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Chapter 11

Maternal Mortality as an Indicator of the Standard of Living in Eighteenth and Nineteenth Century Slavonia[*]

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1. Introduction

The task of the social sciences was succinctly put by C. Wright Mills (1959): to show how the lives of little people were shaped by the passage of great events. This paper is about how the life chances of peasant women, in their most primal experience, childbirth, were shaped by the blind and impersonal forces of institutional and market change.

Insights into the standard of living in the past may rely on different kinds of data. General historical accounts give a broad but often imprecise view. Detailed economic information is often unavailable or difficult to interpret.. A third source is information on the plausible

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impacts of changes in standard of living on the demographic rates and health of populations. Where demographic data are more reliable and more specific than economic or social indicators, we may reverse the indicative arrow and obtain a closer insight into the conditions of life.

In this paper we seek to combine all forms of evidence. General information on regional economic history is relatively abundant. Detailed economic information is sporadic and inspecific; good time series are especially rare. Demographic information is often reasonably good, indeed quite good if derived from family reconstitution of parish records. Thus our best practical approach to understanding the economic and social history of the region is through examination of the demographic record, a record of the results of levels and changes in the 'standard of living'.

We briefly recapitulate and refine earlier analyses of demographic responses to economic and social stress in the population of Slavonia in a period of tumultuous structural change c. 1750-1900 and then focus on maternal mortality. Our motivation is to contribute to the long-running debate on the costs of industrialisation and more broadly on the costs of development in general. Who pays the short-term costs of structural change? Did demographic indicators improve or worsen as feudalism relaxed, monetisation increased, and capitalist agriculture struggled to develop? What role did traditional and imposed social structures and arrangements play in the risk of maternal mortality?

This paper will show that:

Feitel for assistance in family reconstitution work, to Kenneth Wachter for statistical advice, and to participants at the Arild conference for their comments. None of these institutions or persons is responsible for any errors.

- The strength of short-term Malthusian responses to food shortage, as proxied by grain prices, was high by contemporary standards and increased in times of crisis and over the long term.
- The physical stature of military recruits in the broader region diminished until about 1850, then rose.
- Maternal mortality was often higher than that in other regions of the same historical period.
- The expectable physiological patterns appear: maternal mortality is most severe at the first birth, usually increases with age for each parity, and is higher for multiple births.
- Maternal mortality increased episodically in periods of military mobilisation when male labour was withdrawn from family farming and replaced by female labour. Military parishes show higher levels of maternal mortality than civil parishes.
- Maternal mortality increased over time, commensurate with monetisation, land shortage, general immiseration, diversion of male labour to wage earning, and decay of the joint family system that provided household economies of scale in labour.
- The rate of increase in maternal mortality was greater for new brides (primiparous females), who were traditionally at the bottom of the household hierarchy, than for more established wives.
- The infant mortality rate shows some of the same episodic structure and increase over time as maternal mortality, confirming the impacts of economic and social change on infants, perhaps through stress on their lactating mothers or declines in surrogate nursing.

- The mortality of mothers after the immediate postpartum period ("background mortality") also shows some of these effects, suggesting their influence through maternal depletion, as well as through more rapidly acting disease and obstetrical difficulties ('maternal mortality').

2. The Study Region

The region (see Figure 11.1) is of interest because until 1848 part of it and until 1871 the remainder, were inhabited by a servile peasantry. It exhibited scarcely any modern economic development until after World War I.

Figure 11.1 here

Slavonia is the triangle of land between the Drava and the Sava rivers, with its apex in Srem and its base at the Ilova river. It fell to the Ottomans in 1526, was reconquered by the Habsburgs 1683-90, and repopulated by both Catholic and Orthodox Slavs as well as some Hungarians, Slovaks, and Germans. Population growth on the new frontier was rapid, both by natural increase and migration. Households were relatively autarkic, and tended to become more complex over historical time. Economies of scale in such households provided some relief from emerging land shortage, even though agricultural intensification (other than through increased or more efficient labour inputs) was virtually nil (Hammel and Wachter 1996a; 1996b; Hammel and Kohler 1997; Kohler and Hammel 2001).

From the earliest reoccupation, but formalised in 1745, the region along the Sava river was part of the Austrian Military Border, directly administered by the Habsburg crown, populated by peasants obliged to render perpetual military service. Ultimately, the Border system was abandoned, largely because of its ineffectiveness under late 19th century conditions. Six of the seven parishes used in this analysis were military parishes. The Military Border experienced 14 mobilisations in the period under consideration (1756, 1763-64, 1778-79, 1788-90, 1792, 1799, 1804-12, 1814-15, 1820-21, 1831, 1846, 1848, 1859, 1866). These mobilisations differed in intensity and duration, but we have virtually no detail on which local regiments were most impacted in each.[1]

The impact of military service on the Bordermen was very great. Even in peacetime, frontier duty could draw off an important fraction of adult manpower, from about 10 per cent (Rothenberg 1966: 92; Roksandić 1988: vol. I, 24) to a third of militarily able men (under the so-called canton system). Although feudal taxes and obligations were less in the military than in the civil zone, there was a head tax, and obligatory labour demands were high. For example, in 1810 the 6 regiments west of Slavonia furnished additionally about 5 days per year from men who were not invalided (see below) (Roksandić 1988: vol. I, 24, 27, 122). The church imposed a tithe. Conditions were sometimes exacerbated by illegal exaction of labour for the benefit of Austrian officers. The burdens reached critical impact in wartime. In 1792-1801 the Border mustered over 100,000 men, almost double the usual number of about 55,000, and in those wars suffered 38,000 casualties (Rothenberg 1966: 93). During the hostilities with Turkey 1787-91 the total population of parts of the Slavonian and Banat regions of the border is reported to have plummeted from 343,000 to 57,000 persons (Vaniček 1875, III: 474). The Third Provisional Croatian Regiment that was formed under French command during the Napoleonic occupation of the western Border lost 80 per cent of its

[1] The standard sources (Hietzinger 1817, 1820; Vaniček 1875; Rothenberg 1960, 1966) are often inspecific about which regimental regions of the Border were most directly involved. However, in these major crises, most may

personnel on the Russian front in 1812 (Roksandić 1988: vol. II, 292-3). In 1802, 54 per cent of the adult male population of the 6 western regiments was classified as invalided; in 1810 it was still 42 per cent (Roksandić 1988: vol. II, 30-1). The Military Border was decommissioned in 1871 and united with Civil Croatia in 1881. Unlike civil serfs, military serfs incurred no amortisation burden on emancipation.

The region north of the Border was part of civil Croatia, administered by Croatian feudatories of the Hungarian crown. Feudal tenure in civil Croatia was terminated in 1848, but former serfs incurred a heavy financial burden, required to amortise the value of the land they received over the next 20 years. (Implementation was delayed perhaps by a decade or two on account of administrative and legal confusion.) Many civil serfs were landless or almost landless and worked for wages on the latifundia that dominated the civil zone of Slavonia.

Agriculture in both zones was extensive, with an emphasis on stockbreeding, and there was little improvement in agricultural technology. Accommodation to land pressure was achieved by economies of scale in large, complex, joint households, which appear to have become more common after about 1750.[2] These were later undermined by increasing

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have been.

[2] Such households are referred to in the ethnographic and historical literature (but not in peasant discourse) by the term, *zadruga* (loosely, 'co-operative'). They are typically agnatically defined, with father and married sons, or married brothers, or even cousins. They were perhaps most developed in the Military Border of Croatia, encouraged and codified by the Austrians as a way to ensure household survival while some manpower was drawn off for military purposes; their mean size in the 6 western regiments was about 11 persons (Roksandić 1988: vol. I, 35). (For a review of issues concerning such households, see Tomasevich 1955: 178ff.; Hammel 1968; Hammel 1972, 1977, 1980b, 1980a, 1984; Todorova 1993; Čapo-Žmegač 1996.)
Equally important in the present context was the effect of such households or their near analogs in households of closely related agnatic kin that were located in close propinquity, on the presence of multiple females associated with a core of male agnates, either as their wives or sisters. These women provided economies of scale in female labour, reciprocal child care, surrogate nursing, and mutual succour and assistance. While the universality or typicality of such households have been criticised as a facet of the orientalization and essentialization of 'Balkan' populations (Čapo-Zmegač 1996; Todorova 1993), they were frequently attained during the cycle of household development, even when not common in the cross-section. Even in medieval times households containing more than one conjugal unit were less than half of all households, in the cross-section. The attainment of multiple conjugal units is strongly influenced by demographic conditions. Thus, for example, the number of households containing a married father and a married son is a function of the overlap in the married lives of parents and children and thus strongly dependent on age at marriage and longevity. The number of households containing married brothers is strongly dependent on the net reproduction rate. Indeed, the virtual impossibility of the universality of fraternal joint families can be shown by the fact that for the average married pair to have

monetisation and intra-household rivalry, especially after emancipation, as money taxes replaced feudal labour obligations, and also as the more personalistic elements of the Napoleonic and successor codes began to replace the more communally oriented customary law.

Peasants produced mostly for subsistence. However, as monetisation progressed, and debt burdens mounted, peasants in the civil zone increasingly worked for wages to pay debts and taxes. In the military zone, men not on border patrol nor stationed away from home often worked for wages in repairing roads, hauling goods, and so on, in addition to their corvée obligations. In both zones, open range pig herding was a source of money income. Peasant plots were ultimately minuscule and in Civil Slavonia coexisted with large estates. Attempts to introduce manufacturing (glass, or silk spinning) mostly failed, in part because of the lack of transportation infrastructure. There was some commercial extraction of natural resources (charcoal, lumber, and potash) after 1870, especially in the former military zone. Until the mid-19th century freight transport for export was by wagon over rough mountain roads to Adriatic ports. The Sava River was choked with debris and unsuitable for large-scale water transport. The first railroad reached Zagreb only in 1861; the line serving Slavonia from the Danube along the Sava to Zagreb and ultimately to Rijeka was not built until 1871. All these lines terminated in ports controlled by Austria or Hungary. Commercialisation of agriculture on large properties was impeded by lack of transport, by competition from Austrian and Hungarian interests, and by the import of cheap foreign grain to regional markets (Vienna, Budapest) through Adriatic ports and thence via Austrian and Hungarian rail lines (Tomasevich 1955; Karaman 1972).

Both mortality and fertility were sensitive to fluctuations in grain prices (thus plausibly to grain supply), and that sensitivity peaked in the 1840s (Hammel 1985; Hammel and Galloway

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two sons surviving to marry would require that the population double in each generation. (On these issues, see Halpern and Anderson 1970; Hammel 1990.)

2000a, 2000b), as social and economic conditions worsened. Fertility control was known and practised from an early date, and levels of fertility show evidence of decline perhaps as early as the 1760s-80s, plausibly in response to land shortage and parental desires to provide viable inheritance to their children (Hammel 1993; Hammel and Herrchen 1993; Hammel 1995). Abortion was practised at least from the 1760s, and appears to have increased in response to economic privation (Hammel and Galloway 2000a). The region, like neighbouring parts of Hungary, became politically notorious for its low fertility (Andorka and Balazs-Kovacs 1986; Vassary 1989). The military population, although subject to occupational risks until 1871, seems to have been in a more favourable economic position.[3]

3. Measures of Economic and Demographic Stress

We use several measures of stress, against a more general and less measurable historical background. The most direct economic measure is the fluctuation in grain prices in regional markets, reflecting supply-side climatic influences on harvests, since in a largely subsistence economy, little change in demand occurred.[4] This fluctuation is measured as annual (or

[3] This contention is disputed by some Croatian historians as a self-serving claim of Austrian apologists; nevertheless, the peasants of the time apparently evinced a preference for military status because feudal dues were less than in the civil zone, and the military establishment is sometimes reported to have provisioned villages in times of famine. To be sure, such reports are from Austrian sources. Much of our information about economic developments is general and insufficiently specific with respect to region. Regions were diverse. The Austrian sources give little systematic information on the local military border except 1830-47. Hungarian sources often do not differentiate between Hungary proper, Croatia, and Slavonia. There are no wage series, only some price series.

[4] The grain prices are regional prices based on the Vienna market and correlate closely with those of the Budapest market and (for a more limited time range) prices on the Zagreb market. Regional grain prices mostly reflect supply, conditioned largely by regional climatic factors. We have no information on local prices or the supply factors driving them. Neither do we have information on shifts in demand, plausibly driven by military provisioning in time of war. Peasants rarely bought or sold grain. They could buy it in time of need only if they

monthly) differences from a moving average, and analysis focuses on changes in the elasticity of mortality and fertility with respect to grain prices, over time.[5] Increases in elasticity (positive for mortality, negative for fertility) are taken as indicators of increased stress. Information on the stature of persons is another potential measure of stress. Figure 11.2 shows the 5 year lag sum elasticities of mortality and fertility with respect to grain prices for 25 Croatian parishes (including the seven used for reconstitution), and the heights of Hungarian soldiers, centred on their decade of birth (Komlos 1989: Table 2.1).[6]

Figure 11.2 here

The sensitivity of mortality and fertility to price shocks rises in the post-Napoleonic period, reaches a peak in the 1840s, then falls back by the early 1850s. Detailed analysis suggests increased sensitivity of mortality across a broad range of military parishes in times of military mobilisation (Hammel and Galloway 2000b). The rise in the 1840s suggests increasing crisis for the peasants before civil emancipation in 1848 and liberalisation of military tenure in 1850. The fallback suggests some amelioration thereafter when the fruits of the labour of civil serfs became their own with cancellation of feudal obligations, but before the burdens of amortisation were felt. Similarly, military serfs may have invested more when they were

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engaged in wage labour to raise cash; they could sell it in time of surplus to raise cash for taxes and amortisation payments. Grain was produced commercially on the large estates in the civil zone, but not in the military zone.

[5] Elasticity is the proportional change in some quantity induced by a 100 per cent change in another. For example, if the elasticity of mortality with respect to the price of grain were 0.2 (20%), a doubling of the price of grain would increase mortality by 20 per cent. Elastiticies may be positive or negative. Such elasticities may be estimated over several time segments. For example, one may estimate the effect on mortality levels in year t of price changes in that and the previous 4 years, i.e. at yearly lags 0, 1, 2, 3, and 4. The sum of these lagged elasticities, the 'five year lag sum', is often used as a summary measure. See Hammel and Galloway (2000a, 2000b) for an explication of the method and application to Slavoniana data.

[6] These are the heights of 'taller Hungarian soldiers', i.e. those with heights above the historically highest lower boundary imposed. Komlos gives data for the decade of birth, e.g. '1790', thus with a decade centre at 1795. Under the assumption that nutritional deprivation would have its most lasting effects if it occurred during late pregnancy and before weaning, one would choose to centre the height data on the centre of the decade of birth. If, on the other hand, one assumed that the most important effects occurred during the adolescent growth spurt, when some 'catch-up' is possible, one would centre perhaps on age 15. I am obliged to Richard Steckel for his comments on this matter at the Arild conference, giving his preference for centring on the decade of birth.

assured of the heritability of tenure for their children. After 1848 there were fewer mobilisations, and cordon duty was less onerous, since the Bosnian-Serbian frontiers functioned more as customs borders than as military lines or anti-plague barriers.[7] The fallback may also reflect an improved disease environment after cessation of the great cholera epidemics or simply a culling of the more vulnerable in the previous peak.

There is also some evidence of increasing crisis in the elasticities beyond the 1850s. After the amelioration of the early 1850s, the elasticity of mortality increases again for civil serfs. This increase may reflect the burden of amortisation and pressure to produce or work for cash. There is a spike and then a fallback in the elasticity of mortality for military serfs. The elasticities of fertility ameliorate in the 1850s, then intensify (negatively) for a time in the 1860s. It is notable that the elasticity of fertility in the same year as a price shock (and indeed with a monthly lag commensurate with the second trimester of pregnancy) comes to dominate the fertility response, suggesting that abortion became more frequent as a means of fertility control. Increased recourse to abortion (for which the region was notorious in medical, legal, and ecclesiastical circles) may indicate increased economic pressure to control births and may have had deleterious health effects.[8]

There are no height data on Croatian military recruits; as an approximation we examine here information from Komlos' study of Hungarian recruits (1989), which we might use as a rough guide to regional conditions. The heights of recruits, shown by the decade of their birth, descend to a low point at about the same time as the peaking of elasticities of mortality and

[7] Of course, the exact mechanisms are unknown and differ for civil and military serfs. For civil serfs, feudal dues in the form of corvée labour were relatively light. Additional feudal taxes could be assessed. Church tithes were assessed and may not have changed at all. Only peasants with allodial holdings were subject to strictly feudal dues. Civil serfs also farmed so-called industrial land, land arrogated from the commons, in which the landlord also had rights, and paid a sharecropping portion to the landlord. Such dues would not have changed with emancipation. The levels of these dues varied according to the practices of different estates. Military serfs had obligations as border guards after the Napoleonic Wars, as well as in road maintenance, fortification maintenance, and haulage. These would not have changed until 1871. Such obligations also differed in practice between different parts of the Military Border.

[8] The ethnographic, historical and medical accounts suggest that herbal abortifacients were used and also that crude mechanical abortion was employed, often resulting in tetanus.

fertility with respect to price shocks. These minimal achieved adult heights may reflect malnutrition in childhood and also retarded development in utero and during infancy; that is, they may reflect the nutritional status of the mothers. However, there is no indication in these data (on Hungarians) that this nutritional crisis deepened or even continued much beyond the 1850s. Instead, it may reflect economic and social conditions leading to the Revolution of 1848.

We should also take into account changes in family composition of households. Multiple family households seem relatively rare in the earliest censuses of 1698 and 1702. A large proportion of households at that time was of new in-migrants, and these were predominantly nuclear in structure.[9] Reliable data on household size and composition are rare, and all such data are difficult to interpret. Nevertheless, complex households appear to increase to the mid-19th century and then decline. We conjecture that increases in size and complexity were an adaptation to an increasing scarcity of land that did not allow subdivision of holdings into viable plots for heirs. Economies of scale were generated in larger and more complex households, since adult labour inputs could be specialised. Households could continue to be autarkic and generalist, as they appear to be in the earliest census (Hammel and Kohler 1997).[10] The general social and economic history literature for Croatia is replete with discussions of the collapse of the 'joint household system' or '*zadruga*' in the last half of the19th century. As noted, firm, consistent, and comparable data, especially in time series are hard to find, and samples are often small. Nevertheless, we cite as an example Čapo-Žmegač's finding (1990) of an increase in the proportion of multiple-family households on

[9] Karl Kaser, personal communication.

[10] Theories about the origins and functions of complex family organisation abound. The potential for such 'patriarchal' organisation has deep roots in Indo-European social structure and kinship systems. The value of such organisation to the households themselves in frontier situations has been noted above. There were also advantages to overlords seeking to maximise the availability of labour, especially in periods of peak labour demand, such as military mobilisation or mass corvée labour on large estates, since a single adult male from such households could be left to tend the family plots which the rest were drawn off.

the estate of Cernik (one of our 7 reconstituted parishes) in the first part of the 19th century, and a decline in that proportion in the second half.

Many authors have deplored the decline of the *zadruga*, citing as evidence instances of the division and dissolution of households. In this they ignore the fact that, as epiphenomena of an agnatic, patrivirilocal residence pattern, such households normally dissolved, only to be reconstituted in later generations.[11] Notwithstanding this criticism, the frequency of occurrence of such households did decline, and their corporacy was diminished. Especially important was the growing frequency of ‘secret divisions’ (*tajne diobe*), in which peasants divided their holdings without reporting the often prohibited change. Contemporary political debate and legislation focused intensely on mechanisms for preserving the family system, traditional inheritance practices, and a guaranteed minimal size of homestead.[12]

It is important to note the social position of women in these ‘patriarchal’ households. The senior wife, usually the wife of the eldest competent male, thus in principle the ‘father’s wife’ or ‘elder brother’s wife’, managed the labour of co-resident women, and her domination of them and of her sons was an important dynamic. Women born into the household ordinarily left it on marriage.[13] Women marrying into the household were strangers to it and typically viewed as the sources of conflict and ultimate fission. The relations between mothers-in-law and daughters-in-law, and between brothers’ wives, were classically difficult. Women worked hard, often in field labour and especially when men were absent. The most recent brides were at the bottom of the hierarchy. Their husbands were usually junior males who, as younger men, were most likely to be called away for military duties.

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[11] Agnatic kin are those related by links through males. Patrivirilocal residence is a pattern in which a bride resides with her husband who resides with his father or other agnatic kin.
[12] For a useful summary of the economic issues, see Tomasevich (1955) and for information on extant and divided households in 1890, see Zoričić (1894).
[13] If a household had no sons, the husband of at least one daughter might move into the household of the wife’s parents.

4. Data

The core of this analysis uses reconstituted records of baptisms, marriages, and burials from seven contiguous parishes of central Slavonia, in the region of Cernik-Nova Gradiška (see Figure 11.1). Cernik was a civil parish, the others, including neighbouring Nova Gradiška, were military. Cernik was a modest market town, Nova Gradiška until 1871 the headquarters of the Gradiška regiment, 3 kilometres from Cernik. This analysis is based only on the Catholic population; suitable records for Orthodox population, constituting about a quarter of the total, were not recoverable, and the numbers of Jews and Protestants were minimal. No Muslims remained after 1691.[14]

The reconstitutions are based on 23,307 marriages 1717-1864, 112,181 baptisms 1714-1898, and 94,077 burials 1717-1898.[15] The seven parishes enter and leave the data set at different times, but often only because of the division of large parishes into smaller ones. Data availability ceases for different kinds of records at somewhat different times in different parishes. These characteristics pose problems of potential compositional effects for the analysis. The parish data are of good quality, especially after 1760. Table 11.1 shows the pattern of data availability over time. Other analyses of these and more general demographic data from the region suggest that the parishes were broadly similar.

Table 11.1 here

[14] In the census of 1857 the Gradiška Regiment had a population of 56,402, of which 76 per cent were Catholic, 24 per cent Orthodox, plus 6 Uniates, 7 Protestants, and 3 Jews.

In this analysis we use the subset of data for mothers with extant first marriage records: 13,202 marriages, 56,546 baptisms in those marriages, 8,737 baptisms of the mothers, and 7,119 burials of mothers. The 56,546 birthings in these 13,202 reproductive histories form the units of observation in the analysis. The mean age of mothers at parturition was 30.7. The mean birth interval was 2.6 years. 2.6 per cent of parturitions were multiple births. The median year of birthing was 1819; the mean was 1817.

Four hundred seventeen mothers died within 60 days of these births, yielding a crude 'rate' of maternal mortality of 0.0074; this is a gross rate, not taking into account estimates of background mortality unrelated to pregnancy.[16] The age of a woman at each birth was reckoned from the calendrical dates of that birth and her marriage and her age at marriage. Age at marriage was reckoned from the dates of wife's baptism and marriage where available, else calculated from the dates of marriage and death and reported age at death, if known. For the remaining women, age at marriage was imputed from the mean age of women of known age.

5. Maternal Mortality

Maternal mortality was common in Western countries until quite recently and until perhaps the mid-19th century was often at levels similar to those in modern LDCs.[17] While the

[15] Evidence from scattered libri status animarum and the Chronicle of the Monastery of Cernik indicates that infants were usually baptized at birth by the midwife. We use "baptism" and "birth" synonymously.

[16] Strictly speaking, this is an estimate of the probability of dying, not a rate. In the body of the analysis we use a mortality rate, defined as the number of deaths divided by exposure time in person-years.

[17] Loudon (1992: Table 1.1) shows levels between 4.7 and 5.1 per thousand for England and Wales, 1851-1900. Wrigley *et al.* (1997: Table 6.29) estimate rates in the range of 12 to 17 per thousand baptisms (corrected for stillbirths and no births, thus 'per confinement' and corrected for background mortality) for England 1600-1750. Rates for Germany, Sweden, and rural France, adjusted to achieve comparable definitions, were estimated by these authors to be in the range 9 to 12 per 1000 between about 1700 and 1900.

estimation of maternal mortality has serious problems (see below), its use as an indicator of the level of well-being and an insight into family structure and gender relations is generally accepted. Because it is, like other aspects of women's reproductive health, a central topic of intellectual and practical concern, because it is so prominent in the European past and because its diminution occurred only in the latest stages of what might loosely be called modernisation, it is an inviting topic for historical analysis, and especially for a volume on the standard of living in the past. Figure 11.3 shows maternal deaths per live birth over varying spans of time from England, Germany, Sweden, and from the Slavonian data.

Figure 11.3 here

The trend is flat or downward overall in England, Sweden, and Germany (with a short increase in the latter after 1825); thus while maternal mortality was steady or declining in the those countries, it was increasing in Slavonia until after the 1860s. Peak levels of maternal mortality in Slavonia equalled or exceeded those in most other locales.

5.1 Definitions of Maternal Mortality

Clinically and broadly defined, maternal death is death that occurs in consequence of pregnancy. In practice and by modern internationally agreed definition, maternal deaths are deaths occurring during pregnancy or within some established span of time after parturition (see the discussion in Andersson, Högberg *et al.* 2000). Current international definitions use a 42-day time span. Demographic historians have variously used 30, 42, and 60 days (Wrigley, Davies *et al.* 1997: 309, n.144).

Definitions of maternal mortality based on elapsed time since giving birth of course omit pregnancy-related deaths prior to that point (e.g. from eclampsia, miscarriage, abortion, etc.) Selection of different spans may also have different consequences. The risk of mortality is highest at the termination of pregnancy, then declines rapidly.[18] A summary of the excellent Swedish data (Wrigley, Davies *et al.* 1997: Table 6.28), following Schofield (1986), shows that 29 per cent of maternal deaths after a live or stillbirth occurred on the day of birth (day 0), 19 per cent in days 1-3, and 11 per cent in days 4-6. Ninety-two per cent of these deaths had occurred by 30 days, 96 per cent by 42 days, and 98 per cent by 60 days. Recalculated as daily risks, all categories show dramatic decline from birth to day 2, then a slower decline out to day 60 (Fig. 4). The risk of death following a stillbirth is much higher than that following a live birth (Wrigley, Davies *et al.* 1997: 310) and these deaths occur rapidly. Andersson *et al.* (2000) show that having had a previous stillbirth is an important risk factor in subsequent births; thus women with difficulties in parturition are at special risk.[19] Illegitimate births are initially the next riskiest, perhaps reflecting an inferior physical condition of mothers bearing children out of wedlock, or poor care before, during, and after birthing. Maternal deaths associated with multiple births are the next riskiest.

Figure 11.4 here.

5.2 The Two Foci of Maternal Mortality Analysis

[18] However, where rates of abortion and of fatal consequences of abortion are both high, some substantial fraction of maternal deaths may occur earlier, typically 3-6 months earlier. Similarly, deaths from ectopic pregnancy, eclampsia and some from infectious disease exacerbated by immune suppression will occur before parturition, not after. See Högberg (1985: 1-22) for discussion and data.

[19] This paper and others by Prof. Ulf Högberg and colleagues at Umea University are some of the most detailed analyses of the subject in the literature.

Analyses of historical maternal mortality have focussed on two issues: (1) estimating the level, and (2) searching for correlates. Since most determinations of maternal mortality are based on elapsed time since birth, the accuracy and completeness of baptismal registration are essential, as noted. Some crosschecks are available from other data sources. In the reconstitution data, there were 417 maternal deaths within 60 days of 56,546 parturitions (see above). In 350 burial records, there are notations suggesting childbirth issues.[20] Of these only 311 are the deaths of adults; neonates also die in childbirth.[21] The overall rate of 0.0074 maternal deaths per live birth approaches the high end of the range calculated by Schofield (1986: 238) for Sweden 1756-1860 (maximum .011), is higher than any of the analogous rates from 13 English parishes except in the period 1650-99 (maximum .041), approaches the peak German rates given by Imhof (1986: 125) for 1810-1899 (maximum .010) and the German rates reported by Knodel 1825-99 (.010 -- .012)(1986). The Slavonian peak rates, as noted, are even higher.

In the census of 1910 data given for all of Croatia 1906-1910 show maternal mortality per live birth closely fluctuating around 0.005 (Croatia 1905: Table III:56). The census distinguishes *babinje* (*Wochenbett*, childbed) at 0.004, *bolesti rodila* (*Geburtskrankheiten*, diseases of birthing) at 0.0007, and *babinja groznica* (*Kindbettfieber*, childbed fever) at 0.0002. The first category accounts for 81 per cent of the sum of these, the second for 14 per cent, and the last for 5 per cent. These categories scale well to our expectations of the timing of maternal mortality of different kinds: childbed deaths from direct obstetrical causes occurring rapidly, indirect deaths more slowly and deaths from infection perhaps slowest. The

[20] in partu, in partus, paru, partu, dificilis partus, parus dificilis, puerperium, in puerperio, in puerperium, in puerperis, partu infelico, post partum, post partum sanguini, peritonitis puerpera, pleuritis et puerper, sepsis puerperalis, texak porod (Cr. ‘difficult birth’).
[21] Notice that burial records are not written for unbaptized persons, so that there are several hundred cases in which baptism must have been immediate.

overall rate estimated for historical Slavonia is about double that reported for Croatia as a whole 1906-10.[22]

5.3 *Stillbirths*

Since the rate of maternal mortality per stillbirth is much greater than that for live births, the true rate of maternal mortality cannot be accurately estimated from live births alone. However, available data on stillbirth rates for Slavonia and environs are quite uncertain, reflecting not only differences in obstetrical practice across time and space but also variation in the propensity to baptise (and thus record as live births) neonates *in extremis* (Table 2). Because of this, we make no attempt to inflate the maternal mortality rate per live birth on the basis of either stillbirths or assumed proportions of parturients undelivered. In any case, our focus is not so much on estimation of the rate as on the correlates.

Table 2 here

5.4 *Multiple Births*

It is clear from the literature that parturients are at greater risk of death in a multiple than in a single birth. We mark confinements as multiple if more than one baptism occurs with the same mother on the same date. In analysis it is the birthing, not the infant, that is the event of interest. Note that parity counts in this analysis are counts of birthings, not of children borne.

[22] Tables 57 and 58 of the census give regional breakdowns for the more common causes of death, but there are no data on those related to maternal mortality. Thus it is impossible to narrow the comparison to Slavonia or segments thereof.

5.5 Background Mortality

While the majority of deaths within a short time of parturition can be expected to be direct obstetric deaths, the proportion that is will vary according to the occurrence of epidemic disease and the efficacy of obstetrical techniques. Our approach in graphical analysis is to subtract the estimated risk of 'background mortality' from that of mortality within the critical time period, to obtain an estimate of net maternal mortality. In regression analysis we use background mortality centred on the year of birth as a predictor of maternal death so that estimates of the effects of other predictors are effectively of their influence on net maternal mortality.

Background mortality can be estimated in several ways. Wrigley, Davies *et al.* (1997: 312 ff.) use the mortality rate of husbands in the same critical period. Indeed, deducing the maternal mortality rate by comparing male to female mortality has been a common practice (see for example Henry 1987). However, where there are other correlated components to the gender difference, maternal mortality will be mis-estimated. For example, where tuberculosis was an important cause of death, female survivorship in the 18th-20th centuries was often markedly worse than that of men. Cortes-Majo *et al.* (1990) has pointed to this specifically; more general discussions of gender differences are found in Ginsberg (1989) and Hammel *et al.* (1983). The numbers of males and females with tuberculosis as the reported cause of death in the Slavonian data are 1,640 and 1,622, respectively, almost equal. By contrast, the numbers of males and females suffering some form of violent death (drowning, kicks by horses, falls from trees, murder, gunshot, etc.) were 190 and 91, respectively. Thus, using males for background mortality would result in an underestimate of maternal mortality.

We have estimated background mortality, by calendar year and age of mother, with a risk period from 61 to 730 days after giving birth and for nulliparous women, within 2 years of marriage. Two years is somewhat shorter than the mean birth interval (2.6 years).[23]

6. Analysis

We focus on individual women in order to examine the correlates of individual cases. The unit of analysis is a birthing to a specific mother. 'Mother' means a particular woman in her first marriage, and 'birthing' means one of a series of birthings to that mother, in that marriage. At each such birthing, a mother has a known or estimated age, a known parity, and we know whether either she or her current husband is in a first or later marriage.[24] The parish, date of birth, date of marriage, and other ancillary data are also known. The outcome variable is whether or not the mother died within 60 days of the index birth. The tool employed is logistic regression.[25] We follow a parallel approach in analysing background mortality, i.e., deaths to parturient women 61-730 days after birthing.

[23] More precisely and for computational convenience, we count deaths and exposure time from birth up to the 61st day, and from birth (or from marriage for nulliparous women) to the 731st day. The 2-year window gives an count of deaths from all causes. Subtracting the 60-day set from the 730-day set gives deaths and exposure within the 2-year but beyond the 2-month window. The corresponding mortality rates are computed from these deaths and exposures. Note that what we compute is a mortality rate, m(x), not a ratio of deaths to live births or a crude rate of deaths per women in some age range. Note also that using a longer span after 60 days to estimate background mortality will begin to pick up deaths from pregnancy-related causes, such as abortion, ectopic pregnancy, eclampsia, as the end of the background mortality span begins to capture women returning to fecundability, i.e. pre-parturitional deaths at the next parity.
[24] Reconstitution gives many examples of couples with linked children but no record of the marriage itself. Such 'sibsets', as we call them, because they consist of sets of persons with the same parents, could be the children of couples who married outside the parish and subsequently migrated in, or children to a marriage with no surviving record. We do not include such data here, because parity, age, and remarital status of mother are unknown. Similarly, although we can identify higher order marriages from the marriage records, we have not yet fully automated linkages between successive marriages and thus do not include higher order marriages here.
[25] We follow the traditional practice of assuming that a woman who did not demonstrably die within 60 days of giving birth actually survived to the end of the 60-day period. We were concerned that we might in this way miss

6.1 Risk Factors

Different plausible factors may account for differences in maternal mortality risk. We have some expectations from the literature and earlier work on this region.

- Some factors are presumably biological, namely parity, age, multiple birthing, and prior stillbirths. Generally speaking, the risk of death in childbirth is highest at the first parity, falls, and then climbs at successive parities, although it may fall off on account of selection effects, the more robust women surviving to have the higher order births. The risk tends to increase with age at each parity.. Figure 11.5 shows data from the Slavonian parishes. Risk in the Slavonian data rises with age at parity 1 except for the rare cases of women having a first birth past age 37 (where numbers are minuscule). Risk also rises with age at parities 2-4. Risk declines with age up to age 37 for parities 5-7, then rises; the decline is anomalous. Risk rises with age for parities over 7, then falls at the end, but the estimates are based on rather small numbers. Thus, the general expectations are more or less confirmed where data are sufficiently dense. At any age, risk is usually highest for parity 1, then lowest at parity 2-4, then increasing with parity except for selection effects. At any parity, risk tends to increase with age, although this trend exhibits some irregularities. These are also the same patterns described by Knodel for historical German data (1986: Table 7).

Figure 11.5 here

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some women who might have emigrated and died outside the parish within 60 days, and conducted a parallel analysis in which we demanded evidence of survival in the form of some other event occurring to the mother. If that event were a last birth, we did not admit that birth to the analysis but used it only as a censoring event. The two forms of analysis did not differ importantly in their results. Similarly, we assume that women who did not die in the 61-730 day period following a birth did survive it.

- An interesting question is whether the risk of death is increased by short birth intervals. It is difficult to examine it without adequate pregnancy histories. For example, under a maternal depletion hypothesis we might expect a negative relationship between mortality and the length of the previous interval or of the mean interval over all previous births. However, if intervals are lengthened by unknown stillbirths or abortions that may traumatise the mother, or if conception delay is lengthened by ill health, this relationship could be obscured or even reversed. Therefore we expect that risk will be lower where the lifetime average birth interval is long, but higher where the immediately preceding interval is long.[26]

- Some ecological factors may enter. Some parishes are closer to the Sava River and thus to swamps that were malarial until quite late in the 19th century. Six of the seven parishes were military. Earlier work leads us to anticipate that civil parishes became more sensitive to economic fluctuation and were under greater economic stress before emancipation in 1848, with some amelioration thereafter. However, a greater reactivity to economic conditions may have occurred while general mortality levels were declining. The great cholera epidemics of the 1830s had ceased by then, and by the later decades of the century, swamps were being drained, so that endemic malaria was less of a problem.[27] As noted, these two trends may not be in conflict; that is, it is possible that overall mortality was declining while at the same time mortality was becoming more sensitive to short

[26] Obviously, there is no difference between these intervals for women whose terminal parity is 1, and the expectation suggested will be clearest for women with higher terminal parities.
[27] 541 of 31,683 attested causes of death were for smallpox (variola, febris variolanus). Almost all of these were reported after 1850. How much of total adult mortality was smallpox related is not yet clear.

term economic changes. The proportion constituted by maternal deaths out of all deaths of married women increased after 1850. It is not attributable to the intrusion of ill-prepared physicians into the birthing process (cf. Högberg and Broström 1986), since we do not have any evidence of the entrance of physicians or of the use of lying-in hospitals in this area.

- A likely effect of increased labour demands brought about by monetisation and pressures to produce cash, could have been increased workloads for women. Female workloads could also have been induced by episodic withdrawal of male labour, especially in the military parishes, during periods of mobilisation. Since the organisation of female labour in joint households was hierarchical, and the youngest brides traditionally did the hardest work, we might expect that younger women would show the strongest evidence of sensitivity to such labour demands. We will show that mortality at first parity increased faster than mortality at higher parities.

6.2 Compositional Problems

There are several kinds of potential compositional problems (see above section 4, Table 11.1).

- Marriages begin at the latest in the 7 parishes (B, C, G, O, P, S, V)[28] in 1790, end in 6 in 1857 and in one in 1864.

- Baptisms are recorded in all 7 parishes from before 1790 to 1857 in 7 parishes but beyond 1857 only in 4 (B, C, G, and V).

- Burials are recorded in all 7 parishes from before 1790 to 1857 in 7 parishes but beyond 1857 to 1891 in 1 (O) and to 1898-99 in 4 (B, C, G, and V).

From this it can be seen that it is all right to start analysis in 1790 (by which time data quality is already excellent), but not clear where to end it. Indeed, a case can be made that it is all right to start analysis in any parish as soon as the data in it seem reliable, since overall results would be affected over time only by inter-parish compositional differences, which could be controlled. After 1857 there are no more marriages, with the result that lower order parities gradually disappear from analysis, since the stock of marriages ages after 1857. Mortality should drop for several years since there were no new first births (which are the riskiest), but gradually mortality might rise, as more and more birth were at successively higher and somewhat riskier parities and as women aged. We solve this problem by truncating graphical analysis in 1860, before compositional change in the parity structure becomes severe, or by controlling for parity in the regression analysis.[29]

6.3 Graphical Analysis

Here, as elsewhere, risk is defined as the total number of deaths in a year (maternal or background) divided by person-years of exposure. Figure 11.6 shows 5-year moving averages

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[28] Bogičevci, Cernik, Nova Gradiška, Oriovac, Petrovo Selo, Štivica, Vrbje.

[29] Note also that any aggregate analysis of maternal mortality may be sensitive to changes in overall fertility. If fertility is controlled by stopping behaviour, depending on the stopping point different proportions of women will bear children at parities of different risk. We do not attempt to take these factors into account but have opted to control for parity level at appropriate points in the analysis.

of (gross) maternal mortality risk, background mortality risk, net maternal mortality risk and the probability of dying in childbirth (for comparison with the standard reporting measure) from the 1750s to the 1860s.[30] The common measure of maternal deaths per birth (or per n births) tracks gross maternal mortality well. Net maternal mortality, that is, gross maternal mortality minus background mortality, also tracks gross maternal mortality well, differing only where there are marked fluctuations in the background.

Figure 11.6 here

Figure 11.7 shows net maternal mortality separately at parity 1 versus higher order births, truncating parity 1 data in 1860 to avoid the results of the cessation of marriage recording in 1857, but continuing higher order parities to 1870. The peaks of mortality for the two parity series are similar but not identical. The long-term increase in net maternal mortality at parity 1 is greater than for higher order births. This difference may offer a critical insight into explanatory scenarios. If maternal mortality is increased by increased labour demands on women, especially as economies of scale diminished with the decline of the joint household system, the data suggest that it was the youngest wives that bore the brunt of these demands. They were at the bottom of the household hierarchy, with few political allies. Their husbands were the youngest of a set of brothers, thus themselves political juniors, and would have been the most likely to be called up for military service, thus more likely to be absent. These young wives would have been asked to do the most work. It is their mortality that increases most sharply over the long run.

Figure 11.7 here

[30] The probability of dying in childbirth, estimated as maternal deaths per birth, is the usual measure employed, sometimes per 1,000, or 10,000, or 100,000 births.

6.4 Confirmatory Evidence in Infant Mortality

We examine infant mortality in Figure 11.8 to detect any similarities to maternal mortality. Infant mortality increases over the time period, at about the same rate as net maternal mortality. There is also a rough coincidence of peaks and troughs for net maternal and infant mortality after about 1780. Both of these outcomes suggest that many of the social and economic factors affecting mothers also affected their infants. Indeed, the deaths of mothers may have led directly to the deaths of nursing infants, especially as the joint family system decayed and surrogate nursing became more difficult, but this effect would have been small, since relatively few mothers died, compared to infants.

Figure 11.8 here

7. Regression Analysis

The unit of analysis in the logistic regression model[31] is the individual birthing by a mother. We distinguish two kinds of outcome:

[31] Logistic regression is one of several accepted methods for analysing dichotomous outcomes. Here the outcome is whether the mother dies or not. The coefficient for any independent variable is the logarithm of the relative odds ratio, or

$$\ln\left(\frac{p_{x_i}}{(1-p_{x_i})}\right)$$

- Maternal death, with the outcome scored 1 for death within 60 days, else 0.
- Background death, with the outcome scored 1 for death within 61 to 730 days, else 0, but women who died within 60 days were excluded.

Independent variables are, depending on the model:

- Age.
- Parity (dummies, grouped with parity group 2-4 omitted since it has expectably the lowest mortality: 1, 5-7, 8+, coded 1 if the parity of the birth falls in any group, else 0).
- Parish (dummies, with Cernik, the civil parish, omitted, coded 1 if the birth was in each parish, else 0).
- The preceding birth interval, or for parity 1, the interval from marriage.
- The mean lifetime birth interval.
- Crisis period (the occurrence of any of the crises described above, thus coded 1 for a crisis period, else 0). Multi-year crises were specified to include all of the relevant years. Single-year crises were coded to include the year of the crisis and the following year, since mobilisation late in a year would imply absence of males early in the next.
- Multiple birth (coded 1 if the birth was a multiple birth, else 0).
- Year (calendar year of the birth minus 1815). Effectively, this is the influence of calendar year on higher order births; see below.
- Parity1*yr (interaction of Parity 1 and Year, thus the effect of calendar year on parity 1 births only.

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where p_{x_i} is the probability that the outcome (death to the mother) will occur to a mother with characteristic x_i. Confidence intervals for the coefficients are estimated in the usual way, as some multiple of the standard error of the coefficient.

- Background mortality (sometimes the variable of interest, also a covariate where maternal mortality is the dependent variable). Using this as a predictor effectively turns analysis into that of net maternal mortality.[32]

Table 11.3 shows the resulting estimates and corresponding probability values.[33] Because we have prior reason to anticipate the direction of effect of each of the variables, from theory or from broader data, we accept as significant those results for which the two-tailed probability is less than 0.10, thus the one-tailed alpha level is 0.05. We include physiological factors in the model but do not test them separately, given the space constraints for this paper. We test for the occurrence of any of the military or other crises listed earlier but do not test them separately, for the same reasons.

Table 11.3 here

In Table 11.3 are three columns. The first lists the covariates. The second gives results for maternal mortality (0-60 days), and the third for background mortality (61-730 days). Readers should use 10.3 to make their own judgements about the direction and significance of effect of variables.

7.1 Discussion

The stability of nominal data linkage results pursued by different methods and different persons in the history of this project, and the richness of redundancy in the records, give us

[32] We are indebted to Mike Hout for suggesting this.
[33] The collection of birthings analysed here is not a formal random sample, so that the application of the traditional rules of inference can only be approximate.

some confidence that the reconstitution is very close to the actual interpersonal and inter-event connections of the time. Potential truncation biases consequent on the 'deathbed migration' of parturient women, whose deaths would escape our notice, are probably small, since alternative analysis taking such bias into account by demanding firm evidence of survival, gave very similar results (not shown here). Potential biases from compositional effects in changes in the parish constitution of the data set or shifts in the parity distribution as the marriage stock aged after 1857 have been taken into account either by censoring the observations appropriately or by controlling for place and parity.

It is important to note that the graphical presentations distinguish between net and gross maternal mortality and background mortality, the first being the second minus the third. Similarly, the use of background mortality as a predictor of maternal mortality means that the results for other variables pertain directly to net maternal mortality, namely to the residual variance in maternal mortality after accounting for correlation with background mortality.

The data show that

- Patterns of maternal mortality (MM) and background maternal mortality (BM) show generally expectable effects of age, parity, and multiple births.
- MM is highest at parity 1, lowest at parities 2-4, sometimes higher at parities 5-7, but falling at parities over 8, with plausible selection effects emerging in the parity 5-7 range.
- MM and BM increase with age, given parity.
- The risk of MM and BM are higher for multiple births.
- The risk of MM and BM is higher if the lifetime mean birth interval for mothers is short.
- The risk of MM and BM is higher if the immediately previous birth interval is long.

- MM and BM increase over time, the former more than the latter.
- MM but not BM increases during episodes of mobilisation of male labour for military purposes, taken jointly. If examined singly, not all crises have a significant effect, but all are in the expected direction (not shown here).
- Military parishes usually show higher MM and BM than the civil parish.
- Fluctuations and trends in MM and BM are roughly commensurate with other indicators of demographic stress, such as the elasticity of mortality and fertility with respect to grain prices, and to some extent with stunting in the adult stature of some soldiers of the region.
- MM, BM, and to some extent vulnerability as indicated by elasticities of mortality and fertility, continue to increase after major military mobilisations had ceased but in a period of increasing monetisation, amortisation burden for civil serfs, and decay of the joint family system.
- MM at parity 1 increases more steeply than MM at other parities over historical time. The episodic increases at parity 1 are proportionally greater than at later parities.
- Infant mortality follows the same trend of long-term increase in MM and BM, and to some extent echoes the episodic peaks.

The use of female mortality beyond the traditionally critical 60-day period for estimation of background mortality, rather than the use of male mortality within the 60-day period, suggests that narrow estimation of maternal mortality, ‘death in childbirth’, far from exhausts the assessment of the burdens of childbirth on women. That we find important physiological and socio-economic correlates of BM as well as of MM is of particular interest.

That the physiological variables of age and parity show generally expectable patterns with respect to MM and BM gives us further confidence in the reliability of the data. Parity effects other than selection effects, however, are seldom significant in BM. Risk is expectably increased by multiple births. The effects of the mean birth interval, negatively associated with MM and BM suggest that maternal depletion, as well as obstetrical difficulties and postpartum sepsis may have played an important role in maternal mortality overall. The positive associations between length of the immediately previous interval and MM or BM suggest that difficulty in bringing a pregnancy to successful termination in a live birth, with unfavourable implications for the following pregnancy, may play a role. The data do not permit us to support this inference directly with information on spontaneous abortions, stillbirths, or the consequences of intentional abortion.

The long-term increase of MM and BM parallels some specific, and some general indicators of social and economic stress. The elasticities of mortality and fertility with respect to grain prices, hence the vulnerability of the population to short term food crises, show something of the same trend, although it is raggedly interrupted after 1850 and shows differences between civil and military parishes. Evidence of nutritional insufficiency in the declining stature of military recruits in neighbouring Hungary follows a parallel trend but only up to 1850. Infant mortality shows the same increasing trend as MM and BM, possibly independently, but possibly affected directly by the deaths of mothers, inability to lactate, and losses of household economies of scale for surrogate nursing. At a more general level, there were changes in social and economic structures. The feudal system collapsed; whatever its burdens, its customary protections also collapsed, and for civil serfs there was an added burden of amortisation. Military obligations lessened after the Napoleonic wars, and there were few significant effects of mobilisations on MM and BM thereafter; nevertheless MM and BM did increase after 1815. The need for cash increased over time, especially as feudal dues were increasingly converted to monetary taxes and as amortisation payments had to be met. The joint family system, which afforded some economies of scale, permitted selfsufficiency, and lowered the need for cash decayed rapidly, in the civil zone and in the military zone after decommissioning. All of these trends parallel the long-term increase of MM and BM.

The episodic peaks in MM are of particular interest. Graphical presentation shows a reasonable match between such peaks and periods of military mobilisation (Fig. 11.7). The regressions show that MM is positively correlated with such mobilisations in general, although not always with any particular mobilisation. That coincidence is not apparent for BM. We would expect that exogenous disease effects would become more important after the 60-day cut-off for MM, while direct obstetrical deaths would predominate in the first day or so of the 60-day span, with puerperal disease emerging thereafter, then deaths from other causes but exacerbated by parturition. Since the general crisis effect and many of the individual crises effects are strong for MM but not for BM, we infer that the effect of crisis was felt predominantly on factors directly related to parturition, and that disease introduced by soldiers returning home was of lesser consequence. Since it was the absence of males, rather than their presence that seems operative, our attention focuses on the withdrawal of male labour from the household, on the shift of labour burden to women, some of whom were pregnant, parturient, or nursing, others of whom would otherwise have been able to assume the ordinary labour burdens of the former. Losses of household economies of scale as the joint family system decayed would have exacerbated these matters. The secular trend toward wage labour, drawing men away from the family farm, would have increased these effects over time.[34]

[34] It is important to note that in some degree, the movement of grain prices parallels our narrative of socio-economic change. One could plausibly offer a model in which grain price changes, in the short and long run, were the driving forces, rather than the structural changes in the labour market and in the households of peasant producers. Some changes in grain prices were of course correlated with the structural shifts. Grain prices sometimes increased in time of mobilisation, either because of military buying or because of drops in supply as labour was drawn off the farm, or both. As peasants were drawn off the family farm into wage labour to raise cash for taxes and amortisation, or to buy food as family farms became smaller through inheritance division, production may have dropped, again raising prices. Simply substituting grain price movements for a broader story of change seems to us to sacrifice historical richness for numerical precision.

That women at parity 1 were at higher risk may not be entirely a physiological phenomenon but may reflect the inferior position and greater labour demands on new brides, as well as the juniority and probably more frequent absence of their husbands. It is noteworthy that the secular increase in mortality occurs at a higher rate at parity 1 than at later parities. Further, the episodic increase at times of military mobilisation is generally greater at parity 1 than at later parities.

8. Conclusion

In this analysis we have applied graphical techniques and logistic regression to try to understand the correlates of maternal mortality in 18th and 19th century Slavonia, defining gross maternal mortality as death occurring within 60 days of a birth, background maternal mortality as death 61-730 days after a birth, and net maternal mortality as the difference between these. Maternal mortality was high by the standards of the time and probably higher than maternal mortality in the rest of Croatia in the early 20th century.

Physiological factors such as age, parity, multiple birthing, and birth intervals show expectable results. These results increase our confidence in the reliability of the data derived from family reconstitution. However, our interest is mostly in social and economic factors.

The data show that in this region, peripheral to emerging centres of industrialisation and political power, competing interests in Austria and Hungary limited economic development. Globalisation of world grain markets, competition from cheap foreign grain, and inferior local transportation infrastructure were important constraints on such development. Macro-level social structures were slow to change, the emancipation of civil serfs occurring in 1848 but of military serfs only in 1871.

Maternal mortality as customarily defined, within 60 days of birth, was as high or higher than that in other, contemporary European countries, indeed higher than most historical levels except those in 17th century England. Rapid changes in socio-economic conditions – the collapse of serfdom and imposition of money taxes and amortisation burdens, increasing monetisation, and the decay of the joint family system – appear to have exacerbated maternal mortality, as well as other indicators of demographic vulnerability such as responses to food supply and the infant mortality rate.

Periods of military mobilisation also exacerbated maternal mortality. Some of these effects were felt not only within 60 days of birthing but also extend out two years, suggesting that nursing, as well as parturient mothers were made more vulnerable by these changes. Nevertheless, crisis effects are stronger for maternal than for background mortality, suggesting that it was the absence of males that was determinative.

The most plausible general hypothesis to explain these changes is that withdrawal of male labour from family subsistence farming resulted in extra burdens of heavy labour imposed on females, some of whom were pregnant or nursing. Such withdrawal of male labour would have occurred during military mobilisations and would have been worsened by increased participation in wage labour to meet the growing need for cash. Similar exacerbation would have resulted from losses in economies of scale, especially in the availability of labour by non-pregnant or non-parturient females, as the joint household system decayed. These hypotheses are supported at the micro level by evidence that the most socially vulnerable of women, brides new to the household, had higher levels of mortality and a more rapid increase in that mortality overtime.

In general, no part of this historical borderland between Europe and Asia, between the Habsburgs and the Turks, between Christianity and Islam, between feudalism and capitalism, tells a pretty story. In this account with general sources sharpened by demographic analysis, we see that the burdens of change fell more heavily on the peasant than on the lord, on the poor than on the rich, on women than on men, and on the most vulnerable women in particular. That was the price of progress, in a transformation that indeed ultimately left everyone better off, even if out-migration was until 1945 the safety valve that may have permitted re-balancing of land and labour. It is ironic that the same factors of economic globalisation, development of cheap transportation, and the collapse of ancient social systems leading to the difficulties here depicted, also facilitated their solution, as the victims of structural change escaped to the New World.

Some of these conclusions could be reached from a reading of the general economic, social, and ethnographic history of the region. Others could not be. Nowhere in that history would we have seen that maternal mortality increased over time, or that it bore more heavily on the youngest wives. Nowhere would we have seen that the episodic and secularly increasing diversion of male labour from family farming impacted wives, or that losses of household economies of scale increased the labour burden of women and diminished their sources of support as mothers. The demographic evidence here presented not only reinforces that from the broad historical sources, it adds a critical and often more penetrating insight into the standard of living and its changes. The ghost of the Reverend Malthus serves us well.

Chapter 11.

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Table 11.1. Data Availability by Parish and Date

Parish	Marriages Start	Marriages End	Baptisms Start	Baptisms End	Burials Start	Burials End
Bogičevci	1790	1857	1789	1897	1789	1897
Cernik	1717	1864	1714	1898	1717	1898
Nova Gradiška	1756	1857	1756	1898	1756	1898
Oriovac	1726	1857	1724	1857	1726	1891
Petrovo Selo	1766	1857	1766	1857	1766	1857
Štivica	1790	1857	1789	1857	1789	1857
Vrbje	1790	1857	1789	1898	1789	1898
Overall	1717	1864	1789	1898	1717	1898

Table 11.2. Stillbirth Rates

Military Border 1830-47	0.0074
Croatia 1874-80	0.0106
Croatia 1881-90	0.0131
Croatia 1891-1900	0.0188
Croatia 1901-10	0.0222
Croatia 1906-10	0.0222
Požega County 1906-10	0.0179
Nova Gradiška 1910	0.0087
Five Swedish parishes (Schofield 1986: Table 9.2)	0.0298

Table 11.3. Results of Logistic Regression

	Death within 60 days of birth	Death between 60 days and 2 years of birth
Covariates	Effect	Effect
Intercept	-5.046 (.337) ***	-3.783 (.194) ***
Age	0.012 (.009)	0.022 (.006) ***
Parity		
Parity 1	0.597 (.130) **	0.064 (.087)
Parity 2-4 (reference)	-	-
Parity 5-7	-0.081 (.145)	-0.011 (.082)
Parity 8+	-0.067 (.224)	-0.126 (.129)
Previous birth interval	0.226 (.032) ***	0.200 (.021) ***
Lifetime mean birth interval	-0.626 (.081) ***	-0.670 (.053) ***
Number of births		
Single birth (reference)	-	-
Multiple	0.709 (.205) ***	0.076 (.160)
Background mortality	0.018 (.008) *	-
Parish		
Parish B	0.717 (.211) ***	0.432 (.155) **
Parish C (civil, reference)	-	-
Parish G	-0.021 (.153)	0.363 (.088) ***
Parish O	0.330 (.174) †	0.185 (.116)
Parish P	0.297 (.150) *	0.509 (.091) ***
Parish S	0.245 (.213)	0.180 (.145)
Parish V	0.142 (.186)	0.323 (.114) **
Crisis period		
No crisis (reference)	-	-
Military crisis	0.314 (.106) **	0.005 (.066)
Year (origin=1815)	0.004 (.002) *	0.003 (.001) *
Parity 1*Year	0.009 (.004) *	0.003 (.003)
Number of birthings	56,546	56,129
Number of deaths to mothers	417	1,124
DF	56,528	56,112
Deviance	4761.4	10,739
Model χ^2	163.9	278
DF χ^2	17	16

Standard errors in parentheses. P-values based on two-sided tests.

† p<.1; * p<.05; ** p<.01; *** p<.001

1815 is the median year of birthings. The effect of Parity 1 is the effect in 1815. The effect of Parity 1*Year is the effect of the year difference from 1815 on Parity 1 births.

Fig. 11.1
Croatia, Slavonia, and the Military Border

Fig. 11.2
5 Year Lag Sum Elasticities of Mortality for Civil and Military Croatian Parishes, and Hungarian Military Heights Centered on Decade of Birth

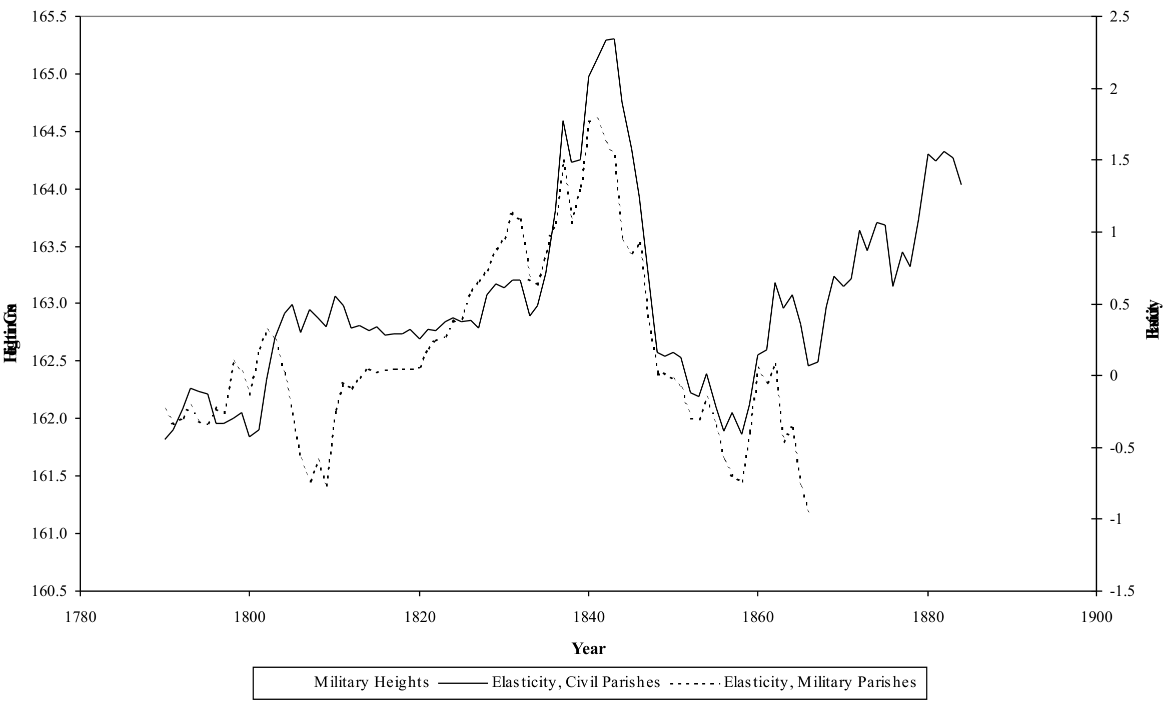

Fig. 11.3
Historical Maternal Mortality Rates

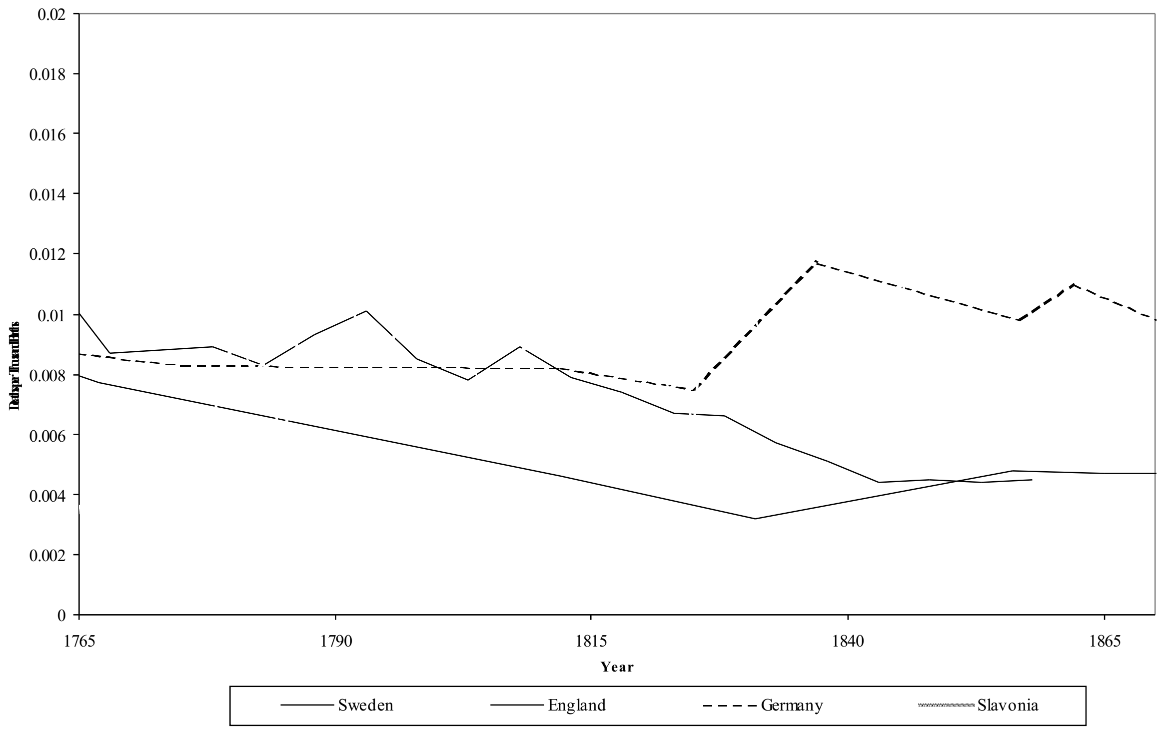

Fig. 11.4
Risk per Day of Maternal Death, by Category

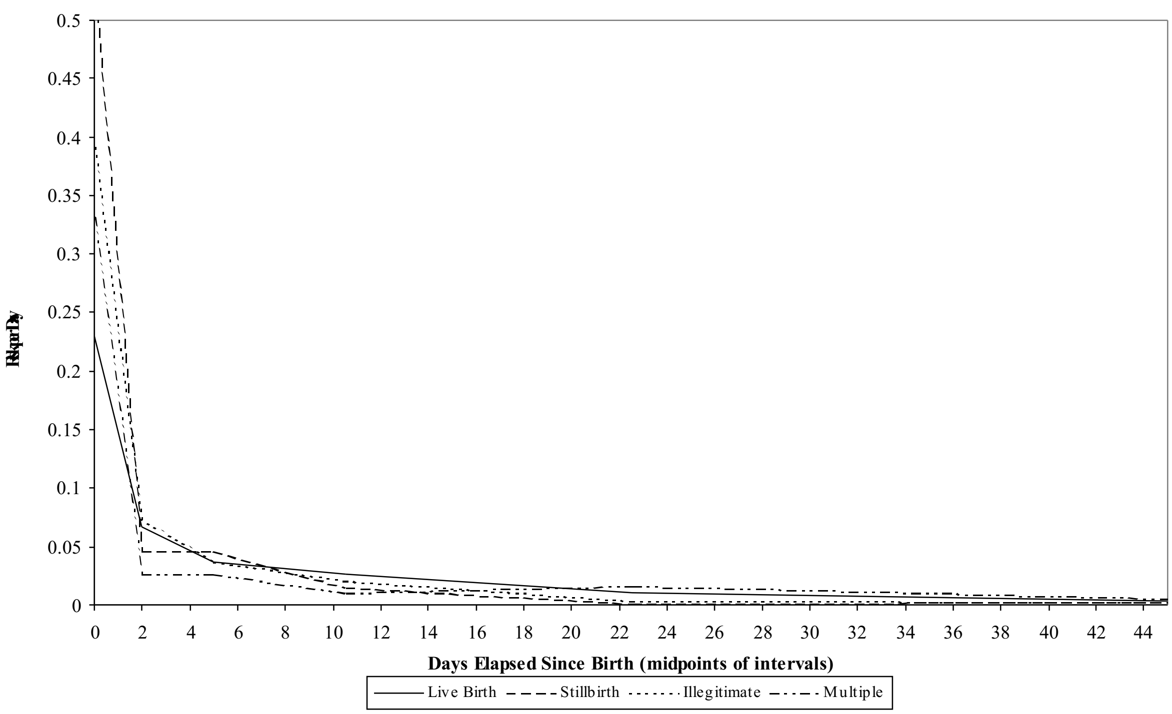

Fig. 11.5
Maternal Mortality by Age and Parity, Slavonian Data

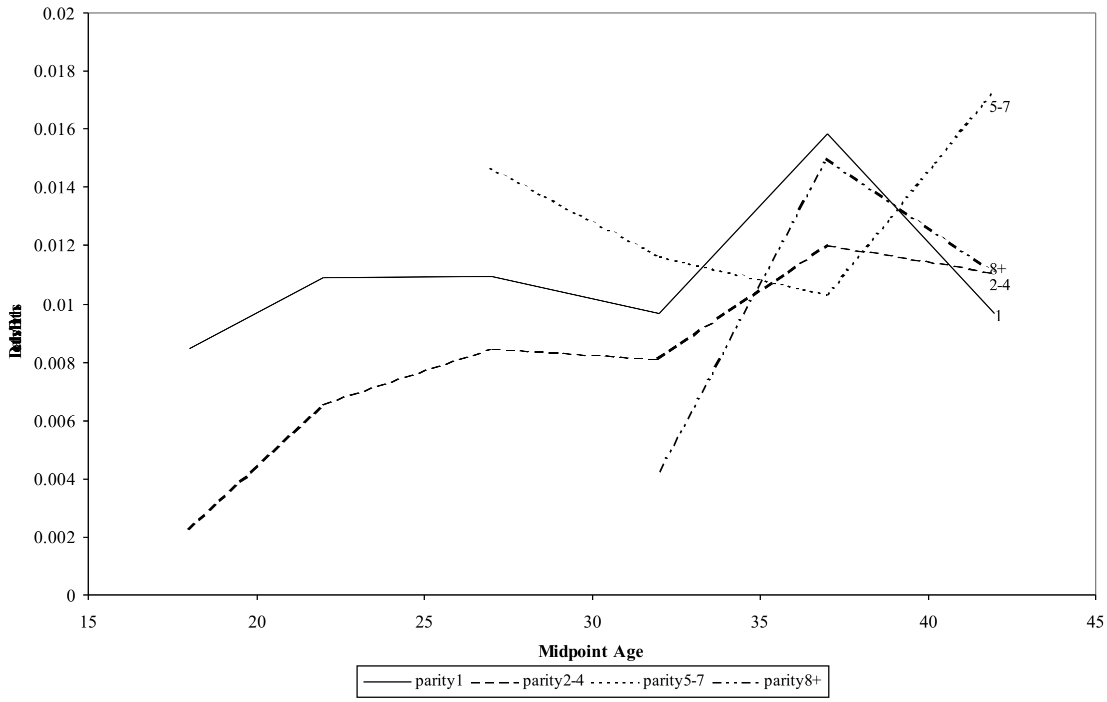

Fig.11. 6
Gross Maternal, Background, and Net Maternal Mortality Risk and Probability of Dying in Childbirth, by Year, 5 Year Moving Averages for All Parities

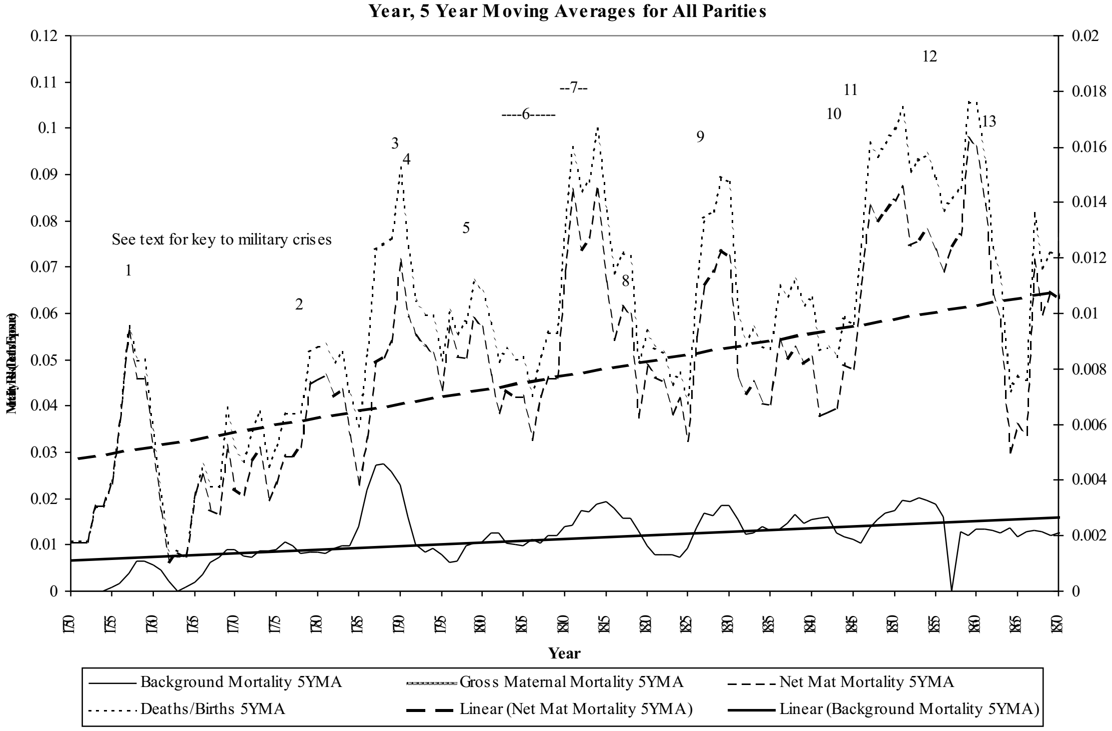

Fig. 11.7
Net Maternal Mortality at Parities 1 and >1, 5 Year Moving averages

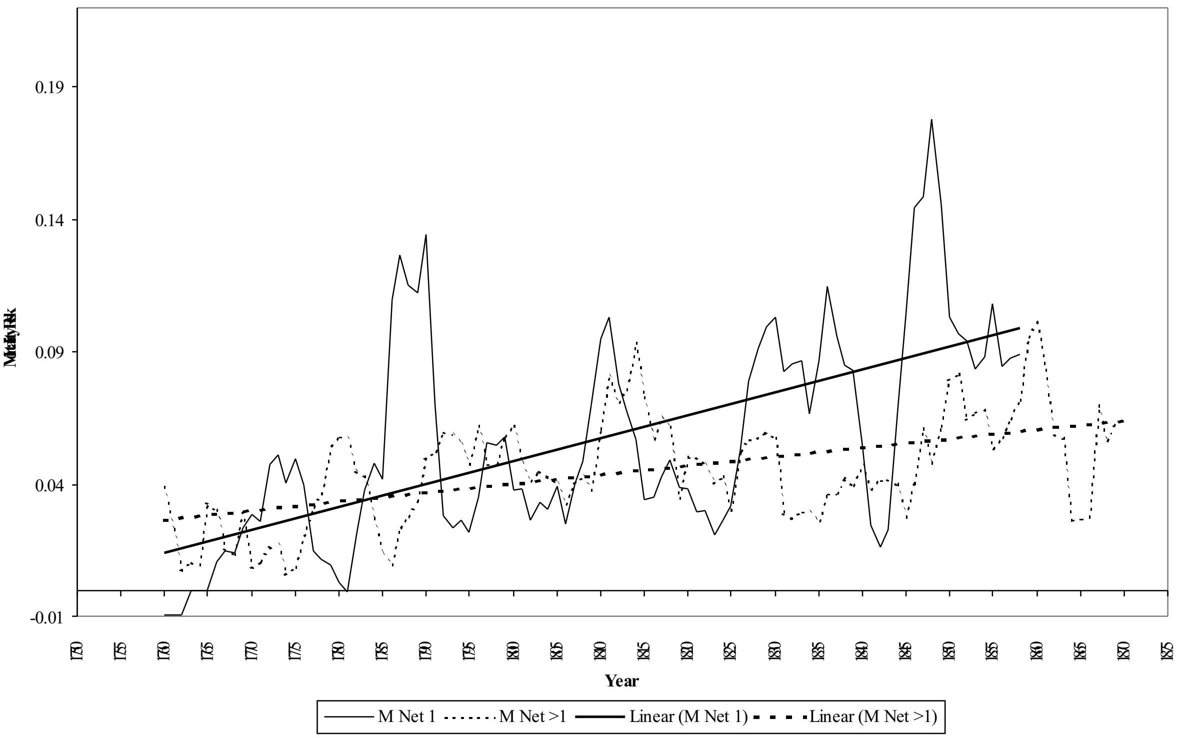

Fig. 11.8
Net Maternal Mortality and Infant Mortality, 5 Year Moving Averages