Marriage and Divorce: The Role of Unemployment Insurance*

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Abstract

We study the interplay of risk sharing at the household level and the unemployment insurance system. To quantify the importance of spousal insurance for marriage and divorce decisions, we exploit a German labor market reform that tightened unemployment benefit means-testing and thus provides exogenous variation in the need for risk sharing. We show that treatment intensity varies with nationality. To compute reform effects on marital surplus and stability, we combine a marriage market matching model, differences-in-differences estimation, and the German marriage and divorce registers. In line with matching theory, we find that intermarriage became significantly less attractive due to the increased exposure to unemployment risk. We explore the role of factors that potentially affect both labor and marriage market outcomes, such as language, and find that our results are robust. Lastly, we find that the stability of marriages formed despite the reform increased, which is consistent with a better selection of couples.

Keywords: Marriage, Divorce, Household Risk Sharing, Unemployment Insurance, Labor Market Reform, Intermarriage
JEL Classifications: J10, J12, J15, J64, J65

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1 Introduction

Living in a union with another individual is beneficial for many reasons. Besides the emotional value of companionship and love, economic motives matter for partner choice, too. First, economies of scale and household specialization increase joint consumption and utility (Muellbauer, 1977; Becker, 1981; Grossbard-Shechtman, 1984). Second, the family facilitates risk sharing: a working spouse provides insurance against income shocks, e.g. due to unemployment or sickness (Lundberg, 1985; Cullen and Gruber, 2000; Shore, 2010). Both motives represent sources of economic rents that generate a *marital surplus*. This surplus governs marriage and divorce decisions in modern theories of the marriage market (e.g., Bruze et al., 2015; Goussé et al., 2017; Gayle and Shephard, 2019).

While a thriving literature analyzes household consumption choices, sharing rules, and welfare empirically,[1] relatively little is known about the quantitative importance of household-level risk sharing. Most existing studies either focus on time-series correlations between marriage, divorce, and unemployment rates at the macro level[2] or on associations between unemployment and marital instability at the micro level.[3] We provide a complementary study that exploits both variation in the exposure to unemployment risk and a social security reform to identify the effect of within-household insurance on marital surplus. A key insight underlying our identification strategy is that insurance against income shocks is not exclusively provided at the household level. The social insurance system is a substitute. The value of this substitute varies over time as social policies change, altering the demand for within-household insurance. In theory, this changes marital surplus and, thus, influences marriage and divorce decisions.

Our laboratory to test this mechanism is a reform of the German unemployment insurance (UI) system. UI is a substitute for spousal insurance because generous unemployment benefits limit the dependence on the partner upon job loss. Marital surplus is

[1] Blundell et al. (1994), Pesaran and Wickens (1999), and Chiappori and Mazzocco (2017) are excellent surveys of this literature. Lise and Seitz (2011), Browning et al. (2013), and Cherchye et al. (2015) are examples of recent contributions.

[2] A common finding in this literature is that marriage and divorce rates are pro-cyclical, that is, they decrease in recessions. Correlations with the unemployment rate are typically negative (Amato and Beattie, 2011; Hellerstein and Morrill, 2011; Schaller, 2013; González-Val and Marcén, 2017a,b). Wang (2019) studies joint job search decisions of couples in a life-cycle model with risk sharing. Using US micro data, she finds that gender differences in the cyclicality of unemployment can be explained by household-level risk sharing.

[3] Based on Danish and Norwegian micro data, Jensen and Smith (1990) and Hansen (2005) suggest that unemployment is an important contributing factor to marital instability.

higher because the partner's income stream is less volatile in expectation. Conversely, if unemployment benefits are low or means-tested against the partner's income, shocks have to be absorbed within the household and marital surplus is lower.

In January 2003, the "Hartz I"[4] reform—the first of four labor market reform packages implemented in Germany between 2003 and 2005—sharply tightened the means testing of long-term unemployment assistance against the partner's income. This element of the reform increased the demand for within-household insurance and, thus, made individuals who are exposed to unemployment risk less attractive in the marriage market. Note that in 2003, the German unemployment rate was 10% with an increasing trend, see Figure 1.

To evaluate the reform's effect on the marriage market, we first study the variation of unemployment risk at the individual level. We estimate how labor market transition probabilities correlate with different observable characteristics using process-generated social security data from the Federal Employment Agency. We find that nationality is a quantitatively important determinant of unemployment risk, even conditional on education, gender, time, and region. The job-loss hazard rate for native Germans is 24% lower compared to non-German workers.

In the main part of our empirical analysis, we estimate the effects of the Hartz I labor market reform on marital surplus and stability in a differences-in-differences framework. Based on our finding that non-German nationality increases unemployment risk, we define marriages between German citizens and spouses of foreign nationality.[5] These *intermarriages* are on average more exposed to unemployment risk and form our treatment group. We verify the composition of this group in a number of robustness checks.

We have access to the universe of legal marriages[6] and divorces in Germany between 1997 and 2013.[7] Using these population registers, we have sufficient numbers of observations even in narrowly defined age-nationality cells. To the best of our knowledge, this is the first paper in the family economics literature that uses these data.

[4]The so-called "Hartz reforms" were named after the chairman of the commission that proposed the reforms, Peter Hartz, who was at that time director of human resources at Volkswagen. We provide more details on the reforms in Section 2.

[5]Note that our definition is based on citizenship and not ethnicity. In related research, Caucutt et al. (2018) use a comparable empirical design to investigate to what extent racial differences in marriage market outcomes in the U.S. are explained by high unemployment and incarceration rates of black men.

[6]The nature of these data restricts our analysis to legally-married heterosexual couples, although the idea of insurance within the household similarly applies to cohabiting and same-sex couples.

[7]These data are compiled by the statistical offices of the 16 federal states based on information from the civil registry offices and divorce courts, respectively.

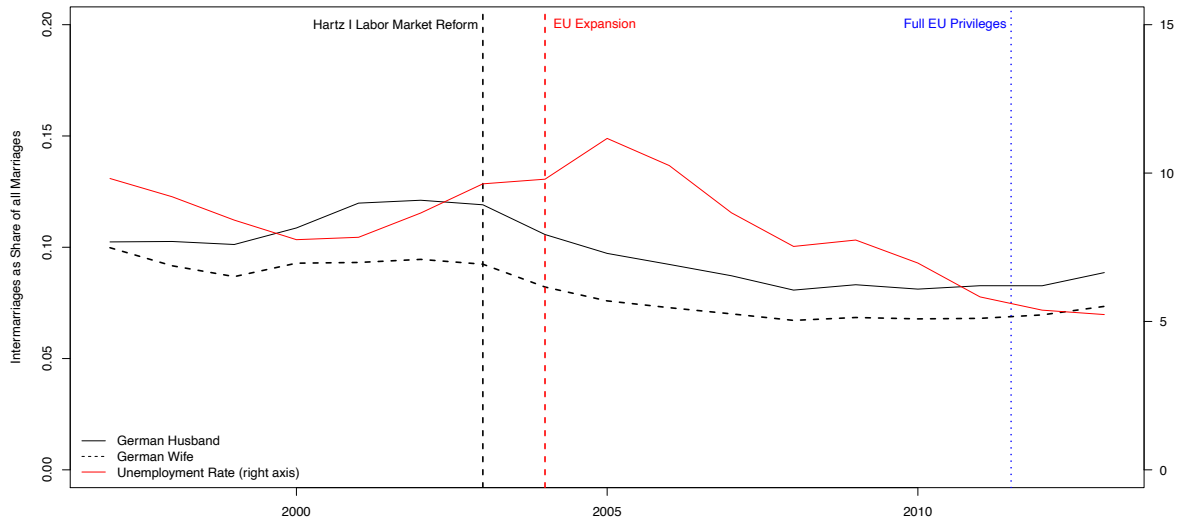
We combine the well-known theoretical foundations of transferable utility models of the marriage market (Becker, 1973, 1974) with a quasi-experimental empirical design. Our primary outcome variable is marital surplus, which we estimate using the simple non-parametric estimator that arises in the marriage market matching model of Choo and Siow (2006). A key advantage of the model-based estimator is that both changes of the number of available singles over time and permanent differences between marriages among natives and intermarriages, e.g. due to cultural differences, language, or the law, are explicitly taken into account. Data inputs, in addition to the flow of new marriages observed in the marriage register, consist of the populations of single individuals for different age-nationality combinations, which we extrapolate from the German Microcensus.

Our main finding is that the labor market reform had a sizable negative effect on the marital surplus of intermarriages in Germany. According to our preferred specification, the marital surplus of all treated marriages decreased by 6.4% (relative to the estimation constant). For intermarriages in which the wife is the German national, the negative effect extends to 7.3%. Moreover, using the divorce register, we find that intermarriages formed after the reform were significantly less likely to divorce. It is plausible that this increased marital stability is at least partly due to a better selection of couples.

We document substantial feedback effects of the Hartz I labor market reform on the marriage market, and on intermarriages in particular. This is a finding of high policy relevance. For one thing, the marriage market ramifications of the labor market reform were most likely not intended by the policy-maker. Apart from that, intermarriages can be an important vehicle for the integration of migrants (Adda et al., 2019; Azzolini and Guetto, 2017). Reforms of the social insurance system that make intermarriages unattractive may therefore conflict with a successful migration policy.

The potential importance of unobserved determinants of both unemployment risk and marital surplus, e.g. language ability, needs to be addressed. Our approach is twofold. First, we net out time-invariant differences in marital surplus across different types of marriages using fixed effects. Second, we permute our treatment and control group classifications by nationality and language to explore how language ability interacts with the reform treatment. We use the linguistic distance between a foreign spouse's native language and German as a proxy for language ability. Varying the linguistic distance of the intermarriages in our treatment group does not affect our conclusions.

Figure 1: Intermarriage and Unemployment Rates in Germany



Notes: The black dashed vertical line indicates the year in which the Hartz I Reform became effective (2003), the red dashed vertical line marks the year in which the EU expansion took place (2004). *Data Source*: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Marriage Register, 1997-2013, own calculations. The unemployment rate is extracted from OECD data.

An important confounding event is the Eastern expansion of the European Union (EU) in May 2004. The EU expansion granted the right to live and work in any EU country to citizens of eight Eastern European countries, Malta, and Cyprus (the EU10 countries). We control for the effect of the EU expansion on marital surplus and stability using a double differences-in-differences strategy: we estimate the effect of the EU expansion, conditional on the impact of the labor market reform, by comparing intermarriages with a EU10 spouses to intermarriages with spouses from non-EU countries. One might expect that the EU expansion itself had an impact on the German marriage market, similar to what Adda et al. (2019) find in the Italian context. In theory, the marital surplus of intermarriages between Germans and citizens of the new EU member states should decrease due to the EU expansion because marrying a German citizen was no longer necessary to obtain the right to reside and work in Germany. However, due to the gradual opening[8] of the German labor market for citizens of the new member states, we find only small and often insignificant effects of the EU expansion on marital surplus.

Figure 1 depicts German intermarriage rates between 1997 and 2013, constructed using the marriage register, along with the unemployment rate according to OECD data.

[8]Most member states opened their labor markets to citizens of the new member states immediately. Germany and Austria, however, implemented a seven-year transitional period during which labor market access was granted only gradually.

The purpose of this plot is to illustrate the suggestive correlation between the share of intermarriages and the unemployment rate (as a proxy for the risk of job loss). The unemployment rate increased from 7.8% in 2001 to a maximum of 11.2% in 2005. It decreased steadily thereafter. Intermarriage rates evolve almost in parallel for men and women, and the level is always higher for German men marrying foreign women. After some initial increases around the year 2000, the intermarriage rates became flat at first and started to decrease in 2003, the year in which the Hartz I labor market reform was implemented (black dashed line). This trend was hardly affected by the EU expansion (red dashed line). The intermarriage rates started to recover around the year 2011, when the German unemployment rate had reached a historical low. This negative correlation between intermarriage and the unemployment rate motivates our identification strategy.

Other papers in the related literature share with ours the focus on interactions between social policy and the marriage market. Ortigueira and Siassi (2013) assess the quantitative effects of within-household risk sharing on savings and labor supply using a model with idiosyncratic income risk (Aiyagari, 1994) and two decision makers within the household. Among other findings, their model matches well the elasticity of spousal labor supply with respect to UI estimated by Cullen and Gruber (2000). Low et al. (2018) find that a U.S. welfare reform that introduced lifecycle time limits on the receipt of welfare led, inter alia, to higher marital stability. Persson (2020) argues that the elimination of survivor insurance in Sweden had effects on marriage formation decades before expected payout and, additionally, raised the divorce rate and the degree of assortative matching in the marriage market. Anderberg et al. (2020) study how raising the school-leaving age in the UK in 1972 affected partner choices both in terms of (unobserved) ability and qualification. Finally, our study is related to a number of papers with mixed results that study intermarriage in relation to labor market outcomes (Kantarevic, 2005; Meng and Gregory, 2005; Furtado and Theodoropoulos, 2009; Meng and Meurs, 2009; Basu, 2015; Dribe and Nystedt, 2015).

The remainder of our paper is structured as follows: Section 2 describes the institutional background and studies individual unemployment risk using social security data. Section 3 reviews the Choo and Siow (2006) model that we use to estimate marital surplus. Section 4 introduces the marriage market data. Section 5 presents our primary results, and Section 6 contains selected additional results. Section 7 concludes.

2 Institutional Background

2.1 The Labor Market Reform

Our identification strategy exploits a tightening of household-level means testing in the German unemployment insurance system. Due to lower exemption thresholds, the system became less generous because spouses and cohabiting partners had to insure each other to a larger extent than before the reform. This change was part of the comprehensive labor market reform package known as the "Hartz reforms".[9] They were implemented sequentially between 2003 and 2005 and designed to increase labor demand (Hartz I/II), matching efficiency (Hartz III), and labor supply (Hartz II/IV).

The Hartz I reform, which was passed in parliament on December 23, 2002, and came into force straight away on January 1, 2003, is primarily known for deregulating temporary employment and subcontracted labor. A lesser-known element of Hartz I was a sharp reduction of the threshold above which the income of a spouse or cohabitation partner was counted against, at that time, long-term unemployment assistance.[10] Before the reform, the partner's income below a threshold of 520 Euros per year of age of the partner was exempt from means testing up to a maximum value of 33,800 Euros per year for a partner of age 65 or above. This threshold decreased by more than 60% from 520 to 200 Euros per year of age with a new maximum exemption of 13,000 Euros per year.

Before the Hartz reforms, the German unemployment insurance system featured three types of transfers. The first transfer, unemployment benefits[11], is a social insurance benefit that replaces 60–67% of the previous net salary. It is not means-tested and, before 2005, could be received for a maximum duration between 12 and 36 months depending on age and employment history.[12]

Upon exhaustion of unemployment benefits, a second transfer, unemployment assistance, could be received prior to 2005. Claims had to be renewed yearly, but eligibility was not time-limited otherwise. This tax-financed transfer amounted to 53–57% of the

[9]The name is derived from Peter Hartz, who was at that time director of human resources at Volkswagen and chair of the commission that worked out the reform proposals. The commission's work took place during the first half of 2002 and results were presented to the public on August 16, 2002.

[10]"Arbeitslosenhilfe" in German.

[11]"Arbeitslosengeld" in German, renamed to "Arbeitslosengeld I" by Hartz IV in 2005.

[12]Hartz IV limited duration to at most 18 months. Following another reform in 2007, unemployment benefit receipt is until today restricted to 12 months for workers below 50, 15 months below 55, 18 months below 58, and 24 months for workers who are 58 and older.

last net salary and was, as mentioned above, means-tested against the partner's income above an exemption threshold, which Hartz I lowered significantly in 2003.

In 2005, unemployment assistance was merged with the third transfer, social assistance, as part of the Hartz IV reform.[13] Effectively, this set the means-testing threshold to zero. Tax-financed social benefits, traditionally the third and lowest tier of transfer payments in the German social security system, are strictly means-tested and additional sources of income, including the partner's income, are counted against benefit entitlements from the first Euro.

2.2 Unemployment Risk and Nationality

The Hartz I reform changed the demand for spousal insurance against unemployment. The intensity of this treatment varies with the exposure to unemployment risk at the household level. To evaluate the reform's effect on the marriage market, we must take a stance on which households were most strongly affected by the tightening of household-level means testing. To this end, we analyze variation of unemployment risk across individuals by estimating how labor market transition probabilities correlate with different observable characteristics.

We rely on the Sample of Integrated Labour Market Biographies (SIAB), an administrative data set provided by the Research Data Center (RDC) of the Institute for Employment Research (IAB) at the German Federal Employment Agency.[14] The SIAB is a 2% random sample of the German social security registers covering the years 1975 to 2014. We restrict the analysis to the years 1997 to 2002. 1997 is the first year for which the marriage and divorce registers used in the main part of our paper are available. Moreover, to avoid capturing reform effects on unemployment risk, we focus on the pre-(Hartz I-)reform period.

One observation in the SIAB corresponds to a time period (spell) at the worker level with at least one of the following characteristics: (i) employment subject to social security (in the data since 1975), (ii) marginal part-time employment (in the data since 1999), (iii)

[13]This merger resulted in a new transfer called "Arbeitslosengeld II", which is therefore referred to as "Hartz IV" in today's colloquial German.

[14]We use the factually anonymous Sample of Integrated Labor Market Biographies (File: `SIAB_7514`). Data access is provided via a Scientific Use File supplied by the Research Data Center (RDC) of the German Federal Employment Agency (BA) at the IAB, project no. 101693. See also Ganzer et al. (2016) for more details on the data set.

benefit receipt, (iv) officially registered job-seekers or (planned) participation in active labor market policy programs (in the data since 2000). We observe these (un)employment spells with daily precision. Spells end either by a change of employment status, employer, or always at the end of a calendar year. We are interested in estimating conditional rates of job loss (firings/quits) and job finding (hirings). To identify the rate of job loss, we count transitions from employment into unemployment and from employment into inactivity. Transitions from unemployment into employment, both full and part time, identify the job finding rate. We treat changes from full to part-time employment (and vice versa) and transitions between employers as continuous employment.

The SIAB includes information about, among other things, gender, nationality (German, non-German), regional identifiers, and education.[15] We do not observe marital status in the SIAB data. We estimate Cox (1972) proportional hazard models, including nationality, gender and education group dummies as covariates. Moreover, we gradually add region and time fixed effects to our specifications.

The proportional hazard model assumes a baseline hazard that is common to both employed and unemployed individuals along with a log-linear function of covariates. The hazard rate for transitions out of and into unemployment after a number of days, d, with the vector of covariates Z is denoted $h(d, Z)$. γ indicates the vector of coefficients to be estimated, $\lambda(d)$ is the baseline hazard, and v is an error term:

$$h(d, Z) = \lambda(d) \cdot \exp(\gamma' Z) \cdot v. \tag{1}$$

Table 1 presents the results for transitions into unemployment and into new employment out of unemployment. Columns (1)–(4) show estimated hazard rates for job loss (transitions into unemployment) and columns (5)–(8) present estimated hazard rates for job findings (transition into employment). Our preferred specification includes both year and region fixed effects, see columns (4) and (8).

We find that the hazard of transitioning from employment into unemployment is significantly higher for non-natives compared to native Germans. German nationals have

[15]The education variable in German social security data suffers from missing values and inconsistencies, essentially because misreporting has no negative consequences. We impute missing and inconsistent observations using the methodology proposed by Fitzenberger et al. (2006). We use five levels of education: Lower secondary education without/with vocational training, higher secondary education without/with vocational training and tertiary education (University, University of Applied Sciences).

Table 1: Estimated Labor Market Hazard Rates

	Transitions into Unemployment				Transitions into Employment			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
German citizen	-0.233***	-0.232***	-0.281***	-0.281***	-0.088***	-0.088***	-0.117***	-0.117***
	(0.014)	(0.014)	(0.012)	(0.012)	(0.012)	(0.012)	(0.010)	(0.010)
	[0.792]	[0.793]	[0.755]	[0.755]	[0.916]	[0.916]	[0.890]	[0.890]
Female	-0.101***	-0.102***	-0.092***	-0.092***	-0.108***	-0.109***	-0.105***	-0.107***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.013)	(0.013)	(0.012)	(0.012)
	[0.904]	[0.903]	[0.912]	[0.912]	[0.898]	[0.897]	[0.900]	[0.899]
Lower secondary education	0.007	0.008	0.004	0.004	0.181***	0.180***	0.165***	0.163***
with vocational training	(0.016)	(0.016)	(0.015)	(0.015)	(0.012)	(0.012)	(0.011)	(0.011)
	[1.007]	[1.008]	[1.004]	[1.004]	[1.198]	[1.197]	[1.179]	[1.177]
Higher secondary education	0.496***	0.497***	0.535***	0.536***	0.633***	0.620***	0.668***	0.655***
without vocational training	(0.036)	(0.036)	(0.033)	(0.033)	(0.023)	(0.023)	(0.021)	(0.021)
	[1.642]	[1.644]	[1.707]	[1.709]	[1.883]	[1.859]	[1.950]	[1.925]
Higher secondary education	0.280***	0.281***	0.307***	0.308***	0.402***	0.396***	0.421***	0.414***
with vocational training	(0.021)	(0.021)	(0.021)	(0.021)	(0.016)	(0.016)	(0.015)	(0.015)
	[1.323]	[1.324]	[1.359]	[1.361]	[1.495]	[1.486]	[1.523]	[1.513]
Tertiary education	-0.244***	-0.244***	-0.202***	-0.202***	0.205***	0.201***	0.244***	0.239***
	(0.019)	(0.019)	(0.021)	(0.021)	(0.020)	(0.020)	(0.016)	(0.016)
	[0.783]	[0.783]	[0.817]	[0.817]	[1.228]	[1.223]	[1.276]	[1.270]
Observations	283,608	283,608	283,608	283,608	258,413	258,413	258,413	258,413
Year FE		✓		✓		✓		✓
Region FE			✓	✓			✓	✓

Notes: Robust standard errors (clustered by region) in parentheses. Hazard rates reported in square brackets. The omitted education level is "Lower secondary education without vocational training". *Data Source*: RDC of the Institute for Employment Research (IAB) at the Federal Employment Agency, SIAB SUF 7514, 1997–2002, own calculations.

a job loss hazard rate that is 24% lower than the respective hazard rate for workers without German citizenship, see Column (4). Thus, foreign workers are on average more likely to lose their jobs. Crucially, this difference is not driven by the gender or educational composition in the groups of natives and non-natives, because education and gender are controlled for in the regression.

For transitions into employment, the hazard rate of Germans is 11% lower than the hazard rate for foreigners. This difference is significant in our preferred specification including fixed effects, see Column (8). Thus, foreign workers find new jobs out of unemployment quicker than Germans and their unemployment duration is on average shorter. Potential explanations for this finding are lower reservation wages, for example due to lower unemployment benefit entitlements or the fact that for workers of certain nationalities continued employment is a requirement for residence in Germany. Selection could also play a role: upon job loss, some foreign workers might return to their home country, so we don't observe those individuals transitioning back into employment.

The estimated hazard rates reflect differences between Germans and a diverse group of individuals without German citizenship. One would expect that labor market transition probabilities vary greatly across individuals of different foreign nationalities. For

example, citizens of other EU15 countries face no legal barriers to employment in Germany, unemployment benefit entitlements can be transferred across countries, and their language abilities might well-suited for the German labor market. Thus, they might be more comparable to German workers in terms of labor market attachment as compared to workers from non-EU countries. The hazard rate differences we find should therefore be interpreted as a lower bound for the actual differential exposure to unemployment risk for workers without German citizenship. We investigate this issue further in Section 6.2, where we permute the treatment and control group classifications used in the main analysis based on nationality and language.

We find that education has an ambiguous effect on the risk of transitioning into unemployment. Compared to an individual with lower secondary education and no vocational training (the reference category), basic secondary education and vocational training does not reduce the job loss risk. Individuals with a higher secondary degree even face higher job loss risks. Only university education is associated with an average job loss risk below the level of individuals with basic secondary education.[16] Women are about 9% less likely to become unemployed and about 10% less likely to move into employment compared to men in our preferred specification. That is, women have on average longer employment durations, but it also takes them longer to find new jobs out of unemployment. From the estimated labor market hazard rates, it is therefore not clear whether intermarriages in which the female is non-native are more affected by the reform as compared to couples in which the male is non-native. We will get back to this question in our main analysis.

Given the evidence presented in this section, we define treatment and control groups to evaluate the Hartz I reform's effect on marital surplus based on the spouses' nationalities. Exposure to unemployment risk clearly differs between native and non-native workers in the German labor market, also conditional on education, gender, region, and time effects. Thus, intermarriages are more vulnerable in times of high unemployment, and more strongly affected by a less generous UI system.

[16] An explanation for this finding is that many older workers with basic education had relatively stable careers in industrial sectors that have been characterized by collective bargaining and employee representation. Due to the hump-shaped relation between unemployment risk and educational attainment, education itself is an unsuitable proxy for the exposure to unemployment risk.

3 Theory

To formally investigate how changes of unemployment insurance generosity affect different types of unions in the marriage market, we need a metric to evaluate the relative attractiveness of different marriages. To this end, we use *marital surplus* as our primary outcome variable. To estimate it from the data, we rely on the Choo and Siow (2006) model. In this section, we explain the key properties of this model and discuss the assumptions it places on the data.

Choo and Siow (2006) show that a static marriage market matching model with transferable utility (TU) in the spirit of Becker (1973, 1974) yields a simple non-parametric estimator for marital surplus. A useful property is that, under the assumptions of the model, marital surplus alone is sufficient to characterize behavior. The estimator is derived from market clearing conditions and relies on a constant relationship between the observed numbers of married men and women by type and the respective numbers of singles.

3.1 Derivation of Marital Surplus

Marital surplus reflects the gains from marriage for both partners, and those gains vary with both the types of the individual spouses and the institutional environment. In our setting, the types i and j of men and women, respectively, are combinations of nationality and age, as detailed in Section 4. I and J denote the total numbers of male/female types. For each type, the number of individuals in the marriage market is denoted m_i for males and f_j for females, respectively. The following accounting identities hold:

$$\mu_{i0} + \sum_{j=1}^{J} \mu_{ij} = m_i \ \forall i, \quad \mu_{0j} + \sum_{i=1}^{I} \mu_{ij} = f_j \ \forall j, \tag{2}$$

where $\mu_{ij} \geq 0$, $\mu_{i0} \geq 0$, and $\mu_{0j} \geq 0$, are the numbers of ij marriages, single men of type i, and single women of type j, respectively.

Following Choo and Siow (2006), we assume that the utility of a type i man indexed g who is married to a type j woman consists of a systematic and a random component, see (3). The systematic component is denoted $\tilde{\alpha}_{ij}$ and the utility transfer from a type i man to a type j woman τ_{ij}. Thus, the systematic gain from this marriage for the man is given by $\tilde{\alpha}_{ij} - \tau_{ij}$. This gain is independent of both spouses' identity, but it depends

on age and nationality. With different nationalities, for example, the gain could be lower due to cultural or language differences. The random component is an identity-specific idiosyncratic shock, ϵ_{ijg}, which allows for deviations from the systematic utility gain for any combination of types. It is assumed that ϵ_{ijg} is i.i.d. with a type I extreme-value distribution.

$$V_{ijg} = \tilde{\alpha}_{ij} - \tau_{ij} + \epsilon_{ijg} \tag{3}$$

The systematic gain for a female of type j from marrying a type i man is similarly defined and denoted $\tilde{\gamma}_{ij}$.[17] Observing all potential levels of utility, a male (female) individual g chooses whom to marry in the frictionless marriage market by simply picking the highest attainable utility:

$$V_{ig} = \max_j \{V_{i0g}, ..., V_{ijg}, ..., V_{iJg}\}, \tag{4}$$

where V_{i0g} denotes the utility from remaining single. As shown by McFadden (1974), this random utility model, together with the assumed type I extreme-value distribution of the idiosyncratic component and large numbers of men and women, yields a simple quasi-demand function for the number of ij marriages demanded by type i men:

$$\begin{aligned} \ln \mu^d_{ij} &= \ln \mu^d_{i0} + \tilde{\alpha}_{ij} - \tilde{\alpha}_{i0} - \tau_{ij} \\ &= \ln \mu^d_{i0} + \alpha_{ij} - \tau_{ij}, \end{aligned} \tag{5}$$

which depends on the number of type i singles and $\alpha_{ij} = \tilde{\alpha}_{ij} - \tilde{\alpha}_{i0}$, which is the systematic gross return to a type i man from being in a type ij marriage relative to being unmarried. Symmetrically, the number of ij marriages demanded by type j women is given by the quasi-supply function:

$$\ln \mu^s_{ij} = \ln \mu^s_{0j} + \gamma_{ij} + \tau_{ij}. \tag{6}$$

All $I \times J$ submarkets of the marriage market clear in equilibrium. Thus, the surplus of marriages between a type i man and type j woman, our object of interest, can be calculated by adding up equations (5) and (6). The utility transfer cancels out and the

[17] Following the notation of Choo and Siow (2006) the sign of the utility transfer τ_{ij} suggests that women receive a positive transfer. This does not have to be the case.

two systematic components, α_{ij} and γ_{ij}, remain.

$$\frac{\alpha_{ij} + \gamma_{ij}}{2} = \ln \mu_{ij} - \frac{\ln \mu^d_{i0} + \ln \mu^s_{0j}}{2}. \tag{7}$$

Rewriting yields the marital surplus, Φ_{ij}, according to the Choo and Siow (2006) model:

$$\Phi_{ij} = \ln \left(\frac{\mu_{ij}}{\sqrt{\mu_{i0}\ \mu_{0j}}} \right). \tag{8}$$

The number of marriages between type i men and type j women, μ_{ij}, in the numerator is scaled by the number of single men and single women of the respective types, μ_{i0} and μ_{0j}. Intuitively, the surplus (total systematic gain) of marriage per partner for any ij pair is high if we observe many ij marriages relative to the respective single populations. The measure exploits that the observed number of singles of a given type is informative about the expected gains of this type in the marriage market. However, due to market clearing, the surplus does not depend on the availability of different types of singles. That is, there is no option value of waiting longer until a "better" partner arrives, as it would be the case in a search model of the marriage market.

It is worth emphasizing that utility transfers, τ_{ij}, although they do not influence marital surplus, provide an important adjustment mechanism. Transfers change the relative gains to marriage for two partners by transferring resources from one to the other. For example, for a certain married woman of type j, a reduced systematic gain from marriage may have to be compensated by a larger transfer from her type i husband to keep marriage preferable to singlehood for both partners. However, increasing the transfer sufficiently might be infeasible, for example due to budget or time constraints. The number of marriages of this particular combination of types will be lower and, consequently, more existing ij couples might file for divorce. Divorce is not part of the static Choo and Siow (2006) model, but we explore marital stability empirically in Section 6.3.

Holding the marital surplus Φ_{ij} constant, a percentage increase in the stock of available singles of a given male or female type, μ_{i0} or μ_{0j}, results in an equal increase of marriages involving this particular type, μ_{ij}. Deviations from this constant relationship imply a change of marital surplus.[18] In our setting, the reduction of social insurance

[18]Marital surplus is always defined relative to the value of being single. Changes that affect both the value of being single and the value of being married in equal measure will not alter marital surplus.

generosity, which increases the need for within-household insurance against prolonged unemployment, lowers marital surplus. This corresponds to a reduced number of new marriages given non-decreasing single stocks in the data.

3.2 Reform Effects on Marital Surplus

Through the lens of the model, the increased need for within-household insurance due to the Hartz I labor market reform reduced the systematic utility component for married individuals, α_{ij} for men and γ_{ij} for women, respectively. The extent of this reduction depends on the couples' heterogeneous exposure to unemployment risk. We proxy for this heterogeneity using the observed nationality combinations of married couples in accordance with the evidence presented in Section 2. Because the Hartz I reform affected married couples exclusively through stricter means testing, one would not expect an effect on the systematic utility from being single in this case.

The theoretical effect of the 2004 EU expansion on marital surplus, which we also include in our empirical model, is slightly different. Marrying a German citizen is one way for foreigners to obtain the right to live and work in Germany. After the EU expansion, EU10 citizens obtained this right automatically (with initial restrictions), so marrying a German citizen became less attractive, reflected in lower values of $\tilde{\alpha}_{ij}$ and $\tilde{\gamma}_{ij}$. The negative effect on marital surplus was reinforced by higher utility from singlehood for EU10 citizens: $\tilde{\alpha}_{0j}$ and $\tilde{\gamma}_{i0}$ increased because the new opportunities in Germany were granted independently of marital status, so singles benefited as well.

To sum up, the theory suggests that both the Hartz I labor market reform and the EU expansion had a negative effect on the surplus of intermarriages. We study the relative importance of these two effects in Section 6.1.

3.3 Taking the Model to the Data

In principle, a single cross section of data suffices to compute marital surplus according to the Choo and Siow (2006) model. Using the time dimension in our data, we calculate marital surplus on an annual basis based on the flow of new marriages and the number of available singles. Essentially, this measures the flow out of singlehood.[19]

[19]This approach is also the one used by Adda et al. (2019), who estimate an adapted version of the Choo and Siow (2006) model using Italian census data.

In the data, we interpret the individual types i and j of men and women as combinations of age and nationality. Thus, we let $\hat{\Phi}(f_{a,n}, m_{a,n})_t$ denote the estimated surplus of a marriage between a man of age a and nationality n and a woman of age a and nationality n in year t. Thus, the estimator based on equation (8) becomes:

$$\hat{\Phi}\left(f_{a,n}, m_{a,n}\right)_t = \ln\left(\frac{\mu(f_{a,n}, m_{a,n})_t}{\sqrt{\mu(0, f_{a,n})_t \ \mu(m_{a,n}, 0)_t}}\right), \tag{9}$$

where the marriage surplus in any particular year t depends on the observed numbers of females $f_{a,n}$ and males $m_{a,n}$ of a certain age a and nationality n who get married, $\mu(f_{a,n}, m_{a,n})_t$, relative to the geometric average of the available singles of the same types, $\mu(0, f_{a,n})_t$ and $\mu(m_{a,n}, 0)_t$. Intuitively, the more new marriages we observe relative to the single population in every group, the higher is the estimated marital surplus for this particular age-nationality combination.

4 Marriage Market Data

4.1 Marriage and Divorce Registers

The marriage and divorce registers, referred to as MR and DR in the following, cover the universe of marriages and divorces in Germany. Data access is provided by the Research Data Centers (FDZ) of the statistical offices of the German federal states. The marriage and divorce registers are two separate sources of process-generated micro data. They originate from the German civil registry offices and divorce courts, respectively. Both data sources contain information on legally registered marriages of different-sex couples. Cohabiting couples are not covered.[20] The same is true for same-sex couples.[21]

We have access to all waves of the data between 1991–2013 (MR) and 1995–2013 (DR). A few federal states did not report data prior to 1997, so we discard earlier years. We clean the data by removing duplicates, observations where important variables are

[20] It is worth noting that there is virtually no time trend in the cohabitation rate during our period of analysis. According to the German federal statistical office, the share of households with two (or more) members with an unmarried household head was flat around 37–38% between 1997 and 2013. Moreover, the system of joint taxation of married couples in Germany provides disincentives for cohabitation.

[21] Although same-sex couples could form a civil union in Germany starting in 2001, these unions are not covered by the marriage and divorce registers. Same-sex marriages were fully legalized in Germany in 2017.

missing, and marriages formed outside Germany.[22] Moreover, we exclude marriages in which one of the individuals' birth date implies an age below 18.[23] Both data sets are organized at the couple level and contain information on the birth dates of both spouses, the date of marriage, and, in the DR, the date of divorce. Additionally, the data contain various covariates including religion and citizenship of both spouses, place of residence, number of children (before marriage and at the time of divorce), who filed for divorce, and the ruling of the court.

To estimate marital surplus based on the Choo and Siow (2006) model (Section 3), we combine the flow of new marriages from the MR data with stocks of unmarried individuals by nationality and age group extracted from the German Microcensus (described below). We can only extract and merge these stocks for cells in which the number of observations is sufficiently large. Thus, we compute the surplus for marriages in which the (potentially different) citizenship of the spouses belongs to the following eight (groups of) countries: Germany, the EU15 countries (excluding Germany), Poland, Turkey, the EU10 countries (excluding Poland), Romania, former Yugoslavia, and "Rest of the World" (residual category). We use six age groups 18–25, 26–32, 33–39, 40–46, 47–54, and 55–68.

German data protection legislation forbids merging the MR and DR registers at the level of the individual couple. To study marital stability and the incidence of divorce (Section 6.3), we link both registers by counting observations in cells formed by the quarter of the marriage and the nationality of both spouses. We can then merge both data sets at the quarter-nationality-nationality level and "unpack" the linked data-set into individual marriage spells. This allows us to estimate survival models for different types of marriages that were formed before and after the Hartz I labor market reform.

4.2 The German Microcensus

The German Microcensus (MC) is an annual survey that delivers representative statistics on the German population and labor force. Data access is provided by the research data centers (RDC) of the statistical offices of the German federal states. The MC samples 1%

[22]Marriages formed outside Germany were not recorded before 2008 and represent only 0.15% of all marriages thereafter. Some descriptive information on marriages formed abroad can be found in Appendix A.1.

[23]Until 2017, it was legal in Germany to form marriages in which one spouse is adult and the other is at least 16 years old. However, this type of marriage needed to be approved by a family court. Most of these marriages were formed abroad.

of all persons legally residing in Germany.[24] It is the largest household service in Europe. We select all individuals between 18 and 68 years of age who live in private households. For the period after German reunification (1993–2013), this sample is representative of a roughly constant population of about 53 million individuals, of which 47% are male.[25] 72% of men and 64% of women are married. The average labor force participation rates are 62% for men and 46% for women.

In this data set, we identify the populations of singles in the aforementioned age-nationality cells for our period of interest. We can identify singles who live alone and with cohabitants, and we include never-married, divorced, and widowed individuals. A difficulty that we have to overcome is a change of the MC survey implementation in 2005, which changed from a fixed reference week to continuous interviews over the course of the year. For the first couple of years, this led to irregularities in the sampling procedure.[26] To ensure that our findings are not affected by this change, we explore different interpolation techniques for the years 2005–2009, see Appendix A.2. For our baseline results, we rely on a piecewise cubic interpolation. Importantly, our key findings do neither depend on whether or not we interpolate, nor on the specific technique.

We interpret Germany as one big marriage market and, thus, compute the single stocks at the national level. While there is substantial variation in the foreign population share across German regions, this strategy has two advantages. First, the sampling error in the MC is not amplified by extrapolating very small numbers of foreign individuals in some regions to the population level using weights. Second, we ensure that we have large enough numbers of observations to merge the MC and MR data without violating German data protection regulation. Moreover, we included region fixed effects in the analysis of unemployment risk in Section 2.2. Therefore, we know that the higher exposure of foreigners to unemployment risk is not merely an artifact of regional variation.

[24]Participation is mandatory and non-response may be fined. Only a subset of questions can be answered on a voluntary basis. One household member responds for all individuals living in the household, including spouse, children, and other cohabitants if applicable. The survey program of the MC consists of a set of core questions that remains the same in each wave, covering general demographic and socioeconomic characteristics like marital status, education, employment status, individual and household income, among many other things.

[25]Extrapolated from information on 8,426,756 surveyed individuals using sample weights. The average number of observations per wave is 443,513. The population increases somewhat after reunification and reaches a maximum of almost 55 million people in 2007. Afterwards, it starts declining.

[26]See Statistisches Bundesamt (2012) for details of the MC survey change and related problems.

Table 2: Number of Marriages by Nationality and Gender

Nationality	Men	Women
German	6,090,937	5,978,700
EU15 (w/o Germany)	121,023	83,040
Poland	13,380	81,368
Turkey	100,981	55,487
EU10 (w/o Poland)	1,446	15,644
Romania	4,214	24,472
Former Yugoslavia	5,184	33,647
Rest of the World	255,304	313,680
Total	6,626,083	

Data Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Marriage Register, 1997–2013. EU15 (w/o Germany) countries are Austria, Belgium, Denmark, Finland, France, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and United Kingdom. EU10 (w/o Poland) countries are Cypress, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Slovakia and Slovenia.

4.3 Descriptive Evidence

Table 2 presents the distribution of nationalities in all new marriages we observe between 1997–2013 for men and women, respectively. We observe a total of 6,626,083 marriages. Roughly 6 million of these marriages have at least one spouse with German nationality. The largest groups of non-Germans who get married in Germany are citizens of the other EU15 member states, Turkish men, and Polish women. Interestingly, the numbers of Turkish women and Polish men, respectively, are much smaller. For most nationalities, the foreign spouse is more often the wife. Exceptions are the EU15 countries and Turkey, for which the number of foreign husbands is higher. Marriages in which at least one spouse is non-European ("Rest of the World") also make up a significant share of all observed marriages in Germany.

Table 3 provides a closer look by showing numbers of observations, mean ages, and the mean age difference for all combinations of the four big (groups of) nationalities: German, EU15, Polish, and Turkish. Marriages in which both spouses are foreign citizens are relatively rare. They constitute less than 1% of the total number of marriages for the subsample in Table 3. 0.36% are marriages among Turks and 0.37% are marriages among EU15 citizens (not necessarily the same nationality).[27] In 8.2% of all marriages, one spouse is German and the other spouse is a foreign citizen. This is the time average

[27]Due to the small number of marriages without any German spouse, and because marriages among foreign nationals may not show up in the German marriage registers (married abroad), we restrict our main analysis to marriages where at least one spouse is German.

Table 3: Marriage Characteristics by Nationality and Age

		Wife German	Wife EU15 (not German)	Wife Polish	Wife Turkish
Husband German	Share	93.79%	0.89%	1.18%	0.49%
	Mean Age Husband	35.82	36.18	37.40	30.34
	Mean Age Wife	32.91	33.21	31.08	26.37
	Difference	2.91	2.96	6.32	3.97
Husband EU15 (not German)	Share	1.38%	0.37%	0.04%	0.02%
	Mean Age Husband	35.89	30.92	35.62	30.16
	Mean Age Wife	32.87	27.83	28.90	26.54
	Difference	3.02	3.09	6.72	3.62
Husband Polish	Share	0.16%	0.00%	0.06%	0.00%
	Mean Age Husband	30.32	29.27	33.01	30.00
	Mean Age Wife	29.68	29.76	29.72	27.46
	Difference	0.64	-0.49	3.29	2.54
Husband Turkish	Share	1.19%	0.03%	0.02%	0.37%
	Mean Age Husband	27.94	27.23	32.46	27.17
	Mean Age Wife	27.79	26.24	27.55	24.51
	Difference	0.14	0.99	4.91	2.67

Data Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Marriage Register, 1997–2013. Values rounded to two decimal places. Total number of observations in the table is 5,957,349.

of the intermarriage rate in our sample. There are slightly more marriages between German women and foreign men than there are between German men and foreign women. To accommodate this asymmetry in our empirical analysis, we later present results for marriages in which the German spouse is either the man or the woman separately, along with a pooled baseline sample.

Age differences between men and women are almost always positive, that is, the husband is commonly older. German men who marry a non-German woman are on average older compared to German-German couples, although they are much younger in case the wife is Turkish. Conversely, German women who marry a non-German man are on average younger compared to German-German couples, and again much younger in case the husband is Turkish. The only case with a (slightly) negative average age difference are couples of EU15 women and Polish men, but this is a very small group. The largest average age differences exist between Polish women and German or EU15 men. In these marriages, the woman is on average more than 6 years younger than the man. This is more than twice the average age gap in German-German couples. To take into account the observed differences in the age structure across different types of couples, our preferred empirical specification below includes fixed effects for both the wife's and the husband's age group.

5 Reform Effects on Marital Surplus

5.1 (Pre-)Trends of Marital Surplus

Figure 2 presents the estimated marital surplus, $\hat{\Phi}$ according to equation (9), over time. We plot the surplus for marriages where at least one spouse, either the wife or the husband, is German, and aggregate nationalities into four groups: German-German marriages (black), German-EU15 marriages (blue), German-EU10 marriages (orange), and one German spouse with any of the remaining nationalities (gray, includes Turkey, Romania, former Yugoslavia, Rest of the World).

According to the model, the visible ranking of marital surplus for different couples reflects differences in the systematic gains from marriage. On the one hand, factors like cultural distance tend to lower marital surplus relative to German-German couples.[28] On the other hand, if access to the labor market is gained by marrying a German citizen, marital surplus tends to be higher, see the surplus difference between German-EU15 and German-EU10 marriages before the EU expansion. Over time, as EU10 citizens earned the right to live and (later) work in Germany, the surplus converged and eventually the ranking even changed. Although the surplus falls for marriages with both EU10 and "other" spouses after 2003—according to our main hypothesis as a result of the labor market reform—the "other" line remains above the EU15 line, which is consistent with the idea that spouses from non-EU countries still earn labor market access by marrying a German citizen and thus enjoy higher gains from marriage.

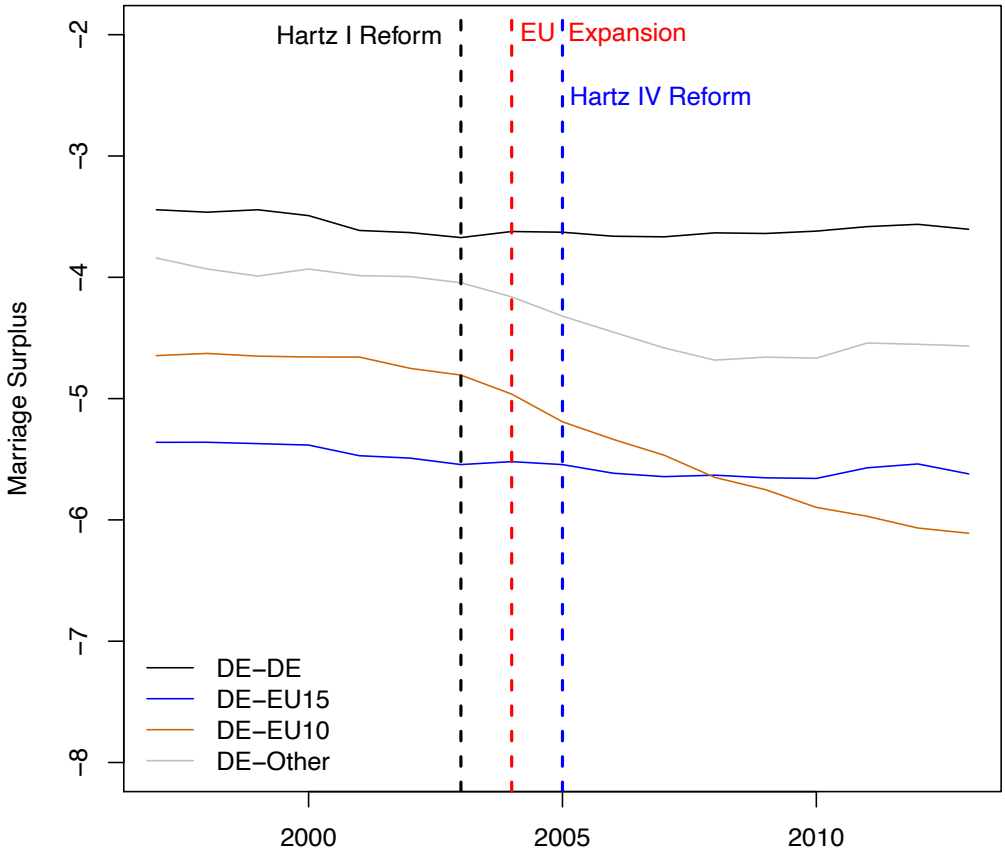
From 1997 until the implementation of the Hartz I labor market reform (black dashed line), the marital surplus evolves in parallel for all nationality combinations and is essentially flat. After 2003, the trends notably diverge. On the one hand, we observe a decline for marriages in which one spouse has EU10 or "other" citizenship. On the other hand, the surplus for German-German and German-EU15 marriages stays flat.[29]

To understand the observed dynamics of the marital surplus, recall the Choo and Siow (2006) model that our estimator is based on. Here, changes in marital surplus reflect deviations from a constant relationship between the single populations and the flow of

[28] We control for such time-invariant differences by using nationality fixed effects in our empirical specifications.

[29] Note that this was not a period of large immigration flows. According to the German federal statistical office, net migration decreased from about 270.000 in 2001 to −50.000 in 2008. It only started increasing again after the Great Recession.

Figure 2: Development of Marital Surplus ($\hat{\Phi}$) over Time



Notes: Marriage surplus for marriages where at least one spouse is German by nationality of the non-German spouse. Single stocks based on piecewise cubic Hermite interpolation. The black dashed vertical line indicated the year in which the Hartz I and IV reforms became effective, the red dashed vertical line marks the year 2004 in which the EU expansion took place. *Data Source*: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Marriage Register and Microcensus, 1997–2013, own calculations.

new marriages. The number of singles may change over time but, ceteris paribus, such changes would lead to proportional adjustments in the flow of new marriages, keeping the surplus constant. According to the logic of the model, the falling surplus we observe for German-EU10 and German-Other marriages therefore reflects "too few" new marriages relative to the single stocks in the respective groups.[30]

This lack of new marriages and, accordingly, the divergence in marital surplus after 2003 can, following our main hypothesis, be explained by the labor market reform and differences in the unemployment risk that households face. We have verified in Section 2.2 that nationality is a robust predictor of unemployment risk. Following the tightening of the means-testing regulations, marriages in which one spouse had a foreign nationality

[30]The logic of the model also implies that changes in the different single populations over time are implicitly controlled for in our empirical analysis. To scrutinize this implication, we rerun our main specifications with the yearly single stocks by gender and per age-nationality cell as additional control variables. Our results are only minimally affected by these additional controls. We exclude this robustness check from the paper for brevity. The results are available upon request.

Table 4: Types of Marriages in Treatment and Control Groups

Nationalities of Spouses (c_h, c_w)	Hartz Treatment (Jan 01, 2003)	EU Treatment (May 01, 2004)	Treatment Dummy $Treat_{HartzI}$	$Treat_{EU}$
German-German	No	No	$= 0$	$= 0$
German-EU15	No	No	$= 0$	$= 0$
German-EU10	Yes	Yes	$= 1$	$= 1$
German-Other	Yes	No	$= 1$	$= 0$

and thus, at least on average, a higher unemployment risk, required a higher degree of within-household insurance and, therefore, became less attractive.

The negative trend in marital surplus for German-EU10 and German-Other marriages that starts in 2003 is neither effected by the EU expansion (red dashed line) nor the Hartz IV reform (blue dashed line), which eliminated means-testing exemptions completely. The surplus of German-German and German-EU15 marriages remains flat around the same two law changes. In 2008, the German-Other surplus stabilizes while the German-EU10 continues to fall. Intuitively, this divergence can be explained by the fact that EU10 citizens gradually gained labor market access in Germany while citizens from "other" (i.e. third) countries still need a German spouse to be allowed to work.

5.2 Empirical Setup

We are now in a position to estimate the effect of the Hartz I labor market reform on marital surplus. We use a differences-in-differences specification to identify the effect of the reform on the treated population. As in the previous section, we restrict attention to marriages in which at least one spouse is German and define treatment and control groups as illustrated in Table 4.

In line with the trends presented in Figure 2 and the analysis of unemployment risk in Section 2.2, German-German and German-EU15 marriages are the control group. All other intermarriages form the treatment group for estimating the labor market reform effect. We are able to separately identify the effects of the labor market reform and the EU expansion because couples with an EU10-spouse were treated by both reforms while couples in which the spouse has another foreign nationality (i.e. not EU10 or EU15) were treated by the labor market reform only. We further explore this in Section 6.1.

To capture the labor market reform treatment, we define a dummy variable $Treat_{HartzI}$ that takes on the value 1 for marriages where the non-native partner has one of the following citizenships: EU10, Turkish, Romanian, former Yugoslavia, Rest of the World. The indicator function $\mathbb{1}\{t \geq 2003\}$ returns the value 1 for marriages formed after January 1 2003, the enactment date of the reform. It follows that our empirical specification to estimate the effect of the labor market reform has the following form:

$$\begin{aligned}\Phi_t(c_h, c_w, a_h, a_w) &= \beta_1 \cdot Treat_{HartzI}(c_h, c_w) + \beta_2 \cdot \mathbb{1}\{t \geq 2003\} \\ &+ \beta_3 \cdot Treat_{HartzI}(c_h, c_w) \cdot \mathbb{1}\{t \geq 2003\} \\ &+ \gamma \cdot X_t(c_h, c_w) + \alpha_t + \delta_c + u_t(c_h, c_w, a_h, a_w), \end{aligned} \tag{10}$$

where the coefficient of interest is β_3. It represents the treatment effect on the treated of the Hartz I labor market reform. c_h and c_w indicate citizenship of husband and wife. a_h and a_w are the age of husband and wife. The year fixed effect α_t controls for time trends such as the generally declining marriage rate in Germany. The fixed effect for the foreign spouse's nationality, δ_c, controls for any confounding factors specific to intermarriages with particular nationalities. This takes care of any unobserved time-invariant determinants of marital surplus. $\Phi_t(c_h, c_w, a_h, a_w)$ is the marriage surplus for a particular combination of age and country or origin for both partners in year t. $u_t(c_h, c_w, a_h, a_w)$ is the residual and $X_t(c_h, c_w)$ is a citizenship and time-specific vector of control variables that, among other things, captures the effect of the 2004 EU expansion, which we unpack in Section 6.1.

5.3 Main Results

We present estimation results for multiple specifications in Table 5. Columns (1) & (2) include all marriages where at least one spouse is German. Columns (3) & (4) condition on the husband being German and columns (5) & (6) condition on the wife being German, respectively. Columns (1), (3) and (5) include fixed effects for the year and the nationality of the non-German spouse, so these specifications correspond exactly to equation (10). For the estimations shown in columns (2), (4), and (6), we also control for the age of both spouses using fixed effects.

Overall, the labor market reform had a significant and sizable negative effect on the

surplus of intermarriages in which the foreign spouse has a non-EU15 citizenship. The estimated coefficient $\hat{\beta}_3$ is negative and highly significant in all specifications. Robust standard errors are reported in parenthesis.[31] Specification (1) shows a decrease of 0.352 log points in the surplus of treated marriages. That is, relative to the constant, marital surplus decreased by 5.7%. Including age fixed effects for husband and wife in specification (2) slightly increases the effect size to 0.385 log points or 6.4%.[32] Under the assumptions of the Choo and Siow (2006) model, these estimates represent causal effects.

When we condition the estimation on either the wife or the husband being German, we see that the negative effects are bigger for marriages with German wives as compared to German husbands. We find a maximum decline of 0.433 log points in specification (6), corresponding to a surplus reduction of 7.3%. In specification (4), the negative impact is only 6.0%. One possible explanation for the asymmetric impact across genders could be that marriages in which the husband is more exposed to labor market risk are generally more vulnerable. Labor force participation and income is on average lower for women in Germany, which is at least partly due to strong and persistent gender norms (Bauernschuster and Rainer, 2012; Lippmann et al., 2019). Thus, wives' ability to insure (their) husbands against unemployment risk could be relatively low.

Overall, we find that the Hartz I reform significantly reduced the attractiveness, as measured by marital surplus, of intermarriages in Germany. This evidence for significant marriage market repercussions of the German labor market reforms is interesting for at least two reasons. First, it is conceivable that policy-makers did not intend to affect the marriage market when they implemented a series of reforms primarily designed to reduce unemployment. Second, intermarriages are often viewed as a vehicle for the successful integration of ethnic minorities and immigrants (Azzolini and Guetto, 2017; Adda et al., 2019). Living with natives can alleviate barriers to labor market access, for example by providing incentives for a fast acquisition of language skills or access to labor market networks. By negatively affecting intermarriage rates, the labor market reform potentially hampered the integration of the foreign-born population in Germany.

[31] Clustered standard errors (by year, unreported) do not affect the significance of our estimated coefficients. To interpret our findings conservatively, we report the larger robust standard errors throughout the paper.

[32] Recall that the single stocks used to compute our outcome, marital surplus, are interpolated (Section 4.2). We present results using both raw data and alternative interpolation techniques in Appendix Figure A.2. Generally, effects sizes are very similar across different interpolations, but smaller compared to using raw data.

Table 5: Labor Market Reform Effects on Marital Surplus

Dependent Variable	Marriage Surplus ($\hat{\Phi}$)					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.352^{***}	-0.385^{***}	-0.310^{**}	-0.388^{***}	-0.417^{***}	-0.433^{***}
	(0.119)	(0.106)	(0.154)	(0.133)	(0.157)	(0.137)
Constant	-6.211^{***}	-6.025^{***}	-6.256^{***}	-6.467^{***}	-6.171^{***}	-5.969^{***}
	(0.144)	(0.154)	(0.169)	(0.194)	(0.167)	(0.191)
	Controls					
Year, Nation FE	✓	✓	✓	✓	✓	✓
Age FEs		✓		✓		✓
Observations	6,725	6,725	3,704	3,704	3,629	3,629

Notes: Robust standard errors in parentheses. Single stocks based on piecewise cubic Hermite interpolation. *Data Source*: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Marriage Register and Microcensus, 1997–2013, own calculations.

6 Additional Results

In this section, we provide additional results to corroborate our main finding. First, we take into account the effect of the EU expansion in the spirit of Adda et al. (2019). Second, we explore within-group heterogeneity in treatment intensity by using foreign nationals' native languages as a proxy for labor market attachment and unemployment risk in Germany. Third, we investigate how the labor market reform affected the stability of intermarriages using divorce data.

6.1 The Effect of the EU Expansion

Adda et al. (2019) study marriage market effects of the EU expansion in Italy and find that it negatively affected intermarriage formation. Here, we check whether the same mechanism confounds the negative effect we attribute to the Hartz I labor market reform in the German context. Adda et al. (2019) argue that lower marital surplus reflects that it was no longer necessary to marry an Italian citizen to gain labor market access. A priori, it is not clear which role this channel played in Germany due to at least two substantial differences between the two countries.

First, Germany restricted labor market access for citizens of the new member states that joined the EU in 2004 and 2007 until 2011 and 2013, respectively. This restriction should weaken the labor market access channel highlighted by Adda et al. (2019). Second,

Germany has a very different history of receiving migrants as compared to Italy.[33] In Germany, intermarriages have been relatively common for a long period of time. About 10% of all new marriages in 1997, the first year of our data, were intermarriages. In contrast, Adda et al. (2019) report intermarriage rates of below 3% for Italian men and around 1% for Italian women for newly formed marriages in 1996. The higher baseline level of intermarriages in Germany, including many marriages with immigrants from non-European countries, could make the EU expansion quantitatively less important for the German marriage market as compared to the Italian one.

The vector of control variables $X_t(c_h, c_w)$ in equation (10) above includes a second differences-in-differences term to capture the effect of the EU expansion on marital surplus. Recall Table 4: we compare intermarriages in which the non-native spouse is from a country that joined the EU in 2004 (EU10) with intermarriages in which the non-native spouse is from a country unaffected by the EU expansion (Turkey, Romania, former Yugoslavia, Rest of the World). The single stocks extracted from the MC are available on an annual basis, so we capture treatment using the indicator function $\mathbb{1}\{t \geq 2004\}$ that returns the value 1 for marriages formed after January 1 2004. The new member states joined the EU only on May 1 2004, but very few marriages are formed during the winter months. The full model, where the additional dummies are written explicitly, is

$$\begin{aligned}
\Phi_t(c_h, c_w, a_h, a_w) &= \beta_1 \cdot Treat_{HartzI}(c_h, c_w) + \beta_2 \cdot \mathbb{1}\{t \geq 2003\} \\
&+ \beta_3 \cdot Treat_{HartzI}(c_h, c_w) \cdot \mathbb{1}\{t \geq 2003\} \\
&+ \beta_4 \cdot Treat_{EU}(c_h, c_w) + \beta_5 \cdot \mathbb{1}\{t \geq 2004\} \\
&+ \beta_6 \cdot Treat_{EU}(c_h, c_w) \cdot \mathbb{1}\{t \geq 2004\} \\
&+ \alpha_t + \delta_c + u_t(c_h, c_w, a_h, a_w), \qquad (11)
\end{aligned}$$

where the treatment dummy $Treat_{EU}(c_h, c_w)$ takes on the value 1 for marriages in which the non-native partner has EU10 citizenship. The interaction $Treat_{EU}(c_h, c_w) \cdot \mathbb{1}\{t \geq 2004\}$ captures the treatment effect on the treated of the EU expansion and β_6 is the respective coefficient of interest.

[33] According to Adda et al. (2019), the share of foreign residents in Italy had been below 2% during the 1990s and started increasing only in the 2000s. It reached around 9% in 2013. Germany has experienced sizable inflows of migrants already in the 1950s/60s. According to the federal statistical office, the share of residents without German citizenship was stable at around 8–9% of the population during the period we study in this paper.

Table 6: EU Expansion Effects on Marital Surplus

Dependent Variable	Marriage Surplus ($\hat{\Phi}$)					
Panel A:	EU Effect Conditional on Labor Market Reform					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{EU} \cdot \mathbb{1}\{t \geq 2004\}$	−0.134	−0.192**	−0.256	−0.231	−0.102	−0.187*
	(0.103)	(0.093)	(0.161)	(0.142)	(0.114)	(0.100)
Panel B:	Unconditional EU Effect					
	All Marriages		German Husband		German Wife	
$Treat_{EU} \cdot \mathbb{1}\{t \geq 2004\}$	−0.224**	−0.292***	−0.360**	−0.358**	−0.236**	−0.327***
	(0.101)	(0.093)	(0.159)	(0.140)	(0.111)	(0.100)
	Controls (Both Panels)					
Year, Nation FE	✓	✓	✓	✓	✓	✓
Age FEs		✓		✓		✓
Observations (Both Panels)	6,725	6,725	3,704	3,704	3,629	3,629

Notes: Robust standard errors in parentheses. Single stocks based on piecewise cubic hermite interpolation. *Data Source*: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Marriage Register and Microcensus, 1997–2013, own calculations.

We report our estimates of β_6 in Panel A of Table 6, again separately for all marriages, marriages with German husbands, and marriages with German wives. Similar to the Italian case discussed in Adda et al. (2019), we find negative point estimates for the effect of the EU expansion on intermarriage surplus. However, conditional on the predating labor market reform, the effects are not always significant and smaller as compared to the unconditional EU expansion effect, which is reported in Panel B of Table 6. This effect is obtained from estimating model (11) without the labor market reform differences-in-differences term. The unconditional effect is highly significant and between 41% and 131% larger than the effect that takes the labor market reform into account. We conclude that taking the labor market reforms into account is important to understand marriage market effects of the EU expansion in Germany. Conditional on the labor market reform, the EU expansion affected the surplus of intermarriages only to a small extent.

6.2 Treatment Heterogeneity

Concerns about the validity of our results could be related to the choice of treatment and control groups, particularly because groups of nationalities mask a lot of potentially important heterogeneity in the exposure to unemployment risk. To help alleviate these

concerns, we rely on differences between the German language and the languages spoken in the remaining EU15 countries. The idea is that speaking a Germanic language facilitates labor market access for foreign-born individuals (Dustmann, 2003; Aldashev et al., 2009). Thereby, it lowers the exposure to unemployment risk and makes individuals from countries with Germanic languages more attractive form the risk-sharing perspective.[34]

To operationalize this idea in the data, we separate the EU15 countries into "linguistically close" (Belgium[35], Denmark, Luxembourg, Netherlands, Austria, Sweden) and "linguistically distant" (Finland, France, Greece, Ireland, Italy, Portugal, Spain, United Kingdom) countries relative to Germany. Figure A.2 in the Appendix shows the development of marital surplus between Germans and EU15 nationals when the EU15 group is separated by linguistic distance.[36] As before, German-EU10 and German-Other marriages experience a fall in surplus after the Hartz I labor market reform, while the surplus of German-German, German-EU15 (close) and German-EU15 (distant) marriages remains stable over time. One could have suspected that marriages in which the non-German spouse is from a EU15 (distant) country are also (partly) treated due to, on average, lower language skills and labor market attachment. This does not appear to be the case, so using language distance reinforces our decision to use both German-German and all German-EU15 marriages as the control group in the main analysis.

To further investigate the language channel, we repeat our main analysis with four different sets of treatment and control groups. First, we re-estimate our baseline model using EU15 (close) and EU15 (distant) as two separate control groups. This is necessary to compare the results because the separation of the EU15 marriages into two categories increases the number of cells. The results, reported in Panel A of Table 7, are very close to our baseline results. Next, we estimate the model using German-German and German-EU15 (close) marriages as the only control group.[37] The coefficients for the la-

[34]Moreover, a small "linguistic distance" directly influences marriage formation due to lower communication barriers and, potentially correlated, fewer cultural differences. However, this channel is time invariant and can thus not explain the time dynamics of marital surplus we are interested in.

[35]German is one of three official languages in Belgium.

[36]Interestingly, the marriage surplus of DE- EU10 marriages converges to the surplus of DE-EU15 (close) marriages over time (, as the initial labor market restrictions for EU10 citizens become less binding) Thus, in terms of marital surplus with a German citizen, EU10 nationals are more comparable to EU15 (close) than to EU-15 (distant) citizens. This is most likely a due to the close historic ties between Germany and some of the EU10 countries, for example due to the influence of the Prussian and Austro-Hungarian Empires in the 18th and 19th centuries.

[37]A detailed overview over the treatment and control groups we use for this exercise is provided in Table A.9 in the Appendix.

bor market reform effect are reported in Panel B of Table 7. They decrease in size but remain significant and quantitatively important throughout all specifications. We also test the counterintuitive case in which only German-German and German-EU15 (distant) marriages are the control group (Panel C). Again, we get very similar and significant estimates. Lastly, we restrict the sample to include German-German, German-EU15 (close), and German-EU15 (distant) marriages only. We estimate the effect of interest using German-German marriages as the only control group. Essentially, this is a falsification test. If we did find significant effects, there would be significant treatment differences within the control group of the baseline specification. Reassuringly, the estimated coefficients become small and insignificant, see Panel D of Table 7

To sum up, we find no effect when comparing German-German marriages to any kind of interethnic marriage, which all experience some sort of language barrier (Table 7, Panel D). Second, when splitting the EU15 observations by linguistic distance to either include linguistically close or distant countries in the control group, the effects decrease somewhat in size but remain significant (Table 7, Panel B & C). This is exactly what one would expect if some untreated groups are "falsely" included in the treatment group. We find no evidence that language, or unobserved characteristics correlated with language, are associated with unemployment risk (treatment intensity) in a way that calls our findings into question. Moreover, our preferred specifications always include nationality and age fixed effects to take their time-invariant effects on marital surplus into account.

6.3 Reform Effects on Marital Stability

In the final step of the analysis, we make use of the German divorce register (DR) data and tools of survival analysis to compare the stability of marriages formed before and after the labor market reform. As explained in Section 4, we combine the marriage and divorce registers at the quarter of marriage-nationality-nationality level to study the survival of different types of marriages. This allows us to check whether potential changes of marital stability are consistent with both the theoretical predictions and the negative effect of the Hartz I reform on the surplus of intermarriages.

The reduction of surplus for intermarriages due to stricter means testing has important implications for selection into marriage. Marriages in which one partner is exposed to high unemployment risk are less frequently observed after the reform. This is equivalent to

Table 7: Labor Market Reform Effects with Language Distance Separation

Dependent Variable	Marriage Surplus ($\hat{\Phi}$)					
Panel A:	Baseline Results with Linguistic Distance Separation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.361^{***}	-0.394^{***}	-0.317^{**}	-0.390^{***}	-0.417^{***}	-0.433^{***}
	(0.092)	(0.082)	(0.126)	(0.110)	(0.129)	(0.112)
Panel B:	Control: German-German & German-linguistic close					
	All Marriages		German Husband		German Wife	
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.291^{***}	-0.307^{***}	-0.265^{*}	-0.315^{**}	-0.333^{**}	-0.340^{**}
	(0.113)	(0.102)	(0.149)	(0.131)	(0.150)	(0.134)
Panel C:	Control: German-German & German-linguistic distant					
	All Marriages		German Husband		German Wife	
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.314^{***}	-0.352^{***}	-0.304^{**}	-0.369^{***}	-0.337^{**}	-0.361^{***}
	(0.115)	(0.103)	(0.150)	(0.131)	(0.153)	(0.135)
Panel D:	Comparing only German and EU15 Marriages (Falsification Test)					
	All Marriages		German Husband		German Wife	
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.042	-0.046	-0.091	-0.083	0.005	-0.012
	(0.228)	(0.195)	(0.239)	(0.205)	(0.242)	(0.205)
	Controls (All Panels)					
Year, Nation FE	✓	✓	✓	✓	✓	✓
Age FEs		✓		✓		✓
Observations (Panels A, B & C)	7,692	7,692	4,171	4,171	4,129	4,129
Observations (Panel D)	2,640	2,640	1,598	1,598	1,650	1,650

Notes: Robust standard errors in parentheses. Single stocks based on piecewise cubic hermite interpolation. *Data Source*: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Marriage Register and Microcensus, 1997–2013, own calculations.

saying that the remaining intermarriages—the ones that were formed despite the reform—are positively selected compared to the group of marriages formed before the reform. One would expect that these marriages have a higher ability to absorb (economic) shocks within the household, because these couples were aware of the reduced generosity of the unemployment insurance system when they got married. Couples who got married before the reform, however, calculated their gains from marriage based on the more generous pre-reform system. As a direct result of this selection effect, we expect that intermarriages formed after the reform are more stable compared to pre-reform intermarriages. Selection also implies that we cannot interpret the effects on marital stability as causal.

To check this hypothesis, we re-apply our differences-in-differences estimation strategy in a Cox proportional-hazard setting (Cox, 1972). This model is similar to equation (1) in Section 2.2. Here, the hazard rate $h(d, Z)$ captures the divorce hazard of a married

Table 8: Divorce Hazard - Diff-in-Diff Estimates

Dependent Variable	Duration until Divorce								
	All Marriages			German Husband			German Wife		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	0.089***	−0.306***	−0.456***	−0.085***	−0.388***	−0.453***	0.178***	−0.280***	−0.475***
	(0.010)	(0.009)	(0.010)	(0.016)	(0.016)	(0.016)	(0.012)	(0.012)	(0.012)
	[1.093]	[0.736]	[0.634]	[0.919]	[0.678]	[0.636]	[1.195]	[0.756]	[0.622]
$Treat_{EU} \cdot \mathbb{1}\{t \geq 2004\}$	−0.307***	−0.595***	−0.486***	−0.208***	−0.646***	−0.562***	−0.022	−0.163***	−0.211***
	(0.024)	(0.024)	(0.024)	(0.029)	(0.029)	(0.028)	(0.051)	(0.051)	(0.051)
	[0.736]	[0.552]	[0.615]	[0.812]	[0.524]	[0.570]	[0.978]	[0.850]	[0.810]
Divorce Year FE		✓			✓			✓	
Divorce Year Strat.			✓			✓			✓
Observations	6,592,292	6,592,292	6,592,292	6,417,362	6,417,362	6,417,362	6,431,657	6,431,657	6,431,657

Notes: Robust standard errors in parentheses. *Data Source*: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Marriage and Divorce Registers, 1997–2013, own calculations.

couple after duration d conditional on a vector of controls Z. γ indicates the vector of coefficients and $\lambda(d)$ is the baseline divorce hazard common to all marriages. As before, we are interested in the estimated coefficient of the treatment dummy interaction $Treat_{HartzI}(c_h, c_w) \cdot \mathbb{1}\{t \geq 2003\}$ to compare marriages in which one partner is a non-native before the reform with marriages of the same type after the reform.

Again, we control for the effects of the EU expansion and, additionally, either stratify by divorce year or include fixed effects to control for influences specific to the year of divorce. When stratifying by divorce year, one allows for different baseline hazards for every single divorce year. This is tantamount to assuming that all divorcing couples in a given year are exposed to the same environment, e.g. the same aggregate labor market situation and legal framework. We are primarily interested in the effects of the labor market reform, so this seems to be the appropriate strategy.[38]

The results are presented in Table 8, separately for all marriages, marriages with German husbands, and marriages with German wives. Column (1) shows the results in the full sample without taking divorce year effects into account. The estimated coefficient of $Treat_{HartzI}(c_h, c_w) \cdot \mathbb{1}\{t \geq 2003\}$ indicates that the divorce hazard increased by 9.3% for marriages treated by the labor market reform. This specification suggests that the labor market reform lowered marital stability, which is not in line with the expected selection effect. The sign of the effect flips in columns (2) and (3) where divorce year effects are taken into account. In both specifications, we find significant and sizable negative effects of the Hartz I labor market reform on the divorce hazard. In other words, treated

[38] In contrast, stratification by marriage year would assume that all couples married in a given year face the same baseline hazard. This assumption seems hard to defend.

marriages became more stable after the reform, in line with the expected selection effect.

With divorce year fixed effects in column (2), the estimated divorce hazard falls by 26.4% relative to the baseline. Thus, marriages with one spouse from a non-EU15 country have a significantly lower divorce risk after the reform. In column (3) with stratification, the effect is even stronger, the divorce hazard falls by more than one third, 36.6%. Both specifications support the idea that intermarriages formed after the labor market reform are positively selected. In Section 5, we found that marital surplus dropped as a result of the labor market reform. Consistently, marriages that were formed despite the reform's negative effect on surplus became more stable than marriages formed before the reform when the UI system was more generous.

We confirm the same trends for the sub-samples of marriages where the husband is German and where the wife is German. There is always a large reduction of the divorce hazards once we control for year fixed effects or stratify by divorce year. We see no clear difference in the effect sizes for couples with German husbands and wives in this case.

Finally, we display the estimated treatment effects of the EU expansion on marital stability. We find that the EU expansion had a further stabilizing effect on the (remaining) marriages between Germans and citizens of the new member countries. The effect is comparable in magnitude to the effect of the Hartz I labor market reform. The negative effects of the EU expansion are larger for marriages with German husbands as compared to German wives. This heterogeneity could partly be explained by the fact that marriages between German women and EU10 men are relatively rare.

7 Conclusion

In this paper, we empirically investigate the importance of within-household insurance for marriage formation and stability. Exploiting a sharp generosity reduction in the German unemployment insurance system—stricter means testing within couples, which was part of the Hartz I reform in 2003—we find that marriages in which one partner had an elevated unemployment risk, proxied by nationality, became significantly less attractive. Provided that both our identifying assumption linking unemployment risk to nationality and the assumptions underlying the Choo and Siow (2006) model hold, the estimated reform effect on marital surplus can be interpreted the as causal.

Taking the labor market reform effect into account, we find that the effect of the EU expansion on the German marriage market is weaker compared to the Italian context studied by Adda et al. (2019). This is most likely related to the fact that citizens of new EU member state received labor market access in Italy while Germany initially implemented restrictions. Moreover, we find that intermarriages formed after the reform are significantly more stable than those formed before the reform. Our interpretation is that the labor market reform resulted in fewer, but better selected intermarriages. These unions are better able to absorb shocks and thus more stable.

The significant and quantitatively important negative effect on the marital surplus of intermarriages in Germany is a finding of high policy relevance. The marriage market ramifications of the labor market reform were most probably not intended by the policy-maker. Moreover, intermarriage is often seen as an indicator for the successful integration of migrants. Reforms of the social insurance system that make intermarriages relatively unattractive may therefore conflict with a successful migration policy and have negative long-run effects. This interpretation of our results is similar in spirit to Adda et al. (2019): if a reform lowers the incentives for intermarriage, paradoxically, the goal of higher labor market participation might interfere with the integration of foreigners.

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A Appendix

A.1 Marriages Formed Abroad

Table A.1: Number of Marriages formed Abroad by nationality of the non-German spouse (selection)

Partner	German	EU15	PL	TR	EU10	RO	Former Yugoslavia	RU	Rest
German Husband	8,619	296	182	173	96	38	69	587	5,442
German Wife	8,619	428	20	528	9	5	71	65	3,315

Data Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Marriage Register, 1997–2013. Total Number of Observations: 20,117

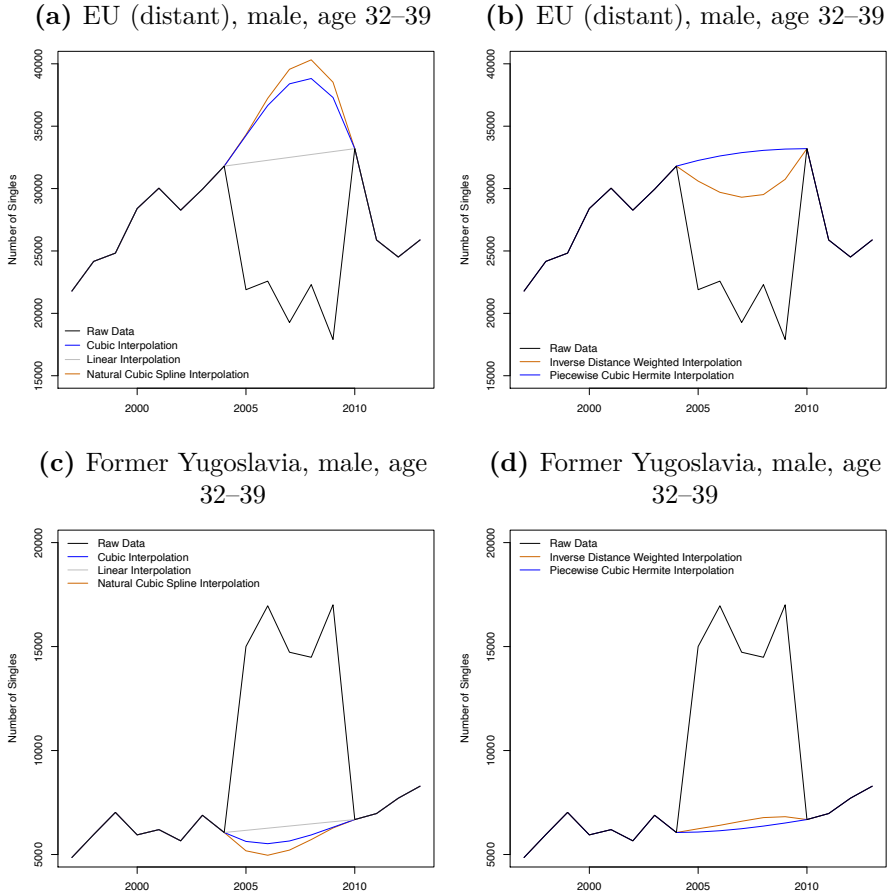
From 2008 onward, the German marriage registers include an indicator for marriages formed outside of Germany ("Auslandsehen"). In addition to German nationals who get married outside of Germany and register their marriage at home, this category also includes two other forms of marriages: (i) marriages of refugees or stateless individuals who reside in Germany and (ii) marriages formed in Germany by foreigners under the jurisdiction of a foreign country, for instance in case the marriage is conducted at an embassy in Germany. According to this definition, marriages formed abroad make up only about 0.15% of all marriages in the data between between 2008–2013. Table A.1 presents the number of marriages formed abroad by nationality of the spouse we observe between 2008–2013.

A.2 Microcensus Sampling Change

In 2005, the statistical offices in Germany changed their sampling procedure for the Microcensus by conducting interviews over the whole course of the year instead of using a fixed reference week. This lead to distortions in the sampling procedure during the first couple of years after the change (2005–2009). Specifically, the sample weights for households that were "hard to reach" for the interviewers at their private address became temporarily unreliable. An example of affected households are single individuals who live alone but are at work all day. For details of the change and the irregularities it caused, see Statistisches Bundesamt (2012).

To illustrate the sampling problem and our procedure to deal with it, Figure A.1 shows two of the most extremely affected subgroups as examples. Example 1 (sub-figures (a) and (b)) plots the single stocks for male EU15 citizens of age 32–39 that are linguistically

Figure A.1: Overview of Imputation Methods



Notes: Single Stocks and Imputation Method Overview for two extreme cases - lingusticly distant EU15 and former Yugoslavian men age 32 to 39. The graphs illustrate the raw data and the following imputation methods: Cubic Interpolation, Linear Interpolation, Natural Cubic Spline Interpolation, Piecewise Cubic Hermite Interpolation, and Inverse Distance Weighted Interpolation. *Data Source*: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Microcensus, 1997–2013, own calculations.

distant to German (used in Section 6.2). Example 2 (sub-figures (c) and (d)) plots the single stocks for male citizens of former Yugoslavia age 32–39 (not part of EU10). The raw data jumps up/down in 2005 and bounces back in 2010. To make sure that these structural breaks, which do not reflect the true dynamics of the single stocks, do not affect our results, we impute values in the affected data range (2005–2009) at the cell (Nationality × Gender × Age) level using 5 different imputation methods: Cubic Interpolation, Linear Interpolation, Natural Cubic Spline Interpolation, Piecewise Cubic Hermite Interpolation, and Inverse Distance Weighted Interpolation. The plots compare all 5 imputations to the raw data (in black). We use two plots for visual reasons. In the main analysis, we report results based on the Piecewise Cubic Hermite Interpolation because this interpolation does not experience large swings in either direction. However, our main results are very similar across all imputations, see the following tables.

Table A.2: Imputation Overview, Results correspond to Table 5

Dependent Variable	Marital Surplus ($\hat{\Phi}$)					
Panel A:	Raw Data					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.441^{***}	-0.475^{***}	-0.366^{**}	-0.444^{***}	-0.522^{***}	-0.539^{***}
	(0.119)	(0.106)	(0.154)	(0.133)	(0.157)	(0.138)
Panel B:	Cubic Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.355^{***}	-0.389^{***}	-0.311^{**}	-0.389^{***}	-0.427^{***}	-0.444^{***}
	(0.119)	(0.106)	(0.154)	(0.133)	(0.157)	(0.137)
Panel C:	Linear Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.349^{***}	-0.382^{***}	-0.307^{**}	-0.384^{***}	-0.414^{***}	-0.430^{***}
	(0.119)	(0.106)	(0.154)	(0.133)	(0.138)	(0.137)
Panel D:	Natural Cubic Spline Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.362^{***}	-0.395^{***}	-0.319^{**}	-0.396^{***}	-0.433^{***}	-0.449^{***}
	(0.119)	(0.106)	(0.154)	(0.133)	(0.157)	(0.137)
Panel E:	Piecewise Cubic Hermite Interpolation (as in Table 5)					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.352^{***}	-0.385^{***}	-0.310^{**}	-0.388^{***}	-0.417^{***}	-0.433^{***}
	(0.119)	(0.106)	(0.154)	(0.133)	(0.157)	(0.137)
Panel F:	Inverse Distance Weighted Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.345^{***}	-0.379^{***}	-0.304^{**}	-0.382^{***}	-0.408^{***}	-0.424^{***}
	(0.119)	(0.106)	(0.154)	(0.133)	(0.157)	(0.137)
	Controls (all Panels)					
Year, Nation FEs	✓	✓	✓	✓	✓	✓
Age FEs		✓		✓		✓
Observations (all Panels)	6,725	6,725	3,704	3,704	3,629	3,629

Notes: Robust standard errors in parentheses. *Data Source*: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Marriage Register and Microcensus, 1997–2013, own calculations.

Table A.3: Imputation Overview, Results correspond to Table 6 (Panel A)

Dependent Variable	Marriage Surplus ($\hat{\Phi}$)					
Panel A:	Raw Data					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{EU} \cdot \mathbb{1}\{t \geq 2004\}$	−0.106	−0.165*	−0.224	−0.199	−0.068	−0.154
	(0.103)	(0.093)	(0.161)	(0.142)	(0.114)	(0.100)
Panel B:	Cubic Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{EU} \cdot \mathbb{1}\{t \geq 2004\}$	−0.131	−0.190**	−0.265*	−0.241*	−0.087	−0.173*
	(0.103)	(0.094)	(0.161)	(0.142)	(0.115)	(0.101)
Panel C:	Linear Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{EU} \cdot \mathbb{1}\{t \geq 2004\}$	−0.136	−0.194**	−0.254	−0.230	−0.105	−0.191*
	(0.103)	(0.093)	(0.161)	(0.142)	(0.151)	(0.100)
Panel D:	Natural Cubic Spline Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{EU} \cdot \mathbb{1}\{t \geq 2004\}$	−0.129	−0.188**	−0.264	−0.239*	−0.087	−0.172*
	(0.103)	(0.094)	(0.161)	(0.142)	(0.115)	(0.101)
Panel E:	Piecewise Cubic Hermite Interpolation, as in Table 6 (Panel A)					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{EU} \cdot \mathbb{1}\{t \geq 2004\}$	−0.134	−0.192**	−0.256	−0.231	−0.102	−0.187*
	(0.103)	(0.093)	(0.161)	(0.142)	(0.114)	(0.100)
Panel F:	Inverse Distance Weighted Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{EU} \cdot \mathbb{1}\{t \geq 2004\}$	−0.132	−0.191**	−0.235	−0.211	−0.114	−0.199**
	(0.103)	(0.093)	(0.161)	(0.142)	(0.114)	(0.100)
	Controls (all Panels)					
Year, Nation FEs	✓	✓	✓	✓	✓	✓
Age FEs		✓		✓		✓
Observations (all Panels)	6,725	6,725	3,704	3,704	3,629	3,629

Notes: Robust standard errors in parentheses. *Data Source*: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Marriage Register and Microcensus, 1997–2013, own calculations.

Table A.4: Imputation Overview, Results correspond to Table 6 (Panel B)

Dependent Variable	Marriage Surplus ($\hat{\Phi}$)					
Panel A:	Raw Data					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{EU} \cdot \mathbb{1}\{t \geq 2004\}$	-0.222^{**}	-0.289^{***}	-0.334^{**}	-0.333^{**}	-0.249^{**}	-0.339^{***}
	(0.101)	(0.092)	(0.159)	(0.141)	(0.111)	(0.099)
Panel B:	Cubic Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{EU} \cdot \mathbb{1}\{t \geq 2004\}$	-0.224^{**}	-0.292^{***}	-0.359^{**}	-0.358^{**}	-0.235^{**}	-0.326^{***}
	(0.101)	(0.093)	(0.159)	(0.140)	(0.111)	(0.100)
Panel C:	Linear Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{EU} \cdot \mathbb{1}\{t \geq 2004\}$	-0.227^{**}	-0.294^{***}	-0.347^{**}	-0.346^{**}	-0.248^{**}	-0.339^{***}
	(0.101)	(0.092)	(0.159)	(0.140)	(0.111)	(0.099)
Panel D:	Natural Cubic Spline Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{EU} \cdot \mathbb{1}\{t \geq 2004\}$	-0.224^{**}	-0.292^{***}	-0.360^{**}	-0.358^{**}	-0.236^{**}	-0.327^{***}
	(0.101)	(0.093)	(0.159)	(0.140)	(0.111)	(0.100)
Panel E:	Piecewise Cubic Hermite Interpolation, as in Table 6 (Panel B)					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{EU} \cdot \mathbb{1}\{t \geq 2004\}$	-0.226^{**}	-0.293^{***}	-0.349^{**}	-0.348^{**}	-0.246^{**}	-0.337^{***}
	(0.101)	(0.092)	(0.159)	(0.140)	(0.111)	(0.099)
Panel F:	Inverse Distance Weighted Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{EU} \cdot \mathbb{1}\{t \geq 2004\}$	-0.223^{**}	-0.290^{***}	-0.327^{**}	-0.326^{**}	-0.255^{**}	-0.346^{***}
	(0.101)	(0.092)	(0.159)	(0.141)	(0.111)	(0.099)
	Controls (all Panels)					
Year, Nation FEs	✓	✓	✓	✓	✓	✓
Age FEs		✓		✓		✓
Observations (all Panels)	6,725	6,725	3,704	3,704	3,629	3,629

Notes: Robust standard errors in parentheses. *Data Source*: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Marriage Register and Microcensus, 1997–2013, own calculations.

Table A.5: Imputation Overview, Results correspond to Table 7 (Panel A)

Dependent Variable	Marriage Surplus ($\hat{\Phi}$)					
Panel A:	Raw Data					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.444^{***}	-0.478^{***}	-0.370^{***}	-0.443^{***}	-0.521^{***}	-0.537^{***}
	(0.092)	(0.083)	(0.126)	(0.110)	(0.129)	(0.112)
Panel B:	Cubic Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.363^{***}	-0.396^{***}	-0.317^{**}	-0.390^{***}	-0.425^{***}	-0.441^{***}
	(0.092)	(0.082)	(0.126)	(0.110)	(0.129)	(0.112)
Panel C:	Linear Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.358^{***}	-0.391^{***}	-0.313^{**}	-0.386^{***}	-0.415^{***}	-0.431^{***}
	(0.092)	(0.082)	(0.126)	(0.110)	(0.122)	(0.112)
Panel D:	Natural Cubic Spline Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.370^{***}	-0.403^{***}	-0.326^{***}	-0.399^{***}	-0.430^{***}	-0.446^{***}
	(0.092)	(0.082)	(0.126)	(0.110)	(0.129)	(0.112)
Panel E:	Piecewise Cubic Hermite Interpolation, as in Table 7 (Panel A)					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.361^{***}	-0.394^{***}	-0.317^{**}	-0.390^{***}	-0.417^{***}	-0.433^{***}
	(0.092)	(0.082)	(0.126)	(0.110)	(0.129)	(0.112)
Panel F:	Inverse Distance Weighted Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.356^{***}	-0.389^{***}	-0.311^{**}	-0.384^{***}	-0.410^{***}	-0.427^{***}
	(0.092)	(0.082)	(0.126)	(0.110)	(0.129)	(0.112)
	Controls (all Panels)					
Year, Nation FEs	✓	✓	✓	✓	✓	✓
Age FEs		✓		✓		✓
Observations (all Panels)	7,692	7,692	4,171	4,171	4,129	4,129

Notes: Robust standard errors in parentheses. *Data Source*: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Marriage Register and Microcensus, 1997–2013, own calculations.

Table A.6: Imputation Overview, Results correspond to Table 7 (Panel B)

Dependent Variable	Marriage Surplus ($\hat{\Phi}$)					
Panel A:	Raw Data					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.301^{***}	-0.317^{***}	-0.264^{*}	-0.314^{**}	-0.360^{**}	-0.367^{***}
	(0.113)	(0.102)	(0.149)	(0.131)	(0.151)	(0.134)
Panel B:	Cubic Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.292^{***}	-0.308^{***}	-0.265^{*}	-0.316^{**}	-0.339^{**}	-0.345^{***}
	(0.113)	(0.102)	(0.149)	(0.131)	(0.150)	(0.134)
Panel C:	Linear Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.289^{**}	-0.306^{***}	-0.262^{*}	-0.313^{**}	-0.332^{**}	-0.338^{**}
	(0.113)	(0.102)	(0.149)	(0.131)	(0.131)	(0.134)
Panel D:	Natural Cubic Spline Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.297^{***}	-0.314^{***}	-0.273^{*}	-0.324^{**}	-0.343^{**}	-0.350^{***}
	(0.113)	(0.102)	(0.149)	(0.131)	(0.150)	(0.134)
Panel E:	Piecewise Cubic Hermite Interpolation, as in Table 7 (Panel B)					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.291^{***}	-0.307^{***}	-0.265^{*}	-0.315^{**}	-0.333^{**}	-0.340^{**}
	(0.113)	(0.102)	(0.149)	(0.131)	(0.150)	(0.134)
Panel F:	Inverse Distance Weighted Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.289^{**}	-0.306^{***}	-0.261^{*}	-0.312^{**}	-0.329^{**}	-0.336^{**}
	(0.113)	(0.102)	(0.149)	(0.131)	(0.151)	(0.133)
	Controls (all Panels)					
Year, Nation FEs	✓	✓	✓	✓	✓	✓
Age FEs		✓		✓		✓
Observations (all Panels)	7,692	7,692	4,171	4,171	4,129	4,129

Notes: Robust standard errors in parentheses. *Data Source*: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Marriage Register and Microcensus, 1997–2013, own calculations.

Table A.7: Imputation Overview, Results correspond to Table 7 (Panel C)

Dependent Variable	Marriage Surplus ($\hat{\Phi}$)					
Panel A:	Raw Data					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.409^{***}	-0.447^{***}	-0.366^{**}	-0.431^{***}	-0.427^{***}	-0.451^{***}
	(0.116)	(0.103)	(0.150)	(0.131)	(0.153)	(0.135)
Panel B:	Cubic Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.309^{***}	-0.347^{***}	-0.299^{**}	-0.363^{***}	-0.331^{**}	-0.355^{***}
	(0.115)	(0.103)	(0.150)	(0.131)	(0.153)	(0.135)
Panel C:	Linear Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.299^{***}	-0.337^{***}	-0.293^{*}	-0.357^{***}	-0.315^{**}	-0.339^{**}
	(0.115)	(0.103)	(0.150)	(0.131)	(0.131)	(0.135)
Panel D:	Natural Cubic Spline Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.314^{***}	-0.352^{***}	-0.304^{**}	-0.369^{***}	-0.337^{**}	-0.361^{***}
	(0.115)	(0.103)	(0.150)	(0.131)	(0.153)	(0.135)
Panel E:	Natural Piecewise Cubic Hermite Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.302^{***}	-0.340^{***}	-0.296^{**}	-0.360^{***}	-0.318^{**}	-0.342^{**}
	(0.115)	(0.103)	(0.150)	(0.131)	(0.153)	(0.135)
Panel F:	Inverse Distance Weighted Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	-0.294^{**}	-0.332^{***}	-0.289^{*}	-0.353^{***}	-0.307^{**}	-0.330^{**}
	(0.116)	(0.103)	(0.150)	(0.131)	(0.153)	(0.135)
	Controls (all Panels)					
Year, Nation FEs	✓	✓	✓	✓	✓	✓
Age FEs		✓		✓		✓
Observations (all Panels)	7,692	7,692	4,171	4,171	4,129	4,129

Notes: Robust standard errors in parentheses. *Data Source*: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Marriage Register and Microcensus, 1997–2013, own calculations.

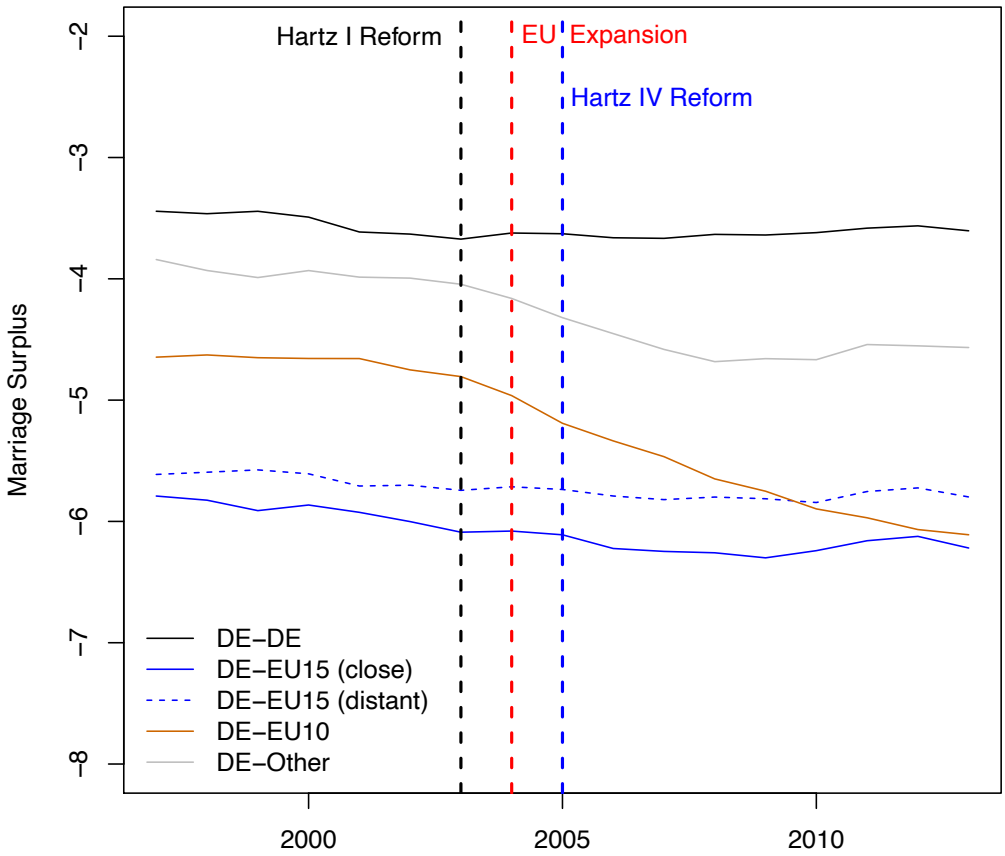
Table A.8: Imputation Overview, Results correspond to Table 7 (Panel D)

Dependent Variable	Marriage Surplus ($\hat{\Phi}$)					
Panel A:	Raw Data					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	0.002	−0.002	−0.055	−0.048	0.057	0.040
	(0.228)	(0.195)	(0.239)	(0.205)	(0.242)	(0.205)
Panel B:	Cubic Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	−0.051	−0.055	−0.096	−0.089	−0.008	−0.025
	(0.228)	(0.195)	(0.239)	(0.205)	(0.242)	(0.205)
Panel C:	Linear Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	−0.041	−0.045	−0.091	−0.084	0.007	−0.010
	(0.228)	(0.195)	(0.239)	(0.205)	(0.220)	(0.205)
Panel D:	Natural Cubic Spline Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	−0.052	−0.057	−0.095	−0.087	−0.011	−0.028
	(0.228)	(0.195)	(0.239)	(0.205)	(0.242)	(0.205)
Panel E:	Piecewise Cubic Hermite Interpolation, as in Table 7 (Panel C)					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	−0.042	−0.046	−0.091	−0.083	0.005	−0.012
	(0.228)	(0.195)	(0.239)	(0.205)	(0.242)	(0.205)
Panel F:	Inverse Distance Weighted Interpolation					
	All Marriages		German Husband		German Wife	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{HartzI} \cdot \mathbb{1}\{t \geq 2003\}$	−0.035	−0.039	−0.087	−0.080	0.015	−0.002
	(0.228)	(0.195)	(0.239)	(0.205)	(0.242)	(0.205)
	Controls (all Panels)					
Year, Nation FEs	✓	✓	✓	✓	✓	✓
Age FEs		✓		✓		✓
Observations	2,640	2,640	1,598	1,598	1,650	1,650

Notes: Robust standard errors in parentheses. *Data Source*: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Marriage Register and Microcensus, 1997–2013, own calculations.

A.3 Robustness: Marital Surplus with Linguistic Distance

Figure A.2: Marital Surplus ($\hat{\Phi}$) incl. Linguistic Distance over Time



Notes: Marriage surplus for marriages where at least one spouse is German by nationality of the non-German spouse when separating EU15 nationalities by linguistic distance to German. The black dashed vertical line indicated the year in which the Hartz I and IV reforms became effective, the red dashed vertical line marks the year 2004 in which the EU expansion took place. *Data Source*: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Marriage Register and Microcensus, 1997–2013, own calculations.

Table A.9: Treatment and Control Groups with Linguistic Distance

Nationalities of Spouses (c_h, c_w)	Hartz Treatment (Jan 01, 2003)	EU Treatment (May 01, 2004)	Treatment Dummy $Treat_{HartzI}$	$Treat_{EU}$
Panel A				
German-German	No	No	$= 0$	$= 0$
German-EU15 (close)	No	No	$= 0$	$= 0$
German-EU15 (distant)	No	No	$= 0$	$= 0$
German-EU10	Yes	Yes	$= 1$	$= 1$
German-Other	Yes	No	$= 1$	$= 0$
Panel B				
German-German	No	No	$= 0$	$= 0$
German-EU15 (close)	No	No	$= 0$	$= 0$
German-EU15 (distant)	Yes	No	$= 1$	$= 0$
German-EU10	Yes	Yes	$= 1$	$= 1$
German-Other	Yes	No	$= 1$	$= 0$
Panel C				
German-German	No	No	$= 0$	$= 0$
German-EU15 (close)	Yes	No	$= 1$	$= 0$
German-EU15 (distant)	No	No	$= 0$	$= 0$
German-EU10	Yes	Yes	$= 1$	$= 1$
German-Other	Yes	No	$= 1$	$= 0$
Panel D				
German-German	No		$= 0$	
German-EU15 (close)	Yes		$= 1$	
German-EU15 (distant)	Yes		$= 1$	