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Kinship structures and survival: Maternal mortality on the Croatian–Bosnian border 1750–1898

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This is an analysis of maternal survival of up to 13,202 mothers following 56,546 births in south central Slavonia (Croatia) in the period 1714–1898, using automated family reconstitution of 23,307 marriages, 112,181 baptisms, and 94,077 burials from seven contiguous Catholic parishes. Physiological factors have the effects commonly expected. Maternal risk is increased by general economic and social conditions that are plausibly related to withdrawal of men's labour from family farming as a result of military mobilizations and growing levels of wage labour. Risk is decreased by membership in large patriarchal kin groups, but is increased by both the presence of classic rivals (husband's brothers' wives) and being married to a husband junior among his brothers. The analysis demonstrates the sensitivity of maternal survival to macrolevel changes in such factors as the collapse of feudalism, military involvement, economic stagnation, and monetization, as well as to microeconomic and micropolitical factors at the household and local kin-group level.

Introduction

Using parish record data from historical Slavonia, the study reported in this paper explores the effects of the microeconomics and micropolitics of patriarchal kin groups on maternal survival, in the presence of physiological and macrolevel social, political, and economic factors. The study confirms earlier results (Hammel and Gullickson in press) on the effects of physiological and macrolevel socio-economic factors, most importantly on the effects of those factors that resulted in episodic or persistently increasing withdrawal of men's labour from family farming. These findings were enriched by the results of analyses prompted by ethnographic evidence. Thus, improved survival chances were found for women from or marrying into larger kin networks. On the other hand, lower chances of survival were found for women with larger numbers of husband's brothers' wives (HBWs) and those whose husbands were younger than their brothers.

We attribute the effect of the size of women's natal kin networks to the ability of large kin groups to command respect and offer assistance to their daugh-

ters, and that of the size of women's husbands' networks to the economies of scale achieved in large, corporate, and relatively self-sufficient patriarchal groupings. We attribute the lower chances of women's survival in the presence of HBWs to the classic rivalry between such women, and the lower chances of those with junior husbands to strong age ranking in patriarchal groupings and the ability of more senior men to insist on better care for their wives. Both rivalry between wives and having a junior brother as husband would, like the withdrawal of men's labour, have the effect of imposing heavier labour burdens on pregnant and parturient women and diminish the amount of nurturant labour available to them. The kinship effects are strong.

Historical overview

Slavonia is the triangle of land between the Sava and Drava rivers of Croatia, its apex pointing toward Belgrade in Serbia, its base approximately at the Ilova near Jasenovac (Figure 1). The Ottomans occupied it from 1526 to 1683, when it was retaken by
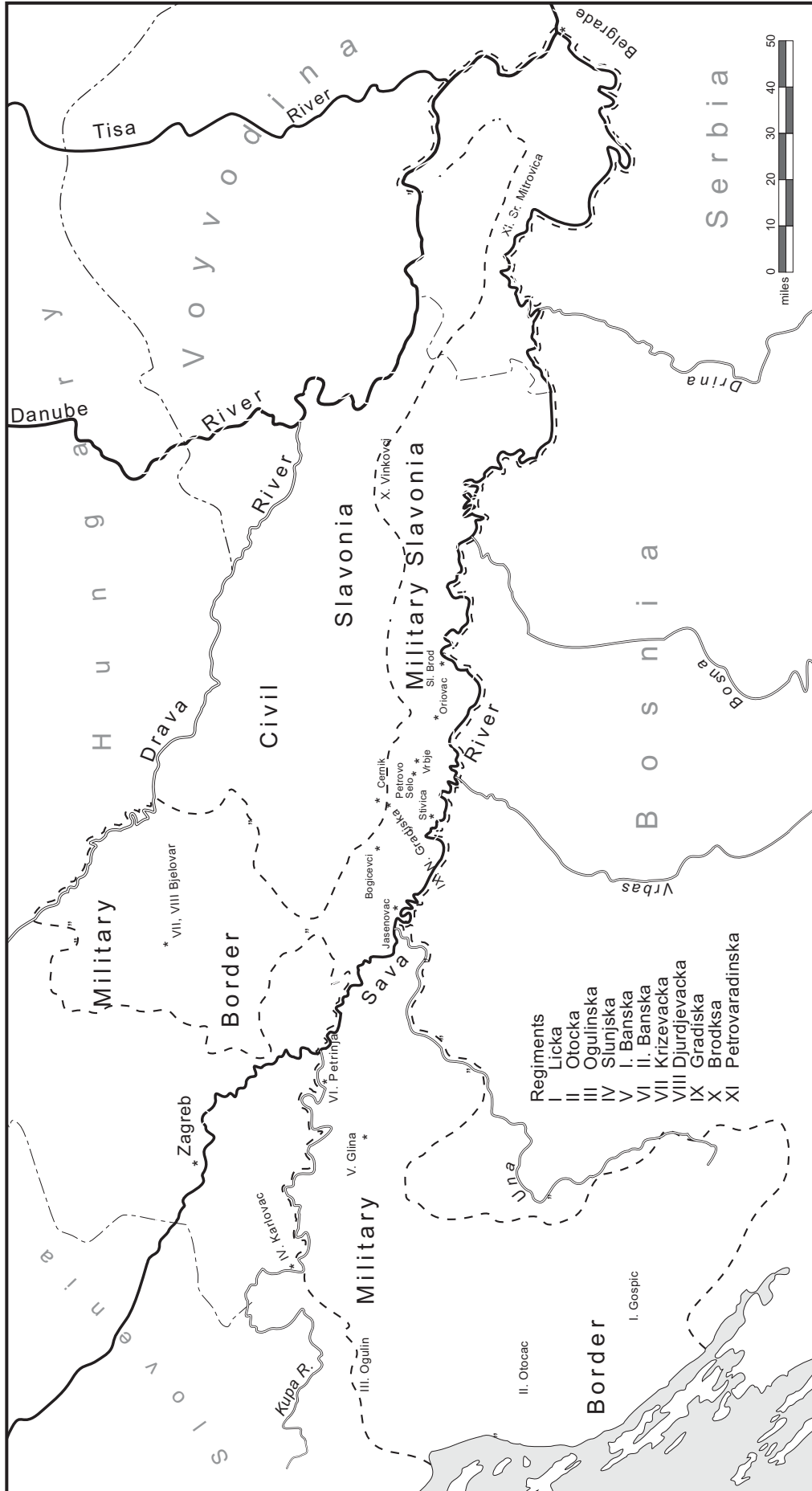
Figure 1   Croatia, Slavonia, and the Military Border

Habsburg forces, but it was not completely pacified until about 1700. The Sava became the border between the Habsburg and Ottoman lands; the parishes studied here are in the zone facing Bosnia across the Sava. The Habsburgs imposed a 'new feudalism' on the region, granting large tracts to favourites of the Court and enserfing the peasantry: those peasants in the immediate vicinity of the border were used in a military capacity, while those farther from the border were used as civil serfs, although the territorial distinction was sometimes imprecise. In 1745 the institutional distinction between the Military Border zone (*Vojna Krajina, Militärgrenze*) and civil Croatia (*Banska Hrvatska*) was formalized. Civil serfs were required to pay money taxes or a portion of their production or both to their landlord, and to provide him with their labour; military serfs were obliged to serve as frontier guards and fight in foreign wars, and also to engage in the construction and maintenance of fortresses and roads. Civil serfdom was abolished in 1848, but serfs were obliged to pay back the value of the land granted to them, over a period of about 20 years. This process, which did not begin in earnest until the 1860s, led to great impoverishment. Military serfs were freed in 1871. They were not required to pay back the value of their land and, unlike civil serfs, had unrestricted access to unenclosed common land. The military and civil zones were united in 1881.

Mobilization of military serfs was frequent, although it is impossible to discover its local impacts; there were 14 military crises in the study period that affected some, if not all, regiments of the border forces. Up to a third of able-bodied male military serfs were on frontier duty at any one time, and another third or more could be called up for foreign wars. Migration into the study area was intense in the early years after the reconquest but slackened thereafter. Natural growth continued, but slowed after about 1780 as peasants began to control their fertility to avoid excessive division of the land among offspring. There is evidence that medicinal and mechanical means of abortion were used at least from the 1760s, and the region was notorious in the nineteenth century for its low fertility (Tomasevich 1955; Rothenberg 1960, 1966; Hammel 1985, 1993, 1995; Andorka and Balazs-Kovacs 1986; Vassary 1989; Hammel and Herrchen 1993; Hammel and Wachter 1996a, b; Hammel and Galloway 2000a, b; see other citations in Hammel and Gullickson in press).

Although there were great estates in the civil zone, commercial agriculture was little developed, partly because the transportation of bulky goods was diffi-cult. Military serfs were the only people permitted to hold land in the Military Border. Agriculture in both zones was non-intensive and devoted largely to subsistence. The rearing of livestock, especially swine, was a major activity and a source of money income along with paid work for civil landlords or for road construction and haulage in the military zone. There was virtually no commercial or industrial development until after 1900. Railroads did not reach the study region until 1871, development having been blocked by competing Austrian and Hungarian interests.

Kinship and household organization

While household organization between the Alps and the Mediterranean and between the Adriatic and the Carpathians varied widely, the study area had a long tradition of complex household formation and the predominance of local agnatic ('patrilineal') group-ings. Usually, sons remained in their natal household at marriage, while daughters moved to their husband's father's household. This residence pattern could persist for several generations, so that as the older generations died, the household core of adult males would come to consist of brothers, then cousins. Eventually, such households would split up, sometimes on the death of the founding couple, sometimes not until several generations later. Even after splitting up, agnatically related households tended to reside close to one another, forming sections of a farmstead, hamlet, or ward of a village. Corporate interests were strongest within the agnatic household itself, with all productive property typi-cally held in common, but some corporate interests also prevailed in the broader agnatic group, taking such forms as the sharing of resources like plough oxen, the exchange of labour at peak season, and access to pasture. There was substantial labour differ-entiation in complex households, with males typically specializing in the care of particular livestock or other farm work, while women specialized in particular types of household production such as weaving and tailoring. Children were often cared for in crèches and surrogate nursing was common. Complex house-holds were most common in the Military Border zone. Their presence there was encouraged by the military authorities because such households could continue to engage in subsistence production even when some of their men were called up for military duty. Within a household, status was a function of gender and age: usually males dominated females, the elder dominated the younger. In-marrying

women were regarded with some suspicion, but their status improved as they bore sons. Characteristic of the relationship between an in-marrying woman and her husband's parents, was the dominance of the latter, especially the mother. The relationship between the wives of brothers (i.e., HBWs) was one of rivalry, often of dislike and suspicion. Folklore (and informants' explicit statements during ethnographic interviews) often attribute the splitting of complex households to disputes between HBWs, each seeking advantage for her own children. (On household organization see Halpern 1958; Erlich 1964; Hammel 1968, 1972, 1980, 1990; Halpern and Anderson 1970; Todorova 1993; Čapo-Žmegač 1996; Hammel and Wachter 1996a, b; Hammel and Kohler 1997; Kohler and Hammel 2001.)

Data

The data for this analysis consist of the ecclesiastical records of 23,307 marriages in the period 1717–1864, 112,181 baptisms in the period 1714–1898, and 94,077 burials in the period 1717–1898 from seven contiguous Catholic parishes in south central Slavonia (Bogičevci, Cernik, Nova Gradiška, Oriovac, Staro Petrovo Selo, Štivica, Vrbje; see Figure 1). The seven parishes came into existence at different times, some as a result of the division of larger parishes; all were recording marriages by 1790 at the latest (Hammel and Gullickson in press, Table 1). The detail of priestly recording improved after about 1750, and the analysis here is restricted to data after that point. Because Hammel had collected marriage data up to 1857–64 only and no new marriages contributed to low-parity births, the parity of recorded births appears to increase soon after this period. Since parity and parish are both controlled in the analysis we do not regard these compositional shifts as producing bias. Baptismal data were recorded until almost the end of the century for several of the parishes.

The priests were generally diligent and the quality of the data is quite good in comparison with many parish registers. The data are rich, especially after about 1750, and include first and last names of (usually) all persons involved in an event, maiden names of brides, full names of baptismal and marriage sponsors, the places of birth, burial, marriage, and often of residence of the principal actors (including the ritual sponsors), and the name of the parish. Marriage records include the name of the father of groom and bride or of the previous husband of a remarrying woman. This richness and redundancy

make reconstitution more reliable. We rejected links for which the data did not provide at least three of the first and last names of both principal actors, for example, of parents on a baptismal record or of spouses on a marriage record, or of both names on a burial record. For this analysis we have used completely automated linkage routines (written in the Perl language), because the computer scripts provide an exact record of the resolution of ambiguities. Fragmentary evidence from *libri status animarum* and the *Chronicle* of the Monastery of Cernik indicates that baptisms were typically performed at birth by the midwife, thus diminishing the number of births followed by neonatal death that might otherwise go unreported. Information for baptismal recording was probably reported to the priest by the midwife, raising the possibility that data for people poorly known in the local community, such as those passing through, might be erroneously reported. However, as discussed elsewhere in the text, such persons are not likely to be included in this analysis.

Methods

The rate of maternal mortality is often used as an indicator of the quality of life and of the relative position of women in society. It has sometimes been estimated for historical populations (Högberg 1985; Imhof 1986; Knodel 1986; Schofield 1986; Henry 1987; Cortes-Majo et al. 1990; Humphries 1991; Wrigley et al. 1997; Andersson et al. 2000). In historical estimation, one is usually obliged to rely on a temporal definition, since death or burial records for past populations seldom contain reliable clinical diagnoses. Since almost all deaths clinically diagnosed as maternal deaths occur quite soon after childbirth, deaths in historical records that so occur are typically evaluated as instances of maternal death. However, since deaths from other causes may also occur soon after delivery, it is necessary to estimate this 'background' mortality. The difference between the latter and recorded maternal mortality yields 'net maternal mortality'.

We count as gross maternal mortality all deaths to mothers occurring within 60 days of childbirth. We estimate background mortality by counting deaths to mothers from 61 days to 2 years from their date of giving birth. Since we use annual background mortality rates as a covariate in the analysis of gross maternal mortality, the effects of other covariates can be construed as those on net maternal mortality.

We estimate the model of maternal mortality using a Cox proportional hazards model. Each woman

Table 1 Baptismal events and mothers by type of record linkage in seven central Slavonian parishes 1750–1898

Linkage	Mothers		Baptisms	
Mothers linked to their own baptism and marriage	8,737 (29%)		37,757 (40%)	
Fathers linked to their own baptism[1]		6,261 (21%)		27,846 (30%)
Fathers not linked to their own baptism[1]		2,476 (8%)		9,911 (11%)
Mothers linked to their marriage only	4,465 (15%)		18,789 (20%)	
Mothers known only from baptismal records of their children	16,475 (56%)		37,712 (40%)	
All	29,677		94,258	

[1]This is a subset of the first category.
Source: Ecclesiastical records of marriages 1717–1864, baptisms 1714–1898, and burials 1717–1898 from seven contiguous Catholic parishes in south central Slavonia.

contributes a variable number of 60-day observation periods to the data, depending on the number of children produced. At each such interval, new values for the covariates are computed. This method does not deflate standard errors despite including multiple exposure periods for each woman (Petersen 1995).

Mothers are known to us because they appear on the baptismal records of their children. We examine a mother's experience in her first marriage only. There are three kinds of mothers in our data-set.

1. Some mothers are linked to their marriage record and from that to their own baptismal record.
2. Some mothers are linked to their marriage record, but not to their own baptismal record.
3. Some mothers cannot be linked either to a marriage record or to their own baptismal record but are known only from the baptismal records of their children.

Overall, there were 94,258 baptismal events (child-births) occurring to 29,677 mothers. Table 1 breaks these down by the three types of mother specified above. Forty-four per cent of the mothers were linked to their marriage, and they accounted for 60 per cent of the baptisms. The number of births per woman where there is no linkage between a child's baptism and the marriage or baptism or both of its mother is about half that in the other types of linkage. Mothers without such linkages are likely to have migrated into the catchment area after their marriage so that we can capture only some of their childbirth histories. Notice that these mothers cannot be included in an analysis that examines age, parity, lifetime average birth interval, or any other factor that requires information on the entire reproductive history.

Because one model we wish to examine includes variables on both consanguineal and affinal kin, we must take a subset of this population. In order to find consanguineal kin for a mother, we must have her own baptismal record, which provides details of her parents and thus links to her siblings. This necessity restricts our sample to the women in the first category (row 1) of Table 1. In order to find her husband's consanguineal kin, we must also have the baptismal record of the father. We are thus obliged to look at only the subset of the population for which both the father's and mother's baptismal record are known for a particular birth event (row 2). As Table 1 shows, the data for a model including consanguineal and affinal kinship are reduced to 27,846 births occurring to 6,261 women, about a third of the original total of births and about 20 per cent of the original total of mothers.

The kinship variables in our model are based on counts of particular types of kin. Such counts may conflate the effects of kin with those of local health environments, because networks with large numbers of kin are networks with large numbers of *surviving* kin. We attempt to control for this difference, which may reflect the local health environment, by including a random-effect term in the model that captures the clustered maternal mortality within affinal agnatic networks. For the jth birth in the ith cluster, the hazard model is

$$h(t_{ij}|w_i) = w_i\lambda_0(t_{ij})e^{\beta'\mathbf{x}_{ij}(t_{ij})}$$

where $\lambda_0(t_{ij})$ is some unspecified baseline hazard, $\mathbf{x}_{ij}$ is a vector of covariates for the jth birth in the ith cluster, and w_i is a random frailty effect specific to each affinal agnatic cluster. This frailty effect is

assumed to be drawn from a gamma distribution with an expected value of 1 and a variance of ϕ. This distributional assumption, although more restrictive than a non-parametric approach, is well established in the literature on frailty effects (Guo and Rodriguez 1992; Sastry 1997a; Powers and Xie 2000, pp. 196–9) and allows for an intuitive interpretation of the ϕ term. Under the gamma distribution, $1 + \phi$ can be interpreted as the proportional increase in the odds of death in an observation period for every other death occurring in the cluster. The use of a clustered frailty term allows us both to explore the degree to which maternal mortality clusters in particular agnatic networks and to control for the potential bias of shared health environments on the contribution of kin to the risk of maternal mortality.

Covariates

Our covariates are divided into three broad groups: physiological, socio-economic, and kinship-network variables. Table 2 shows means and standard deviations for these and other variables.

Most studies of maternal mortality focus on physiological variables such as age and parity (Yerushalmy 1940a, b, 1945; Högberg 1985; Schofield 1986; Loudon 1992; Wrigley et al. 1997; Andersson et al. 2000, *inter alios*). The literature leads us to expect that first births will have the highest risk, but that risk will again increase from the second to higher-order births. At each parity we expect risk to increase with age. Multiple births are more dangerous. Background mortality should be positively correlated with (gross) maternal mortality. In the models, we include age as a continuous variable. We include parity as a set of categorical variables: parity one, parity two to four (the omitted category), parity five to seven, and higher parity. We include a dummy for cases of multiple birth. We include a measure of the birth interval since the last birth (or marriage in the case of first births) and a measure of the mean of all intervals up to the index birth. Background mortality is the crude mortality rate for the entire sample of mothers in the 61-day to 2-year window after a birth for the year in which the reference birth took place.

Birth intervals present a special problem. In historical data of this kind, long birth intervals may indicate unobserved stillbirths and abortions as well as the absence of maternal depletion. These effects are expected to influence mortality in opposite ways and may be conflated by a single birth-interval measure. In earlier research (Hammel and Gullickson in press), we have included both a previous birth-interval term and a lifetime mean birth-interval term. However, this approach is problematic because it incorporates information on future events for all non-final births. Thus we redefine our measure of the previous birth interval to be a deviation from a woman's lifetime average, which captures unobserved difficulties in the interval preceding the index birth. We also include a measure of mean birth interval up to the index birth, which captures maternal depletion. These measures are somewhat problematic for the small number of women who have only one birth, but we find that the results are consistent when these women are excluded and that the inclusion or exclusion of these birth-interval covariates has no substantial effect on other findings in this paper.

The economic and social variables involve military vs. civil status, using parish dummies, with the civil parish omitted. The military parishes were at a slightly lower elevation than the civil parish and were closer to the Sava river. Rates of malaria may have been higher in those locations; there is one mention in the chronicle of the monastery of Cernik of a complaint by villagers who had been moved to a lower-lying area. We have no other specific information on malaria, but it was endemic throughout the lowlands of the Sava and Danube. Similarly, contamination of well water may have been more frequent at lower elevations where the water table was high, but again we have no specific information. Nevertheless, the parish dummies give us some control for these factors in the analysis. This set of factors also includes whether a birth occurred within a year following a military mobilization ('crisis'), and the calendar year of the birth (with 1815 as the origin). Several of these years saw the withdrawal of men's labour from subsistence farming, requiring women to take on a heavier burden of agricultural work—allowing them less time to nurture women giving birth. The regular withdrawal of as much as a third of men in the labour force among military serfs for frontier duty would have imposed a heavy burden on many women. The effects on women would have been greater during major mobilizations that required an even higher proportion to withdraw. In the civil zone, and in the military zone in the last part of the nineteenth century, land shortage, impoverishment, and increasing dependence on wage labour would have pulled men away from family farming, leaving more tasks for women.

The kinship clusters we can deduce from the reconstitution are not necessarily congruent with household boundaries. For example, we estimate the influence of the number of HBWs on a parturient's

Table 2 Descriptive statistics for sub-sample of births in seven central Slavonian parishes 1750–1898

Variables	Means and standard deviations of variables at each birth			
	Mothers linked to a birth and/or marriage		Mothers linked to a real affinal network only	
Variable	Mean	SD	Mean	SD
Woman died in 60-day period	0.007	0.086	0.008	0.089
Physiological variables				
Age	30.685	7.306	29.779	6.885
Parity				
Parity 1	0.229	0.420	0.225	0.417
Parity 2–4	0.478	0.500	0.480	0.500
Parity 5–7	0.223	0.417	0.226	0.419
Parity 8+	0.070	0.255	0.069	0.253
Previous birth interval	2.593	1.773	2.554	1.681
Multiple birth	0.026	0.159	0.026	0.160
Background mortality rate	0.0124	0.0065	0.0129	0.0061
Macrolevel variables				
Parish				
Parish B	0.040	0.195	0.044	0.205
Parish C (civil parish)	0.288	0.453	0.284	0.451
Parish G	0.231	0.421	0.171	0.376
Parish O	0.112	0.315	0.106	0.307
Parish P	0.175	0.380	0.185	0.388
Parish S	0.058	0.234	0.078	0.267
Parish V	0.096	0.295	0.133	0.340
Year	1816.67	29.854	1827.14	24.11
Crisis period	0.316	0.465	0.334	0.472
Network variables				
Husband's brothers' wives			0.400	0.668
All same generation affinal kin			1.384	1.557
All same generation consanguineal kin	1.963	1.901	2.014	1.899
Husband's absolute rank among brothers			1.760	0.389
No husband's brothers' wives			0.688	0.463
Number of mothers	13,202		6,261	
Number of births	56,546		27,846	

Source: As for Table 1.

survival. Some but not necessarily all of these individuals were very likely to have been co-resident with her. If not, they were almost surely on the same farmstead or in the same street, ward, or hamlet. On the other hand, where we estimate the influence of a woman's own consanguineal kin, we can usually be sure that none of them were in the same household, and fewer of them would be close by, although they must have been in the same set of seven parishes, most likely in the same parish, or we would have no knowledge of them. In the rare instances in which a household contained no sons, the eldest daughter might remain in the household on her marriage, to be joined there by an in-marrying husband. Unlike their own parents and their unmarried sisters, such women would not have other wives co-resident, since the other daughters would marry out. We count a mother's sisters only until they married out of their natal group and a mother's husband's brother's wives only once they married into the network of residence of the woman giving birth. We count only persons living and over age 15 at the time of the reference birth. We count parents and siblings but not more distant kin. Thus we may undercount surviving grandparents, uncles and their wives, consanguineal aunts, and cousins. While some records of households in the surviving *libri status animarum* contain details of father's brothers and their sons and those sons'

wives, they are relatively rare. Thus our kin counts are only of the core of the agnatic network, the part most likely to coincide with the household or a superset of it.

Given the household arrangements in this area discussed earlier, we expect the affinal kin count to have a stronger relationship than the consanguineal kin count to maternal mortality, as it more directly reflects the economies of scale operating in the household or network of the residence of the woman giving birth. Nevertheless, we think it likely that women with large consanguineal networks had some assistance and protection from them. However, since we also know that HBWs were not always a resource but also in a competitive position, we include a count of HBWs separately in the models. This allows HBWs to contribute both to the overall affinal network and separately as a distinct entity. We predict that these contributions will influence mortality in opposite ways.

Additionally, because a woman's position in her husband's agnatic network would be a function of his age rank among his brothers, we expect that the more junior her husband, the higher her risk. Wives married to senior brothers were often in an advantageous situation. To capture this potential dynamic, we include a relative rank measure. Senior wives are coded as one and the most junior wife is coded as zero. Intermediate wives were scored at equal intervals between the most senior and most junior wife. If A is the absolute rank where 1 is the most senior rank and there are W women in the network, then the relative rank (R) is

$$R = \frac{(W - A)}{(W - 1)}.$$

This measure preserves the relationship between the most senior and most junior wives regardless of network size. Furthermore, it assumes that intermediate wives of the same absolute rank will have a more senior relative rank in larger households. We find this to be intuitively appealing. This measure is problematic for women who have no HBWs. For these women, we impute a value, treating them like senior wives but also assign them a dummy variable. Owing to the dummy variable, the imputation has no effect on the estimate of the coefficient of the relative rank. The coefficient on the dummy variable also indicates how incorrect our imputation might be. Statistically, the particular value imputed is not important, but we chose the value of one because it allows a direct comparison of the risk of women without HBWs relative to the risk of senior wives in networks with other HBWs. If the coefficient is

negative, women without HBWs do better than senior wives. If it is positive, they do worse.

Results

Table 3 summarizes the results of the Cox regressions. We provide *p*-values for all parameter estimates, even though our data are not drawn from a random sample. Inherent noise is generated in any life-history reconstitution, in addition to the natural variability entailed in life-course processes. By including *p*-values we hope to provide some indication that our parameters are not simply capturing this noise. Nevertheless we note that all of our expectations are directional, so that if *p*-values are to be interpreted, it is the one-tailed values that should be employed. While we have confidence in the integrity of the data, we realize that a particular reconstitution, no matter how consistent it appears or how carefully constructed, is in some sense a sample from a universe of possible reconstitutions from the same underlying data. We do know from examination of the reconstituted data that the marriages recorded tended to be parish endogamous, that ritual sponsors tended to be selected from near by, and that most children of a family were baptized in the same parish. These factors make good linkages more likely, but at the same time they could be the result of reconstitution and not the factors that make reconstitution reliable. There was significant migration into the study area, but mostly before 1750, and some migration out of it, although the historical sources are not very informative on this. There is some suggestion that families with high fertility moved because they were facing land shortages for their heirs. The fact that mean parity increases in the last part of the data, because marriage records were not recovered up to 1900, may impart some bias to estimation of change over time, but the effect of that would be the opposite of the observed increase in maternal mortality over time, since primiparous births carry the highest risk to the mother. These and similar considerations lead us to be cautious in our conclusions. Nevertheless, the effects seem strong.

For comparative purposes, we begin with a model that includes only physiological and macrolevel socio-economic factors. This model uses a larger subset of the data (rows 1 and 4 of Table 1) and thus provides better estimates of these variables. (See Table 3, column 2, 'without kinship'.)

The effects are strong for parity one, multiple births, previous birth-interval deviation (unrecorded stillbirths and abortions), and mean birth interval (maternal depletion). Higher levels of background

Table 3 Cox proportional hazard analysis of the risk of dying within a 60-day observation period after giving birth in seven central Slavonian parishes 1750–1898

Variables	Coefficients and standard errors of covariates	
	Without kinship	With kinship
Physiological variables		
Age	–0.001 (0.010)	0.004 (0.014)
Parity		
Parity 1	0.569 (0.132)***	0.649 (0.193)***
Parity 2–4 (reference)	–	–
Parity 5–7	0.048 (0.146)	0.028 (0.203)
Parity >7	0.221 (0.225)	0.214 (0.310)
Previous birth interval deviation	0.214 (0.036)***	0.231 (0.050)***
Mean birth interval	–0.065 (0.040)†	–0.115 (0.063)*
Multiplicity of birthing		
Single birth (reference)	–	–
Multiple birth	0.876 (0.201)***	0.773 (0.290)**
Background mortality	0.019 (0.007)**	0.020 (0.011)*
Macrolevel variables		
Parish		
Parish B	0.702 (0.210)***	0.546 (0.313)*
Parish C (civil parish, reference)	–	–
Parish G	0.009 (0.152)	0.109 (0.226)
Parish O	0.348 (0.173)*	0.339 (0.250)†
Parish P	0.325 (0.149)*	0.353 (0.207)*
Parish S	0.262 (0.212)	0.346 (0.267)
Parish V	0.131 (0.185)	–0.054 (0.255)
Year of baptism (origin = 1815)	0.004 (0.002)*	0.002 (0.004)
Year of baptism * Parity 1	0.009 (0.004)*	0.006 (0.007)
Crisis period		
No crisis (reference)	–	–
Military crisis	0.313 (0.105)**	0.287 (0.149)*
Network variables		
Number of adult affines		–0.238 (0.083)**
Number of adult consanguines		–0.032 (0.038)
Number of husband's brothers' wives		0.477 (0.236)*
Husband's relative age rank		–0.396 (0.249)†
No husbands brothers' wives		–0.047 (0.338)
Clustered frailty (ϕ)		0.489 (0.677)
Number of births	56,546	27,846
Number of mothers	13,202	6,261
Number of maternal deaths	417	222

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; †$p < 0.10$.
Source: As for Table 1.

mortality are associated with higher levels of maternal mortality. These confirm our expectations. The effects are weak and ambiguous for age and in the expected direction but weak for parities over four. The weakness of an expected positive effect of age may reflect simply the close association between age and parity in a population in which age at marriage was relatively invariant.

The effect of parish identity is fairly consistent, the military parishes generally having higher mortality than the civil parish. We attribute this difference to the greater withdrawal of men's labour from family farming in the military zone, both for regular frontier duty and for military construction and maintenance. The effect of military crises in the Border zone is also positive, strengthening our view of the importance of

men's labour for women's survival. We note, however, that if each of the 14 crises is used individually in the analysis, they do not all have a significant effect (details not shown), though all have a positive sign. One might surmise that the effect of such crises was to increase maternal mortality by the transmission of disease from returning soldiers to their wives, rather than by forcing the wives to undertake the work of their missing husbands. However, in major campaigns—which took place in Italy, Prussia, and other distant locations—the return of soldiers was delayed because they had to walk back. But the effect we see in the regressions is that of mortality risk within a year of a crisis. Further, disease transmission would affect background mortality beyond the 60-day window, and the regressions control for that factor. Also the crisis variable has no significant effect on background mortality (details not shown; see Hammel and Gullickson in press). In other words, it was the absence of men that increased maternal mortality, not their presence. In the same vein we note the increase in maternal mortality over historical time. We attribute this to the known increase in wage labour among military (and former military) serfs as foreign interests began to exploit forest resources, and to the increasing dependence of civil serfs on wage labour. Indeed, land shortage for both classes of serf, and the obligation to pay back emancipation grants for civil serfs, led both to enter wage labour increasingly at the expense of subsistence farming. It is noteworthy that the effect of interaction of baptismal year and first birth is positive: the increase in maternal mortality over time was stronger at first parity than for other parities.

We conjecture that the effect of the withdrawal of men's labour was to increase the labour burden of women. Women in late pregnancy with increased workloads might suffer miscarriage or stillbirth, events that carry high risk of death or damage that might lead to high risk later. We think it likely that some stillborns may have been baptized provisionally during the birth process or *in extremis* and entered on the baptismal rolls. If the mother died in consequence of such a stillbirth or very early neonatal death, our reconstitution would capture it. Other women might have had less time to attend to women in late pregnancy or to women about to give birth, or to assist with surrogate nursing and childcare. A shortage of women available to help (which is also a characteristic of networks with small numbers of adults under any circumstances) could lead to critical failures—not being able to fetch the midwife in time, not being able to keep the bed clean or follow the midwife's instructions for postpartum care, not allowing a woman giving birth enough time to recover from a difficult birth, and so on.

The second model in Table 3 (column 3) includes the kinship factors, and thus the sample size is reduced significantly. The effects of the physiological and socio-economic variables are consistent with those of the previous model, although they are not as strong statistically, owing to the reduction in sample size.

Turning to the network variables: the larger a woman's affinal network, the lower her risk of death. We attribute this to the substantial economies of scale achieved in joint households and in their embedding networks. We know from the scattered *libri status animarum* that many households were quite large, with membership in the 30s (including children), while small nuclear households were rare. Within large households, labour was finely divided, as indicated earlier. Even if a household was not large, it would have some economies if its embedding network was large. We know that oxen were probably shared within agnatic groups but not beyond them (Hammel and Kohler 1997; Kohler and Hammel 2001). Labour exchange was a common tactic in peak season or for tasks for which extra labour might be required, such as raising a roof or the ploughing of boggy fields with a heavy wheeled plough. Agnatic kin were the most important participants in labour exchange. Of course we cannot overlook the fact that large networks might have been more prosperous, even if only because their numerical strength gave them political advantage in the community. But such prosperity need not have resulted in lower maternal mortality.

Similarly, the size of a woman's own consanguineal network has a negative, although small and statistically insignificant, effect. We expected that women with a strong network would enjoy political support and pressure for nurturance. But households and networks were self-sufficient. Agnatic networks were exogamous, and women often came from a different village even if from the same parish. The lineage system was strong, and women tended over their lifetime to be socially incorporated into their husband's lineage (even if not as consanguineal members). These factors may explain the weakness of the expected effect of support from consanguines.

The number of HBWs in a woman's network is positively related to her risk of death, controlling for the size of the adult affinal network. This means that as the proportion of those adults that are HBWs increases, the higher is the woman's risk. To what should we attribute this malign influence of HBWs? The relationship between women who are the wives

of brothers is, according to folklore and ethnographic observation, strained. But it would be a harsh judgement to suggest that HBWs intentionally increased the risk to their sisters-in-law. We must recognize that in the developmental cycle of fraternal joint families, all actors realize that some day the unit (whether it be a household or a lineage) will split up. Over the cycle, and over the life cycle of actors, that anticipation leads to a pursuit of self-interest. The wives, who are viewed as the nuclei of dissent and division, will begin to reserve some resources for themselves. In particular, they will direct their own labour increasingly to the interests of their own maturing conjugal families, leaving less that they can contribute to the nurturance of those outside it. For example, women assisted daughters in the preparation of their dowry and hoarded gold jewellery, which might be part of the dowry and which was handed down from mother to daughter, despite the prevailing patrilineality of the descent system and the fact that females did not ordinarily inherit land, stock, or other communal property.

The relative rank of a woman's husband among his brothers is an important influence. The strong negative value indicates that more senior wives had lower hazards of maternal mortality. We interpret it as an element in the gender/age politics of households and networks. Age dominance was an important feature of kinship relations (see especially Erlich 1964). By itself, the effect of age rank would be ambiguous. The age gap between spouses was not large or greatly variant, and the age of the mother at birth is taken into account in the regressions already. What is at issue is the relative rank, and thus the dominance position of the husband. Our interpretation is that the less dominant a man was in his fraternal set, the less care he could expect by deference or demand for his wife. Similarly, the more junior he was, the more likely it would be that he would be called up for military duty, since younger men were called first, thus leaving his wife at least some of his chores and to negotiate her care by herself.

Women who had no HBWs in their affinal network possibly had a lower risk than women who were senior to other HBWs and certainly did not do worse, as evidenced by the small negative (although statistically insignificant) value of the 'No husband's brothers' wives' variable (Table 3, row 5, under 'Network variables'). From the values of the kinship variables employed here, we might hazard a guess as to the network a woman would prefer to live in or how her survivability would unfold over the life course. Affinal kin were a benefit as long as they were

not HBWs. Therefore, a woman would have her best chances in a large affinal network that was made up of unmarried husband's brothers and unmarried husband's sisters. As these husband's sisters started marrying out and HBWs began marrying in, a woman's hazard would increase, independent of her own age and parity. However, if such a situation were destined to be, a woman was in a far better position if she were the senior member of these in-marrying wives. Figure 2 shows these effects graphically, using the risk factors from the proportional hazard model. It shows a hypothetical lone woman who marries into a household where her husband has two celibate brothers (HB) and two sisters (HZ) who marry out, the first after the woman's first delivery, the second after her second. She has of course no HBW. Her risk increases with each loss of labour in the household. Her curve of risk is paralleled by that of another lone woman, whose husband has no brothers but two sisters. Her risk is higher owing to the absence of the labour of two brothers. It increases with the loss of each HZ but is not exacerbated by the presence of any HBW. A third woman, the first to marry into a household with two HB and two HZ, and thus the senior wife, shows a more complex development of risk. She loses a HZ after her first delivery in this hypothetical scenario and again after her second, but she gains an HBW at the same points. Her risk goes up more steeply than that of the other women, above, because the replacement of the labour of a HZ by the labour of a competing HBW increases her relative risk. Even more extreme is the risk profile of a junior wife, the last to marry into a household in which the HZ have married out and two other competing HBWs are already present. Her risk is high and stays high. Similar expected values can also be computed for other contrasting covariates.

Some control over background conditions of morbidity and mortality is achieved by using background mortality for deaths to women giving birth in a 2-year window. Parish identity also serves as a control over local health conditions. There was also a strong clustering of maternal mortality within affinal networks as evidenced by the size of the random-effect variance (the 'clustered frailty' variable). This clustering reflects unobserved shared environmental conditions. While many of these conditions may have been particular to households or networks, it is also likely that they were common to villages and other, larger geographical groupings. Therefore, the affinal clustering measure we use probably overestimates the extent of clustering that is due just to household or network-level factors (Sastry 1997b). Be that as it may, the value of this variable indicates that a
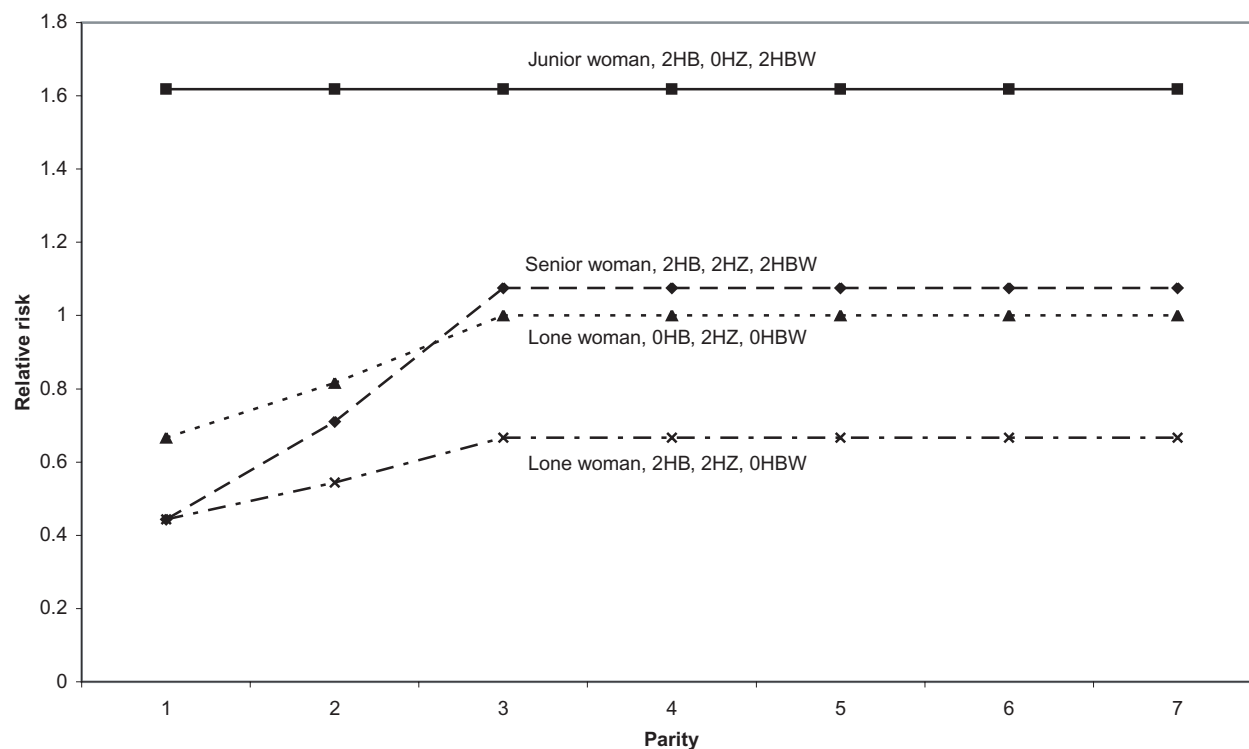
Figure 2 Relative maternal mortality risk for a hypothetical group of Slavonian women 1750–1898
Note: HB = husband's brother; HBW = husband's brother's wife; HZ = husband's sister. Relative risk is relative to that of a woman with no husband's siblings
Source: As for Table 1

woman's baseline risk is increased by about 49 per cent for every maternal death in her affinal network.

Conclusions

In this paper we have extended and refined earlier work on factors influencing maternal mortality among serfs and then emancipated serfs in civil and military regions of Slavonia in the period 1750–1898. Our results for physiological factors give us confidence in the quality of the data, since they are generally in accord with results in the literature. Macrolevel socio-economic influences are plausibly attributable to persistently increasing and episodic withdrawals of men's labour from family farming. Military parishes, which are more subject to such withdrawals even on a regular basis, had higher levels of maternal mortality.

Our particular intent in this paper was to examine the effect of kinship structure and kinship relations on maternal survival. In the context of a strong patrilineal system and a tradition of agnatic corporacy and joint household organization, we find strong and consistent effects. Women married into a large agnatic network enjoyed economies of scale and had a lower risk. However, the number of other wives in

the network in their generation was a counter-influence and raised their risk, in consequence of the self-interest and rivalry of the wives of brothers. Women coming from a large agnatic network also had a lower risk, probably enjoying political support and even intervention on their behalf, but the effect is weak. We attribute that weakness to the self-sufficiency of networks, distance between the network of origin and of marriage, and the gradual incorporation of wives into their affinal networks over the life cycle. The more junior a woman's husband in his own fraternal set, the higher was his wife's risk. Wives in an agnatic network in which maternal risk of death was high for the other wives, also had higher risk. This clustered frailty factor, with background mortality and parish identification, gives us some control over the local health environment. We conjecture as before that restrictions on the ready availability of females who could assist women in late pregnancy and after delivery are the critical factors, here determined by the constitution of agnatic networks within the framework set by macrolevel conditions. Women with husband's unmarried sisters were advantaged; their labour was a public good. Women with HBWs were, everything else equal, disadvantaged. The labour of those women was increasingly privatized. Junior women were disadvantaged because their own

husbands were more likely to be absent and because the labour of other women could less easily be commanded on their behalf. The causality suggested at the microlevel is the same as that put forth for the macrolevel—an institutionally conditioned supply of labour at critical times.

We conclude from the estimation of these kinship factors that the cyclical dynamic of the household and lineage—with its changing producer–consumer ratio, the divergent self-interests of members of social units able to break away from them, and with age dominance an important factor in personal relations—had strong effects on the life chances of women. The study of maternal survival is sharpened and enhanced by taking account of micropolitical factors even within a rapidly changing macrolevel environment. Knowledge of such factors can be gleaned from historical and sometimes from ethnographic sources. Indeed, the evaluation of maternal survival in modern less developed countries, in which strong agnatic structures and complex households (including polygynous ones) often exist, would be furthered by the incorporation of ethnographic and historical knowledge.

Notes

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