECD	OECD	WVS
Portugal	E	E	WDI	WDI	E	OECD	WBES	OECD	OECD	OECD	WVS
Switzerland	E	E	WDI	WDI	E	OECD	WBES	OECD	OECD	OECD	WVS
Turkey	TSI	E	WDI	WDI	E	OECD	WBES	OECD	OECD	OECD	WVS
United Kingdom	E, ONS	E	WDI	WDI	ONS	OECD	WBES	OECD	OECD	OECD	WVS
United States	SA, VS	ICE	WDI	WDI	CPS	OECD	WBES	OECD	OECD	OECD	WVS

Notes: 1. Number of marriages per 1,000 residents, average population. 2. Ratio of fraction female population to total population. 3. Average age at first marriage among 18–65 year-old population (with the exception of Australia, Austria and the United States, who provide the median age at first marriage). 4. Expenditure approach, US$, constant prices, constant PPPs, OECD base year 1995. 5. Fraction of people who agree with the statement "marriage is an out-dated institution;" in order to ensure the most coverage, I use data from the first two waves of the World Values Survey (1989–1991 and 1995–1998), with the exception of Greece, for which data is only available from the third wave (1999). Abbreviations: E = Eurostat, OECD = OECD database, WDI = World Development Indicators, WBES = World Bank Education Statistics, CBS = Statistics Netherlands, ABS = Australian Bureau of Statistics, CSO = Irish Central Statistics Office, MH = Ministry of Health, Labour and Welfare of Japan, JS = Japan Statistical Yearbook, JSB = Statistics Bureau Japan, KNS = Korea National Statistical Office, SNZ = Statistics New Zealand, TSI = Statistical Indicators 1923-2009 of Turkey, ONS = UK Office for National Statistics, SA = Statistical Abstract of the US, VS = Vital Statistics of the US (CDC), CPS = Census Bureau estimates from the Current Population Survey, ICE = Intercensal estimates.

Table S2: Donor weights in the synthetic control for the Netherlands

Country	Weight	Country	Weight
Australia	0.164	Korea	0.002
Austria	0.338	New Zealand	0.029
Czech Republic	0.006	Poland	0.003
Greece	0.001	Portugal	0.003
Hungary	0.003	Switzerland	0.200
Ireland	0.001	Turkey	0.037
Italy	0.209	United Kingdom	0.001
Japan	0.001	United States	0.002

Table S3: Municipalities included in the Bible belt

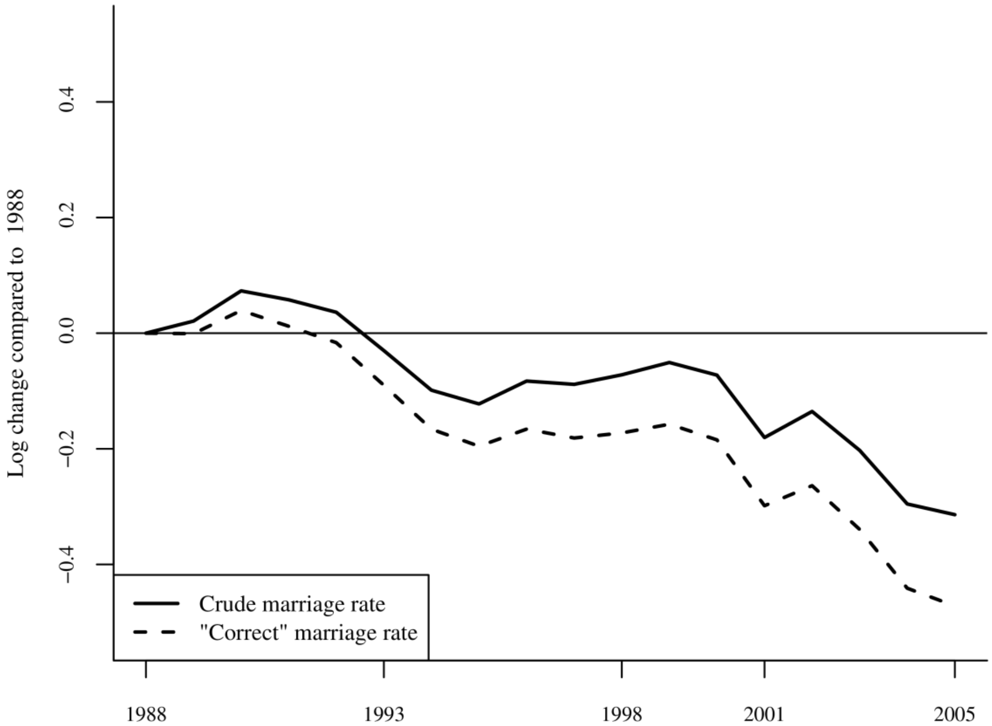
Municipality	Votes for conservative parties (%)	Municipality	Votes for conservative parties (%)
Urk	66.50	Brakel[6]	31.74
Genemuiden[1]	52.52	Tholen	31.70
Staphorst	50.07	Barneveld	31.09
Rijssen[2]	48.58	Hasselt[1]	28.95
Bunschoten	43.10	Liesveld	28.12
Kesteren[3]	39.09	Middelharnis	27.99
Ijsselmuiden[4]	38.39	Sliedrecht	25.34
Oldebroek	37.92	Katwijk	25.32
Nieuw-Lekkerland	37.54	Zederik	24.03
Hardinxveld-Giessendam	37.37	Scherpenzeel	23.99
Kerkwijk[5]	36.79	Ouderkerk	23.93
Nunspeet	36.47	Veenendaal	23.71
Aalburg	34.96	Woudenberg	23.55
Goedereede	34.72	Putten	22.18
Elburg	33.99	Korendijk	21.50
Reimerswaal	33.67	Echteld[7]	21.33
Graafstroom	32.31	Zevenhuizen-Moerkapelle	20.71
Dirksland	31.75	Ede	20.63

Notes: Share of votes in the 1998 election to the lower-chamber of the Dutch Parliament received by the four conservative Christian parties (the Reformatory Political Federation—*Reformatorische Politieke Federatie*, RPF; the Reformed Political Party—*Staatkundig Gereformeerde Partij*, SGP; the Reformed Political League—*Gereformeerd Politiek Verbond*, GPV; and the Catholic Political Party—*Katholiek Politieke Partij*, KPP). 1. Included in Zwartewaterland starting from 1/1/2001. 2. Included in Rijssen-Holten starting from 3/15/2003. 3. Included in Neder-Betuwe starting from 4/1/2003. 4. Included in Kampen starting from 1/1/2001. 5. Included in Zaltbommel starting from 01/01/1999. 6. Included in Zaltbommel starting from 1/1/1999. 7. Included in Neder-Betuwe starting from 01/01/2002.

Table S4: Degree of religiosity of different ethnicities

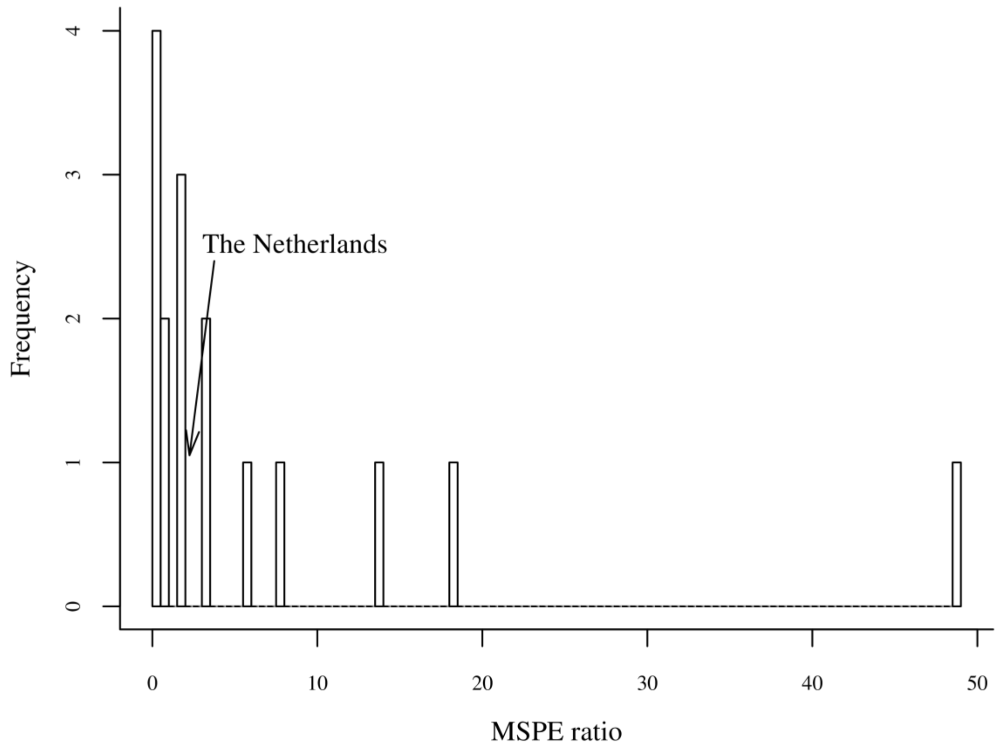
	Netherlands	Turkey	Morocco	Antilles (Aruba)	Suriname	Western countries	Non-Western countries
A. Importance of religion in life – World Values Survey, 4th wave (1999-2004)							
Very important	16.7	80.8	94.3	--	--	25.5	66.1
Rather important	20.7	12.7	4.8			29.9	17.7
Not very important	34.8	3.9	0.7			26.8	10.3
Not at all important	27.8	2.6	0.1			17.8	6.0
No. of observations	1,002	4,601	2,263			51,145	39,590
No. of countries	1	1	1			40	26
B. Importance of religion in life – World Values Survey, 2nd wave (1989-1993)							
Very important	22.1	61.2	--	--	--	22.7	46.3
Rather important	21.7	23.0				26.3	23.3
Not very important	27.3	10.6				29.8	15.2
Not at all important	28.9	5.2				21.2	15.2
No. of observations	1,013	1,018				44,891	13,187
No. of countries	1	1				32	8
C. Frequency of attending religious gatherings (other than special occasions such as weddings and funerals) – Longitudinal Internet Studies for the Social sciences, wave 1 (January and April 2008)							
At least once a month	16.5	37.5	31.8	40.0	25.0	11.3	27.7
Only on special religious days or less often	27.5	50.0	31.8	40.0	75.0	37.9	31.9
Never	56.0	12.5	36.4	20.0	0.0	50.8	40.4
Observations	7,151	40	22	5	4	124	47
D. Frequency of prayer (other than when attending religious gatherings) – Longitudinal Internet Studies for the Social sciences, wave 1 (January and April 2008)							
At least once a month	31.1	61.0	68.2	60.0	50.0	31.1	52.1
Only on special religious days or less often	19.1	24.4	18.2	20.0	25.0	23.0	10.4
Never	49.9	14.6	13.6	20.0	25.0	45.9	37.5
Observations	7,132	41	22	5	4	122	48

Notes: Each cell represents the percentage of respondents within the column who agree with the statement represented on the row. The World Values Survey is run in different countries and column headings refer to the country of residence of the respondent for Panels A and B. The Longitudinal Internet Studies for the Social sciences is a survey run among Dutch residents and column headings refer to the ethnicity of the respondent for panels C and D.

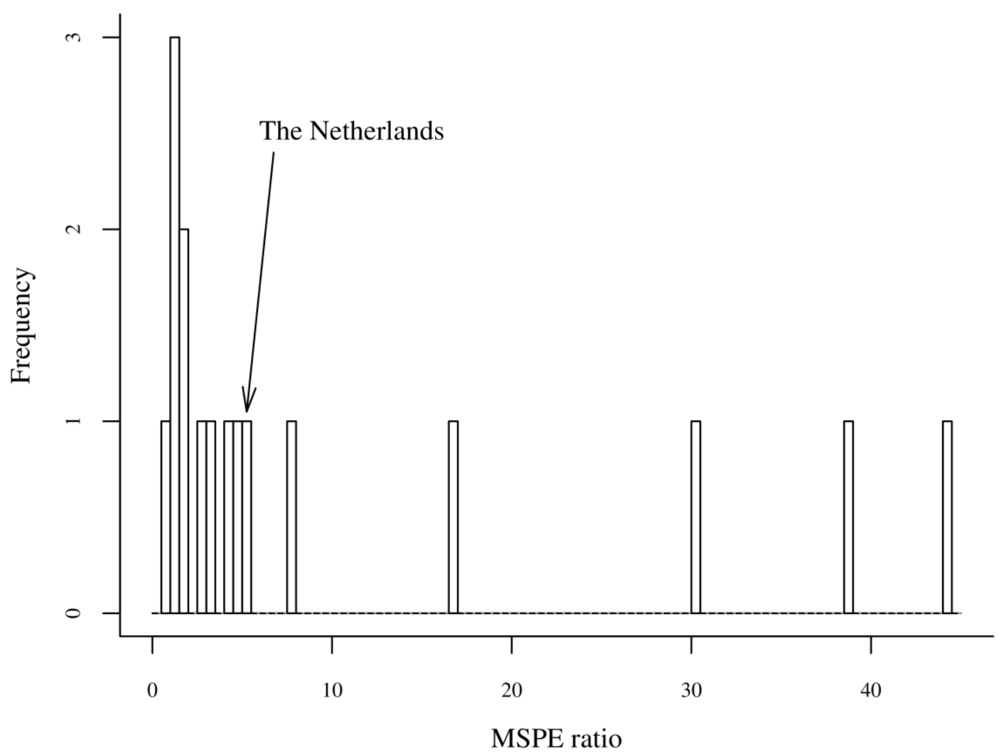


Notes: The crude marriage rate is defined as the number of different-sex marriages per 1,000 individuals. The “correct” marriage rate is measured as the number of different-sex marriages per 1,000 single individuals 18 years- old or older. The lines represent the change in each indicator with respect to 1988 on a logarithmic scale, using data on different-sex marriages from Statistics Netherlands over the period between 1988–2005.

Figure S1: Evolution of two measures of the marriage rate in the Netherlands



(a) Post-intervention period: 1998–2000 (after the registered partnership law)



(b) Post-intervention period: 2001–2005 (after the same-sex marriage law)

Figure S2: Ratio of post/pre-intervention MSPE, Netherlands and full sample of donors

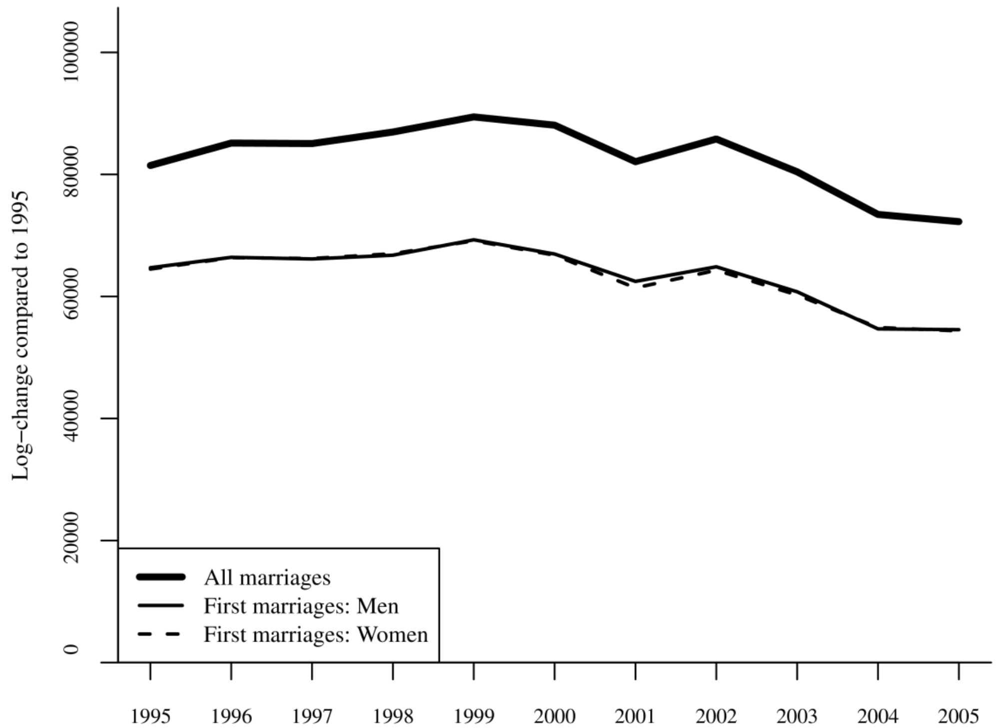


Figure S3: The evolution of all marriages and first marriages for one of the spouses

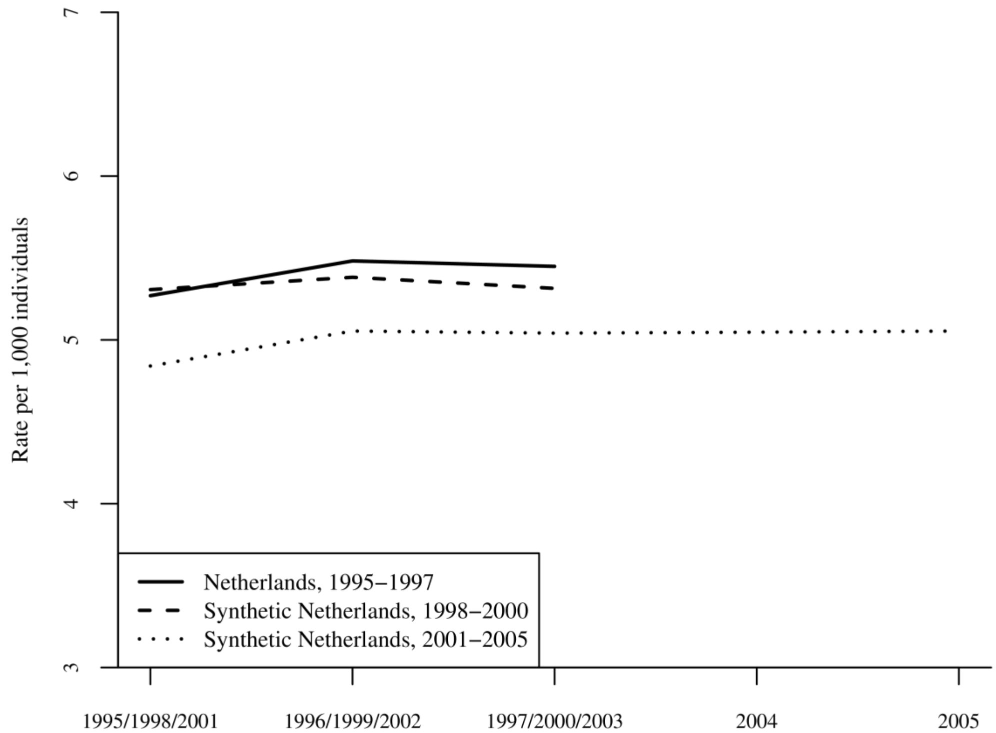


Figure S4: Comparison of counterfactuals, pre- and post-interventions

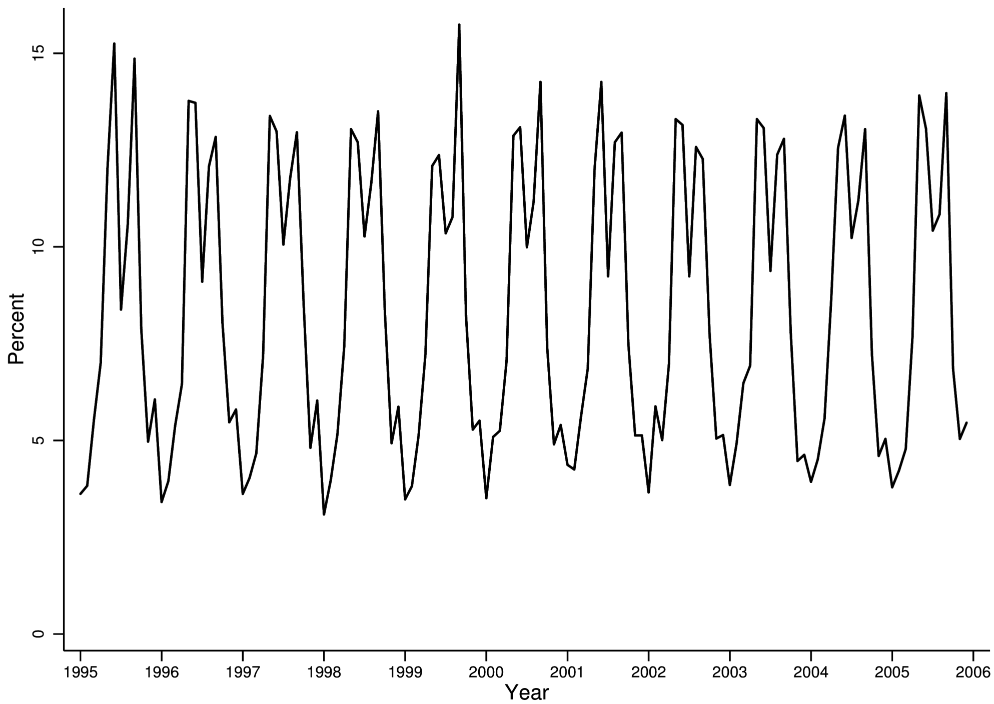


Figure S5: The seasonal pattern of marriages in the Netherlands

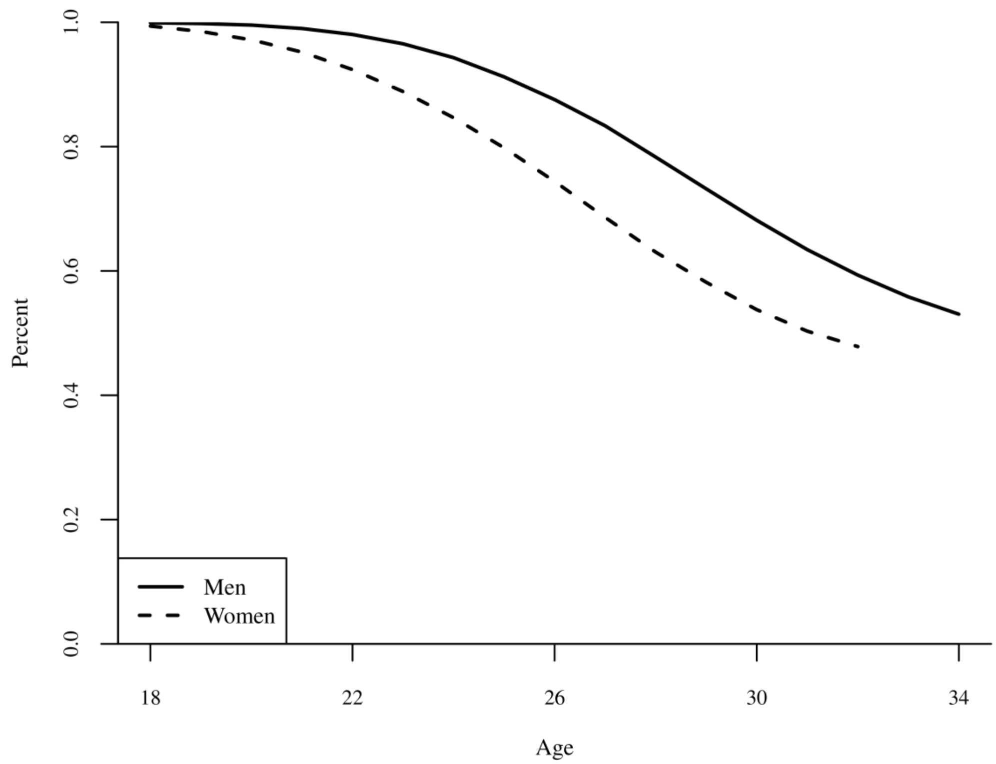
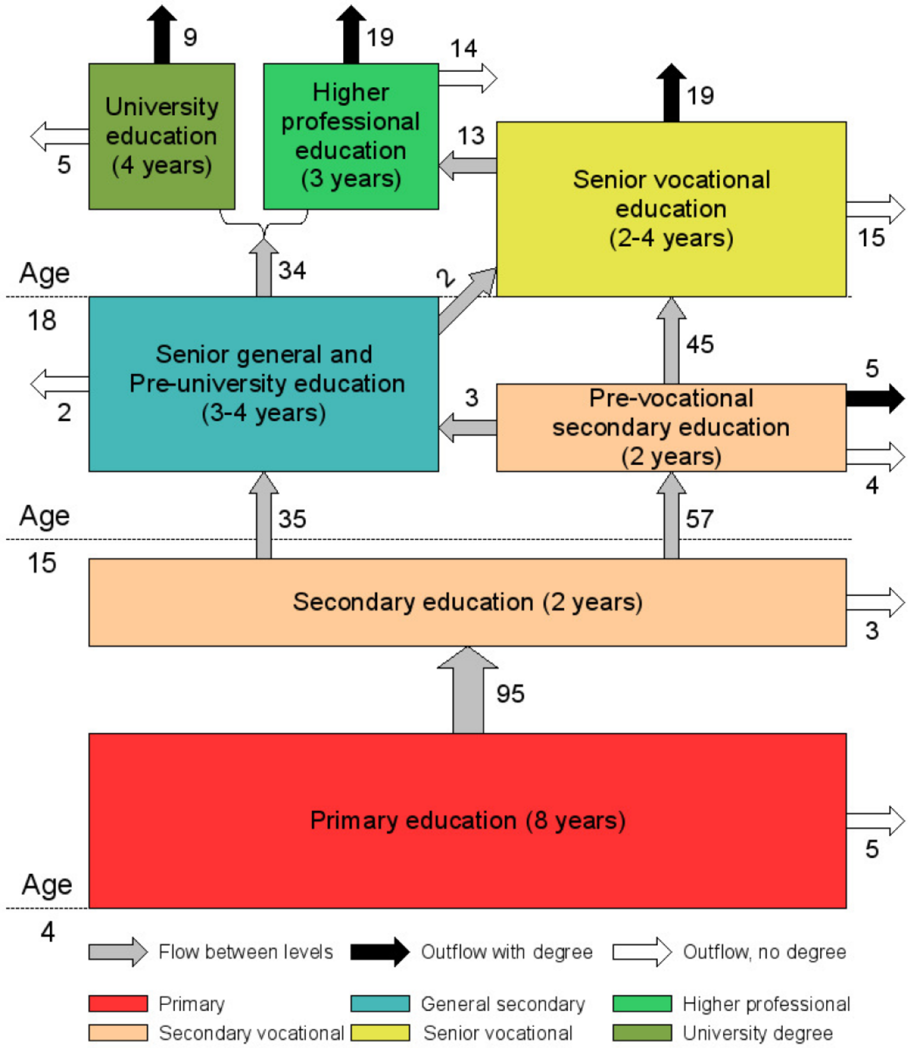


Figure S6: Kaplan-Meier estimates of the survival function (the probability of being single, by age)



Note: Numbers next to arrows represent percentages of a cohort.
Source: Dutch Ministry of Education and Science (2003)

Figure S7: The education system in the Netherlands and the definition of different levels of educational attainment

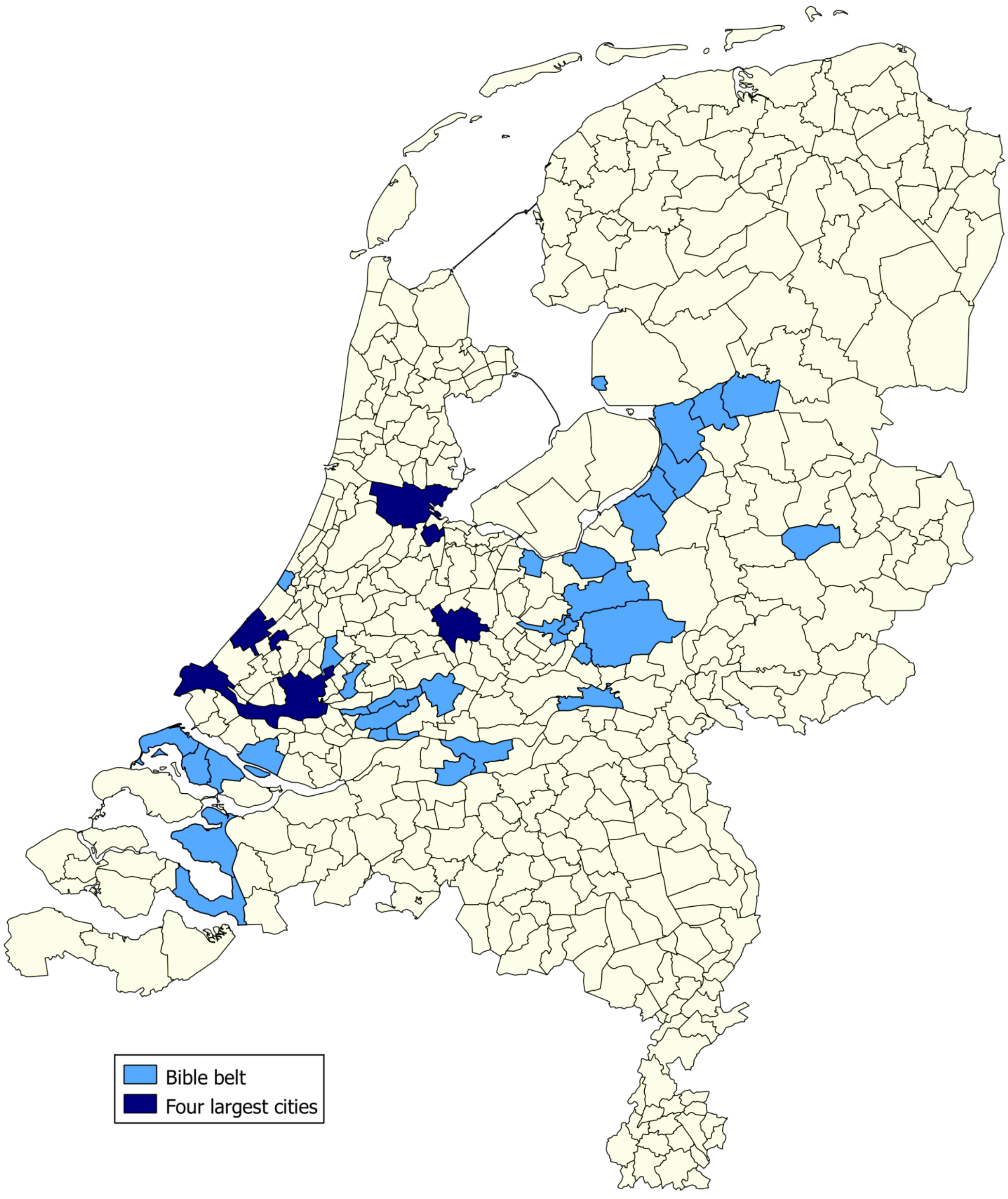


Figure S8: The four largest cities and the Bible-belt municipalities