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The Classes of Death

Socio-economic mortality differentials in Swedish cities during the harvest failure of 1771-72

by

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Abstract: This thesis explores the possibility of a socio-economic gradient in mortality during short-term economic stress in pre-industrial Swedish cities using the harvest failure in 1771-72 as an example of economic fluctuations/high prices. Using newly transcribed data in a logit model, the study finds results indicating that the poor and individuals in occupations categorized as "service and agriculture", for example maids and guards, faced a higher risk of mortality during short-term economic stress than individuals with higher status, relative to the difference in risk between the groups during the base period 1768-70. The poor, being the most vulnerable, faced the highest relative risk in the year of high prices. For those in service and agriculture the response was delayed, reaching its highest value in the year after a year of high prices. Differences in timing likely represent effects of malnutrition and supports the hypotheses of a discriminatory mortality response.

Keywords: short-term economic stress, high prices, harvest failure, Sweden, 18th century, mortality, socio-economic status

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1 Introduction

Short-term economic stress in pre-industrial societies was a recurring, common event, caused by factors such as war and harvest failures, causing prices to soar and real wages to drop and making people go hungry due to an inability to buy and acquire food (Campbell et al. 2004; Dribe et al. 2017; Livi-Bacci, 1989; Ó Gráda, 2009). The malnutrition made people more vulnerable to certain diseases, sometimes making mortality rise swiftly, and as the local storages grew empty individuals would seek the cities, causing the spread of diseases and further increase the death rates (Galloway, 1987; Lappalainen, 2014; Livi-Bacci, 1989).

But *who* died during short-term economic stress? Was it the poor who could not afford food, and when infected by disease, died in larger numbers than the more well-off? Or did the spread of diseases make everyone equally vulnerable, causing mortality to increase indiscriminately regarding one's socio-economic status? These two competing hypotheses has long been discussed and researched without common conclusion and while some researchers argue for a somewhat clear gradient in the mortality response in favour of the higher socio-economic groups (Campbell et al. 2004; Deaton, 2016; Jennings et al. 2017; Ó Gráda, 2009; Scalone, 2014; Sjoberg, 1960), others theorize and present empirical work more in favour of an indiscriminate response during short-term economic stress (Galloway, 1987; Kaukiainen, 1984; Klesment & Lust, 2021; Livi-Bacci, 1989; Lust et al. 2023).

Also, for the case of Sweden, there has been evidence found both in favour of a socio-economic gradient in mortality response (Bengtsson, 1999; Bengtsson & Dribe, 2000; Campbell et al. 2004; Dribe et al. 2010) and against it (Bengtsson & Broström, 2011; Söderberg, 1984). Yet, most studies regarding both Europe and Sweden are focused on rural areas in the 19th century due to limited amounts/availability of data before the 1800s. Thus, the evidence regarding the pre-industrial period and cities is very limited, causing a gap in our understanding of these historical events and their impact on different groups of people.

However, due to a largescale harvest failure in the early 1770s, affecting both continental Europe and Sweden, big parts of the Swedish people suffered short-term economic stress in the form of high rye grain prices in 1771-72 and mortality increased sharply in 1772-73 (Dribe et al. 2017; Larsson, 2006; Post, 1990; Utterström, 1957). The gravity of the mortality crisis makes the period a suitable example of severe short-term economic stress (Dribe et al. 2017). As the

death and burial records of Sweden not only go far back in time but also possesses a high level of detail on an individual level, including information on occupation, age, gender, and cause of death it allows for a part of the gap concerning the connection between socio-economic status, mortality, and short-term economic stress to be filled.

1.1 Aim and Scope

The aim of this thesis is to examine to what extent socio-economic status was correlated with mortality in Swedish pre-industrial cities during short-term economic stress. More specific, the study will use the harvest failure in 1771-72 as an example of severe price increases as a way of finding the effect on mortality for people of different socio-economic status. Short-term economic stress is here defined as an event causing rapid but temporary increases in prices. In order to establish how the high price period diverged from normal mortality patterns the study will examine the period 1768-73 and use the years 1768-70 as a base against which high price years can be compared. Cities covering a large part of the affected Swedish area will be observed including Uppsala, Norrköping (Olai parish), Gävle, Örebro, Karlstad, Hudiksvall, Jönköping (Kristine parish), and Kalmar.

The method used is somewhat unconventional and deserves some explaining already here. Utilizing the individual level data from the Swedish death and burial records, three groups of observations will be formed: Low/normal price years (1768-70), high price years (1771 and/or 1772), and the year after a year of high prices (1772 and/or 1773). By applying a logit model, the transformed probability can be estimated for how much more likely individuals in a certain socio-economic group is of dying in a high price year (or year after a high price year) than the reference group relative to the difference between the two groups in the period 1768-70 (explained further in chapter 5.1).

2 The Harvest Failure of 1771-72

Harvest failures were a common feature in pre-industrial European societies before the major improvements in agricultural output, food storage, and transportation started in the late 18th century (Alfani & Ó Gráda, 2017; Ó Gráda, 2009; Schön, 2013; Wiesner-Hanks et al. 2018). Bad weather in the form of excessive rain, drought, high/low temperatures, and frost could ruin most of the harvest causing extreme mortality and even famine in some cases (Larsson, 2006; Livi-Bacci, 1989; Ó Gráda, 2009; Post, 1990). As information on agricultural output is scarce in sources regarding pre-industrial societies, harvest failure will here be defined as an event causing sudden and sharp increases in prices concerning foodstuffs commonly consumed by most people (Dribe et al. 2017; Livi-Bacci, 1989).

In the early 1770s, large parts of Europe got struck by harvest failure due to persistent cold and wet weather causing major increases in grain prices and mortality in for example France, Germany, Austria, and Sweden (Post, 1990). The food crisis was worst in central Europe and was accompanied by epidemics of for example smallpox, typhoid fevers, and dysentery which was made worse by the lack of food and caused the majority of deaths (Post, 1990).

In Sweden, grain prices started to rise in 1771 and continued to climb in 1772 causing excess death rates in 1772-73 (Dribe et al. 2017). Epidemics of typhus and dysentery were the major causes of death, affecting most of the Swedish area (Castenbrandt, 2012; Larsson, 2006). The spring came "late and dry" (Utterström, 1957, p.435) in 1771 and was followed by heavy rain in the summer and fall causing both the spring and fall harvest to fail in some of the eastern parts of the country (Utterström, 1957). To make things worse the country suffered from a severe winter in 1771/72 and the cold stayed long into the spring and summer of 1772 (Utterström, 1957). It was not only the bad weather that caused bad harvests in 1772 but a lack of seeds due to previous crop yields (Utterström, 1957). Though there were regional differences as to the severity of the harvest failure the period is one of the worst known to affect the Swedish area (Dribe et al. 2017; Larsson, 2006). As some regions still received good harvests the main issue for the common people was not a food shortage but the excessive prices (Utterström, 1957).

3 Theory and Previous Research

Though it may seem natural that short-term economic stress would affect the poor more than the rich, seen as they likely suffered a higher degree of malnutrition, neither the theory nor the empirical research has found a basis for such a simplified answer (Appleby, 1975; Campbell et al. 2004; Fogel, 1986; Galloway, 1987; Livi-Bacci, 1989; Ó Gráda, 2009). Indeed, the question of the mortality response is still very much open and will in this chapter be thoroughly discussed (Appleby, 1975; Campbell et al. 2004). The chapter first describes the theories concerning the impact on mortality of short-term economic stress in pre-industrial societies (3.1) and then moves on to discuss what evidence has been found in empirical research (3.2).

3.1 The Mechanisms Between Short-Term Economic Stress and Mortality

When discussing short-term economic stress and its impact on mortality in pre-industrial societies, a common theoretical approach is to talk about mechanisms (Appleby, 1975; Campbell et al. 2004; Livi-Bacci, 1989). As prices soared, people, starting with the poor, found it increasingly difficult to afford food, causing malnutrition to successively affect the population if prices continued to rise/stay at a high level (Appleby, 1975). The nutritional deficit caused two mechanisms, schematically shown in Figure 1 and 2, to "activate" (Appleby, 1975; Livi-Bacci, 1989). First, the malnourishment lowered the immune system's ability and made people more vulnerable to already present diseases, increasing mortality (Appleby, 1975).

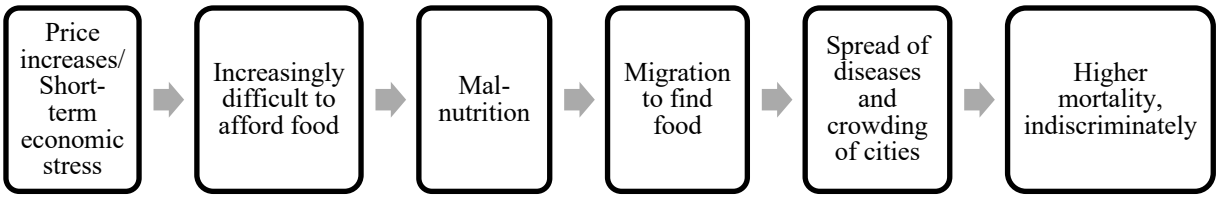
Figure 1: Resistance mechanism during short-term economic stress

Second, as people found it increasingly difficult to afford food or an income bringing family member died, they began to migrate, possibly causing the spread of diseases as well as the

crowding of areas where food were more attainable, most likely cities (Dribe, 2003; Livi-Bacci, 1989). This increased the risk that local outbreaks of certain diseases became epidemic (Livi-Bacci, 1989).

Though the first mechanism naturally affected the poor or less well-off individuals more than the rich, raising mortality discriminately (as long as food was still somewhat available and full-scale famine had not initiated), it is reasonable to assume that the spread of diseases and the crowding of cities could have caused mortality to rise equally much for the less well-off and the rich, killing indiscriminately (Appleby, 1975; Campbell et al. 2004; Livi-Bacci, 1989). However, resistance to and spread of diseases is two paths towards higher mortality that is highly intertwined and it is almost impossible to fully keep them apart.

Figure 2: Migration mechanism during short-term economic stress



Furthermore, as it is very difficult to directly measure resistance to diseases and the spread of diseases, studies concerning the impact of short-term economic stress normally instead investigate differences in mortality between socio-economic groups, using this as an indication of the relative importance of malnutrition/epidemics (for example Campbell et al. 2004; Galloway, 1987; Klesment & Lust, 2021; Scalone, 2014). Something that will become clear in the following chapter on previous research.

3.2 The Mortality Response to Short-Term Economic Stress

In his monograph on the pre-industrial city, Sjoberg (1960) gave early indications of a social gradient in mortality during harsh times, stating that "death rates soar higher in the lower class than in the upper stratum" (Sjoberg, 1960, p.85). Cormac Ó Gráda (2009, p.90) further states that "…mortality has always varied inversely with socioeconomic status, but especially so during famines". Indeed, studies such as Dribe et al. (2010), Campbell et al. (2004), Jennings et al. (2017), and Scalone (2014) finds indications of differences between socio-economic

groups in the mortality response to short-term economic stress. The difference is however not always in the direction one might think. Farmers and rural estates, or more precisely, net producers of food, having naturally greater access to food often suffered less from short-term economic stress than people in the cities, even if they might have been of lower socio-economic class (Campbell et al. 2004; Dribe et al. 2010; Jennings et al. 2017; Persson, 1999).

But the evidence regarding the responses of socio-economic groups is not always even this clear. Studies such as Galloway (1987), Lust et al. (2023), Kaukiainen (1984), and Söderberg (1984) instead indicate very low to non-existent differences between individuals and areas, even when looking at food producers (see Kaukiainen, 1984; Klesment & Lust, 2021; Lust et al. 2023). The differentiated results regarding the existence of a mortality gradient between socio-economic groups during short-term economic stress clearly needs to be disentangled further and separated based on the concerned time periods and demographic subgroups (gender and age) to see if an explanation can be found in the details.

Table 1: Studies concerning differences in mortality response between socio-economic groups during short-term economic stress

Study	***18th/19th century***	***Any discriminative response at all***	***Infants***	***Children***	***Adults***	***Elderly***
Campbell et al. 2004	C/C	X	O	X	X	O
Bengtsson, 1999	C/C	X	O	X	-	-
Bengtsson & Dribe, 2005	C/C	X	-	X	X	-
Luque de Haro et al. 2021	C/C	X	-	-	X	X
Scalone, 2014	C/C	X	-	-	X	-
Dribe et al. 2010	C/C	X	-	-	-	-
Galloway, 1987	C/N	O	O	-	-	-
Alter & Oris, 2000	N/C	X	X	X	O	X
Klesment & Lust, 2021; Lust et al. 2023	N/C	O	X	X	X	-
Jennings et al. 2017	N/C	X	X	X	-	-
Söderberg, 1984	N/C	O	-	-	-	-
Kaukiainen, 1984	N/C	O	-	-	-	-

Notes: "C" indicate that the period is covered by the study, "N" that it is not, for example Bengtsson, 1999 has C/C meaning that both the 18th/19th centuries are covered by the study, "X" indicate differentiated response between socio-economic groups, "O" that no such relationship can be established, and "-" that the study does not cover the concerned demographic group

Table 1 lists a number of studies related to the socio-economic differentiated mortality response in 18th and 19th century Europe. It separates between the existence of a discriminatory response and the response of different age groups. "C" indicate that the period is covered by the study, "N" that it is not, for example Bengtsson (1999) has C/C meaning that both the 18th/19th centuries are covered by the study. "X" indicate that the study shows different responses for socio-economic groups while "O" indicates the opposite and "-" simply means that the study does not cover differences for the concerned demographic group. It should however be stressed that this is a simplification of the studies and that the results sometimes show more complex relationships when investigated deeply. Some general patterns can however be distinguished.

Regarding the mere existence of a response to economic fluctuations, there seems to be a small break between the 18th and 19th centuries where most studies concerned with the 18th century show a differentiated response while the results are much more scattered for those concerned only with the 19th century. Perhaps what this indicate more than anything is the continuous improvements that was made concerning food storages, sanitation, and transportation during the period, affecting the broad masses of the population, making mortality crises caused by short-term economic stress less and less likely (Livi-Bacci, 1998; Persson, 1999; Schön, 2013; Wiesner-Hanks et al. 2018). Including studies concerned with the 19th century, when industrialization began for many of these nations, allows for long-term trends to be distinguished and permits this study to be placed within the larger context of mortality impacts from short-term economic stress (Schön, 2013).

Though the studies lack enough geographical spread to allow for general conclusions, it does seem reasonable to expect differences in mortality between socio-economic groups in the end of the 18th century. Turning to age groups, starting with infants, there is also a quite clear, however opposite, break between the mortality response of infants where socio-economic status seems in general to have been *less* important in the 18th century. Infants were fragile even in the best of times in pre-industrial societies, and though mortality rates could reach very high levels there was naturally less room for increases during times of short-term economic stress (Galloway, 1988; Livi-Bacci, 1989).

3.2.1 Infants

Indeed, in a study of the short-term mortality response to changes in real wages (commonly due to food shortages) in Sweden from 1751-1859, Bengtsson and Ohlsson (1985) finds that the mortality of infants seems, relatively, much less responsive than other age groups and that the response appear stronger in the year of economic fluctuations than in the year after, when larger death rates would be expected. Results which are further supported by Larsson (2006, p.56) who find that: "…infants fared better during the crises than other age categories" during mortality crises in general. Even when separating mortality based on socio-economic group there is little that indicate large increases for infants.

Campbell et al. (2004), in their study of mortality responses to price increases in 18th and 19th century Europe and Asia, present findings for Europe both in support of and in opposition to a gradient for infants though their results in general goes against differences between socio-economic groups. For infants in Italy, mortality for both females and males among the middle

class were even lower during short-term economic stress than during years with average prices (Campbell et al. 2004).

Bengtsson (1999), researching infant and child mortality's connection to economic fluctuations in the Swedish parish Västanfors from 1757-1850, also find evidence suggesting that infant mortality varied without correlation to economic fluctuations and socio-economic group. For the 19th century, the results are a bit different. Findings by Lust et al. (2023) and Klesment and Lust (2021), indeed indicate moderate differences in the risk of death for infants relative to other age groups and also somewhat differing values for people of different socio-economic groups. The area of study concerns differences in farmers/labourers mortality risk between those working on privately/church/state owned manors in 19th century Estonia (then part of Russia) during harvest failure in the 1840s (Lust et al. 2023).

Further results in favour of differences between occupational groups comes from for example Jennings et al. (2017) who find, when observing the effect of short-term economic stress on infant and child mortality on the North Orkney islands in late 19th century Scotland, that for both infants and children age 1-14, there was a higher relative risk of dying if one's father had a non-agricultural occupation compared to those with fathers with agricultural occupations. Though the evidence concerning infants is not clear, it does seem likely that only small to non-existent differences can be expected for the 18th century.

3.2.2 Children

But is there a difference for children ages 1 and above? And where would this mortality difference stem from? Going back to Table 1 it is reasonably clear that there seems to have been a social gradient concerning children seen as this is found by all studies, both in the 18th and 19th century. Bengtsson and Broström (2011) argue that it was not only nutrition itself that impacted the mortality of children but also the state of their parents. If the parents were seriously ill with disease or perhaps even dead, it is not difficult to understand the impact that must have had on the children's chances of survival (Bengtsson & Broström, 2011; Lappalainen, 2014).

Families losing an income bringing member during a food shortage quickly became more vulnerable to dying themselves, something that the upper classes and guild connected families could cope with better due to the help they would receive from being connected to these institutions (Sjoberg, 1960). A point that also Bengtsson and Dribe (2000, p.21) make regarding malnutrition, stating that "…the interpretation is that the household heads were unable to secure the survival of all family members". This idea, that the resistance mechanism might have been

more prevalent, is further supported by for example Dribe (2003) but also May and Anderson (1979):

> *Interestingly, many documented accounts of disease outbreaks are for host populations at high densities, where stress induced by overcrowding or malnutrition is present. It is very likely that such outbreaks are to be explained by the alternative stable states produced by close links between pathogenicity and nutrition or stress, rather than by the commonly accepted hypothesis of enhanced transmission with high density populations (May & Anderson, 1979, p.460).*

Diarrheal diseases such as dysentery, caused by different types of species of the Shigella bacteria, was one of the main killers during times of famines and short-term economic stress, causing the infected to suffer from fever, bloody faeces, and severe gastric cramps (Castenbrandt, 2012). Mortality is closely connected to the nutritional state of the individual and as the incubation period is short, usually less than a week, it could quickly cause high death rates (Castenbrandt, 2012). Could it be that poorer children and families suffered higher death rates both because of diseases made worse by malnutrition such as dysentery and as a consequence of incapacitated or dead adults? May and Anderson (1979) explain it well:

> *…the now widely recognised fact that the impact of an infection is often related to the nutritional state of the host. Broadly speaking, malnourished hosts have lowered immunological competence, and are less able to withstand the onslaught of infection (May & Anderson, 1979, p.460).*

Additionally, Bengtsson (1999) find that child mortality indeed increased substantially in the year after a year of high prices and that a clear difference can be found between socio-economic groups in favour of the more well-off. However, considering the high mortality in smallpox among children during the period, which reoccurred with a few years interval regardless if there was short-term economic stress or not, one should be careful about drawing to big conclusions as periods and areas investigated could be affected by an epidemic unrelated to the economic fluctuation (Appleby, 1975; Bengtsson & Broström, 2011; Larsson, 2006).

Caused by infection with the Variola virus, smallpox was one of the major killers of the period (Larsson, 2006, 2019; Mackenbach, 2020; Persson, 2001). Though not uncontested, it is generally agreed that mortality in the disease was largely unrelated to the infected persons

nutritional status (Appleby, 1975; Fogel, 1986; Larsson, 2019; Livi-Bacci, 1989). In contrast to common consensus (Appleby, 1975; Livi-Bacci, 1989), Bengtsson (1999) however also finds that smallpox mortality was indeed affected by short-term economic stress, something that has also been supported by Larsson (2019) regarding harvest failures.

Results regarding the mortality response for children is certainly differentiated as Campbell et al. (2004), generally do find differences by socio-economic status in Belgium, Italy, and Sweden but where the differences become very widespread when separating between occupations/classes and by gender with some values showing responses in favour of the higher classes while others show the complete opposite. Furthermore, Lust et al. (2023) shows that private manors (being the less preferable employer among private, church, and state-owned manors in pre-industrial Estonia) also have the highest mortality for children age 1-4, closely followed by the church manors and with relatively low values for the state-owned manor (Lust et al. 2023).

In conclusion, regarding differences in child mortality between socio-economic groups during short-term economic stress, it seems indeed as if a gradient existed in the end of the 18th/ beginning of the 19th century. Though the evidence concerning smallpox is somewhat unclear, it does seem likely that lower resistance (in accordance with the resistance mechanism) to diseases due to malnutrition caused not only by low standards of living but also because of a more sensitive family situation made children of the lower socio-economic groups die in larger numbers than among the rich.

3.2.3 Adults and the Elderly

Furthermore, there also seems to be a general gradient in mortality between socio-economic groups concerning adults (Table 1). Adults, being normally strong and resistant, usually had very low levels of mortality and the increased risk during economic fluctuations could be substantial (Bengtsson & Ohlsson, 1985; Fridlizius, 1984). Luque de Haro et al. (2021), when investigating the Spanish town Vera for the period 1797-1812, indeed finds a general gradient in mortality concerning adults in favour of the more well-off. The study is more concerned with epidemic outbreaks than economic fluctuations but still relates to the subject as the epidemics was accompanied by strong price increases (Luque de Haro et al. 2021).

Furthermore, Scalone (2014), when investigating the effect of short-term economic stress on maternal mortality for people of different socio-economic class in rural 18th and 19th century Germany, finds both the highly expected outcome that wives of farmers and farmworkers had

a lower risk of dying during economic fluctuations than non-farm workers, having higher access to food, and that wives of professionals as well as lower skilled and unskilled workers had similar levels of risk.

Bengtsson and Dribe (2005) similarly show that landless adults in 18th and 19th century Southern Sweden, a group among the lower socio-economic classes and sensitive to economic fluctuations, experienced excess mortality for both men and women during short-term economic stress. Some contradictory evidence is however provided by Galloway (1987), who, by separating people into socio-economic groups by level of rent, investigates mortality (as well as fertility and nuptiality) responses in the French city of Rouen during the 17th and 18th century. His findings indicate only small differences in favour of more well-off individuals in the year of high prices and a small reversed trend for the year after a year with high prices (one year lag) (Galloway, 1987).

Most studies however seem to indicate that a difference between adult socio-economic groups existed during economic fluctuations. How come?

> *It is likely that the increase in deaths in the middle age groups is a result of migration into the city during poor harvest years. It is possible that the increase in deaths may have occurred mainly among the in-migrants who, having left a relatively pristine rural environment, were suddenly exposed to London's myriad [of] pathogenic organisms (Galloway, 1985, p.500).*

One of the more difficult diseases to distinguish, both because of the sometimes very undistinguishable symptoms of fever and red spots and because of the many names used by priests to record the disease, is typhus (Larsson, 2006; Mackenbach, 2020). The disease, caused by the micro-organism Rickettsia prowazeki, could both be confused with typhoid infection as well as other diseases connected to fever (Mackenbach, 2020). Typhus mortality is often connected to nutrition, not only because malnutrition likely made individuals more vulnerable to the disease but because events such as war and harvest failures caused migration and increased human contact, conditions very favourable for the disease to spread by means of the body louse (Mackenbach, 2020).

Not only did adults of lower socio-economic status often live more cramped but they were also likely to be the first to move in times of economic hardship and thus vulnerable to epidemic diseases such as typhus both when settled and in migration (Galloway, 1985; Livi-Bacci, 1989; Ó Gráda, 2009). The knowledge about how diseases spread were highly limited and though

malnutrition most likely affected the severeness of infection, it seems reasonable that poorer adults also faced a larger risk of being infected and causing the spread of diseases in line with the migration mechanism (Johannisson, 1994; Livi-Bacci, 1989).

Typhus was however not the only important disease among adults during the period. Tuberculosis, most commonly of a respiratory kind, was ever present in the cities, responsible for a large share of all deaths (especially among young adults), and quite closely connected to nutrition (Mackenbach, 2020). Taken together, though it seems unlikely that children migrated in large masses during short-term economic stress (Dribe, 2003), it is far more likely that adults and particularly young adults did so, possibly making the overall gradient between socio-economic groups a combination of lack of resistance and higher vulnerability through migration.

The last age group, the elderly, though covered by few studies, seems in general to have had low differences between individuals of different socio-economic groups during economic fluctuations (Campbell et al. 2004). Older individuals, in similarity to infants, also normally suffered high levels of mortality and so could increase less during short-term economic stress (Bengtsson & Dribe, 2005; Fridlizius, 1984). While Alter and Oris (2000) and Luque de Haro et al. (2021) offer some results pointing towards a gradient, Campbell et al. (2004) instead demonstrate values that indicate lower responses among the elderly. As written by Bengtsson and Dribe (2005, p.358): mortality among elderly "seem to be more dependent on…their investments earlier in life in sustaining arrangements and relationships, both financial and personal".

Moving forward in the study, what are the expectations concerning differences in mortality between socio-economic groups during short-term economic stress? Straightforward, what is expected is a differentiated response in general as well as for children and adults. It is also likely that this response will be stronger concerning major diseases such as dysentery, typhus, and tuberculosis which lethalness are connected to the nutritional state of the individual. Though not fully clear concerning either group, it is also expected that no major gradient is found for infants and the elderly.

4 Data

In order to estimate the effect of short-term economic stress on mortality for socio-economic groups, this study uses rye prices (described further in chapter 4.1.3) as well as death records (see chapters 4.1, 4.1.1-4.1.2, and 4.2). Rye prices allow for years with prices high enough to cause short-term economic stress to be distinguished while death records are used to estimate the effect on mortality of these high prices.

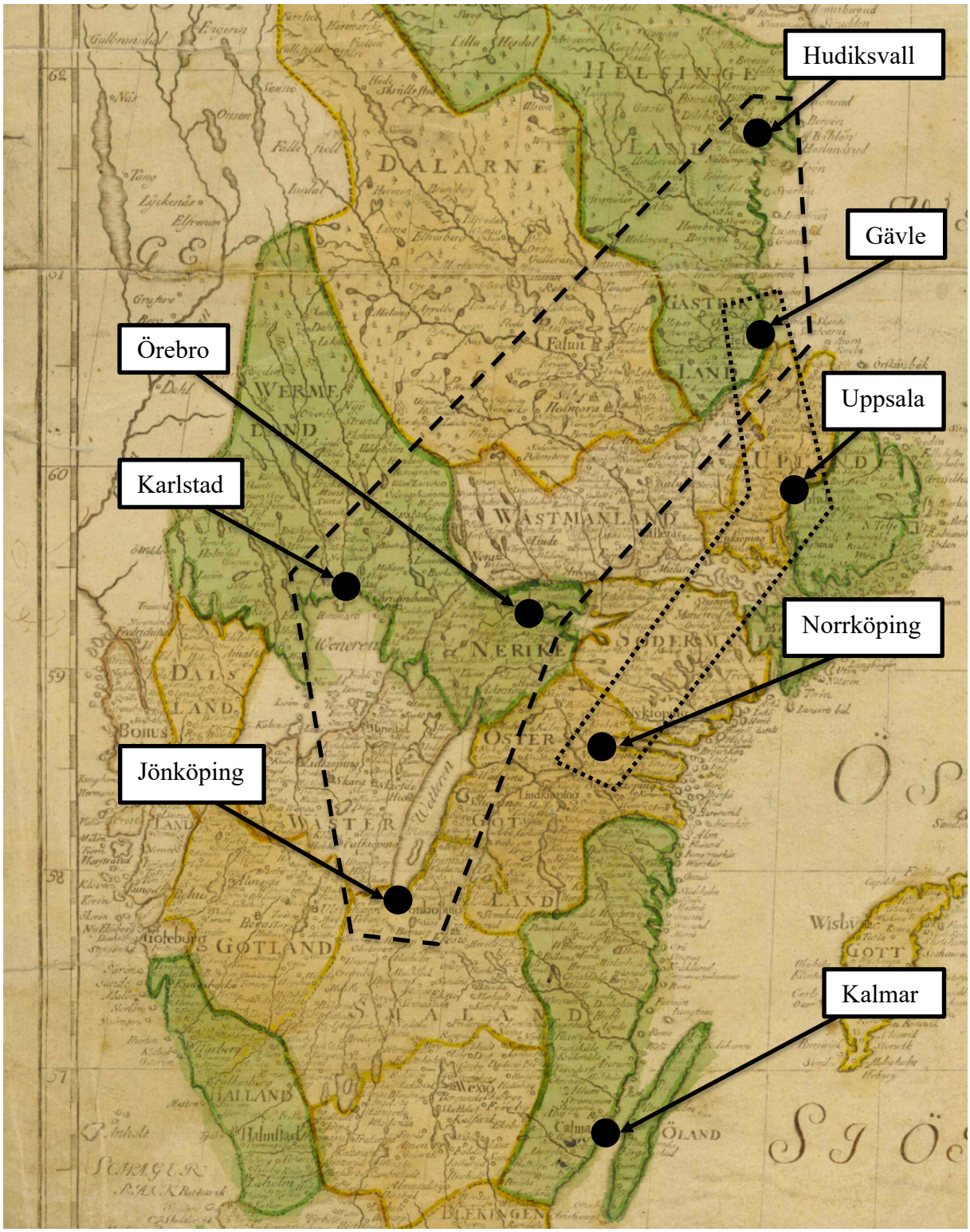
4.1 Source Material

The cities (see Figure 3) studied are Uppsala, Norrköping (Olai parish), Gävle, Örebro, Karlstad, Hudiksvall, Jönköping (Kristine parish), and Kalmar from 1768-73. Two sources are used for data on mortality for the 8 cities. Firstly, individual level data on deceased individuals, extracted manually from the handwritten death and burial registers, are used in a logit model to find the possible difference in risk of dying in a high price year between people of different socio-economic status, relative to the difference in risk of death between the groups in the period 1768-70 (see chapter 5.1 for method). Secondly, aggregated population data, gathered from the Tabular Commissions Mortality and Population tables (in combination with the data from the death and burial registers) are used for descriptive statistics on mortality and as a way of verifying the results found in the regressions (see chapter 5.2 for method).

But why use these 8 cities? Firstly, the cities included in the study cover a large part of the Swedish area and all but Kalmar, which is used as a comparative example in descriptive statistics, were affected by the price increases of 1771-72. Secondly, the death and burial registers for the concerned cities, to a satisfactory level, contain the information needed for this study and includes material regarding not only individuals' year and month of death but also their age, gender, cause of death, and most importantly for this study, occupation/social status. Thirdly, there is information on rye prices covering most of the 18th century for all regions in which these cities are situated (Jörberg, 1972a). Lastly, the population sizes of the 8 cities differ from 1229 (Hudiksvall) to 7933 (Norrköping, Olai parish) in the year 1780, offering a

possibility to cover death patterns representative for both small and "large" cities (Andersson Palm, 2000).

Figure 3: Cities location within the Swedish area, 1747



Notes: Dotted/dashed area indicate cities within regions with high rye prices in 1771/1772, respectively, Source: ©Lantmäteriet, n.d.

In Table 2 the total number of observations is shown, separated by year, gender, age group, socio-economic group (explained further in chapter 4.2), and city as well as by their occurrence during the reference period 1768-70 or a year of high prices/a year after a year of high prices.

Table 2: Number of observations/registered deaths, divided by year, gender, age, socio-economic group, and city

Total/Gender	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***	***Total***
Total	658 (816)	719 (892)	635 (794)	695 (825)	975 (1,141)	1,151 (1,482)	4,833 (5,950)
Men	340 (419)	345 (430)	330 (414)	356 (415)	462 (536)	562 (723)	2,395 (2,937)
Women	318 (394)	374 (459)	305 (379)	339 (410)	513 (604)	589 (755)	2,438 (3,001)
Total/Gender (Excluding Kalmar)	***1768-70***	***Year with rye prices over log 0.2 (≈ 22%)***	***Year after year with rye prices over log 0.2 (≈ 22%)***				
Total	2,012 (2,502)	1,028 (1,083)	1,300 (1,445)				
Men	1,015 (1,079)	511 (537)	611 (682)				
Women	997 (1,061)	517 (546)	689 (760)				
Age groups	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***	***Total***
Infants	181 (238)	208 (258)	213 (261)	178 (219)	214 (261)	202 (256)	1,196 (1,493)
1-14	175 (200)	177 (248)	104 (124)	123 (138)	207 (237)	346 (453)	1,132 (1,400)
15-24	23 (28)	29 (34)	27 (35)	35 (40)	34 (45)	65 (82)	213 (264)
25-44	93 (115)	87 (101)	96 (121)	118 (135)	147 (166)	180 (220)	721 (858)
45-59	72 (91)	68 (80)	71 (97)	81 (96)	138 (164)	150 (193)	580 (721)
60 and over	110 (135)	143 (158)	116 (143)	153 (188)	229 (259)	202 (267)	953 (1,150)
Age groups (Excluding Kalmar)	***1768-70***	***Year with rye prices over log 0.2 (≈ 22%)***	***Year after year with rye prices over log 0.2 (≈ 22%)***				
Infants	602 (637)	221 (239)	249 (263)				
1-14	456 (486)	231 (238)	329 (376)				
15-24	79 (83)	32 (37)	63 (71)				
25-44	276 (296)	151 (157)	212 (233)				
45-59	211 (219)	133 (138)	175 (198)				
60 and over	369 (400)	252 (266)	266 (295)				
Socio-economic group*	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***	***Total***
A	108	104	80	99	153	155	699
M	86	85	71	53	89	114	498
S	87	102	92	104	186	216	787
Pr	271	312	307	324	377	455	2,046
P	32	41	37	40	83	96	329
Socio-economic group (Excluding Kalmar)*	***1768-70***	***Year with rye prices over log 0.2 (≈ 22%)***	***Year after year with rye prices over log 0.2 (≈ 22%)***				
A	292 (62)	158 (105)	194 (143)				
M	242 (67)	107 (69)	146 (100)				
S	281 (51)	179 (108)	257 (152)				
Pr	890 (168)	419 (205)	504 (352)				
P	110 (25)	75 (50)	86 (42)				
City							
Uppsala	626 (626)	***Norrköping (Olai)***	1,587 (1,587)				
Gävle	735 (735)	***Örebro***	559 (756)				
Karlstad	575 (745)	***Hudiksvall***	255 (255)				
Jönköping (Kristine)	509 (509)	***Kalmar***	0 (737)				

Notes: Number of observations used in regressions (excluding Karlstad and Örebro rural parishes and Kalmar city/cathedral parish) followed by (in parentheses) number of observations used in descriptive statistics (including Karlstad and Örebro rural parishes and Kalmar city/cathedral parish), for socio-economic groups see Table 4, * values for descriptive statistics not included as only a few years/cities are used, ** values for descriptive statistics represent only a few years/cities, see Table 14, Appendix A, Source: Death and burial registers, Riksarkivet.se; For descriptive statistics for Örebro: The TABVERK database (the Demographic Database), http://rystad.ddb.umu.se:8080/Tabellverket/Tabverk, based on the Tabular Commissions Mortality tables, scanned by CEDAR, Umeå University (full source see pp.53-54)

A year of high prices is defined as a deviation of log 0.2 (approximately 22 %) or more from the long-term trend (method/definition discussed further in chapter 5.3). Two values are shown for most of the cells.[1] The first value represents observations used in the regressions, excluding the rural parishes for Karlstad and Örebro and the city parish Kalmar (as Kalmar do not have years with high prices). The second value includes these parishes, though Kalmar is still excluded for values regarding the comparison between the period 1768-70 and years with high prices/years after years with high prices.

The reason for excluding the rural parishes of Karlstad and Örebro is that the Tabular Commissions Population tables for these two cities were made for both the city and the surrounding countryside, meaning that the descriptive statistics by necessity must include both the city and rural parish. Regarding Jönköping and Norrköping, only two parishes has been included as they represent the main part of the cities population and has available data on both population and deaths.

4.1.1 The Death and Burial Registers

The registers, recorded by the priests by law from 1686 and with increasing detail from there on, are a primary, eye-witness account, giving them a relatively high trustworthiness as a source (Kjeldstadli, 1992; Larsson, 2006). A few matters need however be discussed with regard to the source's reliability. Firstly, there is some missing data in the registers, mainly concerning occupation, where individuals are labelled not by their occupation or social class but simply as for example a widow, wife, or daughter. But as the information is missing sporadically it should not introduce any large bias nor affect the results in any major way. Secondly, though the sources offer great information on cause of death there is a substantial amount recorded as "unknown disease" or that the individual died from "old age".[2] However, these notations are used almost exclusively on infants and individuals over the age of 60 and so does substantially limit the age groups affected by insufficient recording.

Lastly, though they in general seem to have been relatively good at distinguishing certain diseases as well as keeping track of their congregation and peoples ages, it should also be recognized that the records were written by priests with differing and limited knowledge about

[1] Values for descriptive statistics concerning year/socio-economic group has been omitted as only a few years are used, see Table 14, Appendix A.
[2] "Unknown disease" and "old age" represent 9.1 % (440 observations) and 8.7 % (419 observations), respectively of the total number of observations used in regressions.

diseases and access to records and that the unusual amount of dead people during short-term economic stress and harvest failure might have further impaired their capability to accurately register the cause of death (for a discussion on the reliability of the parish registers see Larsson, 2006).

4.1.2 The Tabular Commission and the Mortality and Population Tables

In 1749 the Tabular Commission started collecting data on the population regarding births, marriages, and deaths but also on the population size, creating a massive amount of data concerning for example age and gender of both deceased and living (CEDAR, 2018). These Mortality (compiled every year by priests) and Population (compiled certain years (see Table 14, Appendix A) by the city council) tables offers not only less information than the death and burial registers (as they only contain aggregated data) but are also less reliable as they were compiled at the end of the year and so further away in time from events such as births and deaths throughout the year (CEDAR, 2018).

The tables however seem relatively accurate and as they will only be utilized to form descriptive statistics concerning the crude death rate as well as mortality divided by age, gender, cause of death, and for years covered by the censuses, by socio-economic status, the results should be reliable enough for the analysis (CEDAR, 2018).

4.1.3 Rye Prices

To establish which years had prices considered high enough to cause short-term economic stress, the study uses rye prices gathered from "A History of Prices in Sweden, 1732-1914" by Lennart Jörberg (1972a) for the counties Uppsala (Uppsala), Östergötland (Norrköping), Gästrikland (Gävle), Närke (Örebro), Värmland (Karlstad), Hälsingland (Hudiksvall), Jönköping (Jönköping), and Kalmar (Kalmar) for the period 1732-75 (see Table 15, Appendix A for price data). The source has been selected due to its detailed coverage on regional prices but also because of its wide use in various studies (Jörberg, 1972a; used in for example Bengtsson, 1999; Dribe et al. 2017; Larsson, 2006; Post, 1990). Why rye is used is due to its wide usage as a food grain in the time period and affected regions (Linde, 2012). The price data is analysed through a filter method (thoroughly described in chapter 5.3) in order to separate years with average prices from those with exceptionally high prices.

However, some possible issues with using rye prices as an estimator for short-term economic stress must be discussed. High rye prices were for example not negative for all people and producers who could still sustain themselves and at the same time have a surplus to sell could benefit from food shortages (Persson, 1999). However, as this study only covers cities it is reasonable to assume that high rye prices affected almost all residents in a negative way (Appleby, 1979; Lindberg, 2007).

Yet, if wages also increased when food prices increased the real wage and standard of living would remain stable (Gary & Olsson, 2019; Prado et al. 2021; Söderberg, 1987). Though nominal wages were increasing in Sweden during the 18th century they increased slowly and does not seem to have responded in any high degree to sharp increases in rye prices, causing real wages to indeed decline during periods of high food prices (Gary & Olsson, 2019; Prado et al. 2021; Söderberg, 1987). Furthermore, it should be recognized that richer individuals spent less of their budget on food than poorer families both in times of normal and high prices (Appleby, 1975; Fogel, 1986; Lindberg, 2007). This is however a natural effect of inequality and the fact that the consumer "basket" differed between social classes is not as important for this study as the fact that rye was consumed by both the rich and the poor (Söderberg, 1987).

Finally, one must also reflect upon how well the markets were integrated in 18th century Sweden and Europe. As the basis of short-term economic stress is economic and not purely based on food deficits, it would be wrong to say that people in cities suffered from short-term economic stress in 1771-72 if food was not available at all. Indeed, evidence found by for example Bengtsson and Jörberg (1975) and Persson (1999) indicate that the markets in Europe and Sweden were well connected and increasingly integrated during the 18th century. Though food shortages made it more expensive to acquire food for all people, it seems indeed as if it still were available for those who could afford it, even during severe famines (Scrimshaw, 1983).

All in all, the discussion verifies that rye prices should be an appropriate variable in determining pre-industrial short-term economic stress in Swedish cities.

4.2 Categorization

Since the purpose of this paper is to distinguish the effect of severe short-term economic stress on individuals of different socio-economic status it is sensible to divide diseases according to how influenced they are by nutritional level (Fogel, 1986; Livi-Bacci, 1989). Or expressed

differently, how strong the correlation between disease, nutrition, and mortality is. However, any division can be questioned as it creates sharp partitions, possibly causing diseases with very similar correlations with nutrition and mortality to still end up in different categories. The following division (Table 3), adapted from Livi-Bacci (1989) and Fogel (1986), is however one that seems reasonably accurate. The table is simplified as the study is only interested in making a division between diseases which are clearly or somewhat clearly related to nutrition (and present in the data) and other diseases/causes of death.

Table 3: Categorization of diseases (adapted from Fogel, 1986; Livi-Bacci, 1989)

Disease	***Common Swedish name (old)***
Clear nutritional influence	
Diarrhoea/Dysentery	Durchlopp, rödsot, rödfeber, diarré
Respiratory diseases	Bröstsjuka, bröstfeber, håll och styng
Measles	Mässling
Whooping cough	Kikhosta
Tuberculosis/Consumption/White death	Lungsot, tvinsot, hektik
Variable nutritional influence	
Influenza	Halsfluss, flussfeber
Syphilis	Venerisk
Typhus	Hetsig sjuka/sjukdom, hetsig feber, fläckfeber, uppsalafeber, rötfeber, feber
Worms	Mask, maskfeber
Heart attack (child)	Hjärtsprång

Notes: Though heart attack normally probably was not connected to nutritional level it seems it might have been for children due to worms or bad food (DDSS, n.d.), the distinction of typhus is difficult and uncertain but these notational titles seem likely to have indicated the disease (Andersson, 2021; DDSS, n.d.), Source: DDSS, n.d.; Fogel, 1986; Livi-Bacci, 1989

The division and hand coding of diseases are however further challenged by the terms used by the priests, which in some cases has a clear counterpart in the medical definition of the disease but which often could be interpretated as several different diseases and with diverse understandings depending on whether a harvest failure and/or epidemic occurred at the same time (Andersson, 2021; DDSS, n.d.; Larsson, 2006). The division into the two classes affected by nutrition should therefore be seen as suggestive, though likely broadly reflecting the correlation between disease, nutrition, and mortality (Fogel, 1986; Livi-Bacci, 1989).

Another area of categorization that requires explanation is occupations. The registers contain hundreds of occupational and social titles which has all needed to be hand coded. This study utilizes the international division called HISCO (Historical International Standard Classification of Occupations) (see Table 4) to the furthest extent possible as it is frequently used by similar studies and so offer some comparability (Bengtsson & van Poppel, 2011; Westberg, 2021).[3] As a large share of the individuals in the registers are not listed according to an occupation but merely as for example burghers (privileged city residents) or different types

[3] The coding of occupations into HISCO was greatly aided by the SWEDPOP HISCO occupational codes (unpublished).

of “poor people” the division has been extended to incorporate these people. Children/women are furthermore often listed according to their fathers/husbands occupation if they did not have an occupation of their own. Something that has to be taken into consideration when judging the results later on.

From the HISCO categorization and additional class 10 for “poor people”, five groups have been formed in order to achieve a reasonable number of observations in each group and due to the sometimes-ambiguous division of occupations in the registers.

The occupations/social classes of the Tabular Commission’s Population tables have also been coded for the study’s descriptive statistics and a more detailed description of the occupational categorization concerning these *censuses* is given in Table 16, Appendix A.

Table 4: Categorization of occupations

Group	***Description***
HISCO	
0/1	Professional, technical, and related workers
2	Administrative and managerial workers
3	Clerical and related workers
4	Sales workers
5	Service workers
6	Agricultural, animal husbandry, and forestry workers, fishermen, and hunters
7/8/9	Production and related workers, transport equipment operators, and labourers
Additional class	
10	Individuals listed as “poor”
Socio-economic group	
A	Administrative and professional (groups 0, 1, 2, and 3)
M	Merchants and burghers (group 4 and individuals listed only as burghers)
S	Service and agriculture (groups 5 and 6)
Pr	Production (groups 7, 8, and 9)
P	Poor (group 10)

Source: CEDAR, 2018; Westberg, 2021

But which occupations lies within these aggregated socio-economic groups? In Table 5 the five most common titles are listed for each group. These are not always strictly occupations but indications of an individual’s social status/class, such as people listed only as burghers, which could mean a master craftsman as well as a merchant but generally implies a person of higher social status then for example a maid or a poor person (Lindkvist & Sjöberg, 2019). The same goes for individuals listed as poor, though this is not an occupation it does show that the person would most likely be in a vulnerable position during short-term economic stress.

The titles listed does not represent one specific occupational title but are congregated somewhat as many different versions of very similar occupations were used by individual priests in the death and burial registers and some professions were quite similar such as different types of smiths or being a master or apprentice tailor.

Table 5: Most common titles/occupations for socio-economic groups

Socio-economic group	***1***	***2***	***3***	***4***	***5***
A	Skeppare (skipper, 167, 20.0%)	Visitör/inspektör (visitor/inspector, 52, 6.2%)	Rådman (magistrate, 52, 6.2%)	Styrman (ship officer, 41, 4.9%)	Mätare (measurer, 26, 3.1%)
M	Handelsman (merchant, 220, 39.1%)	Borgare (burgher, 218, 38.7%)	Danneman (b) (trustworthy man, 34, 6,0%)	Handlare (tradesman, 25, 4.5%)	Mannen (b) (man, 16, 2.8%)
S	Vakt (guard, 175, 18.9%)	Piga (maid, 132, 14.3%)	Dräng (common worker, 97, 10.5%)	Soldat (soldier, 59, 6.4%)	Fiskare (fisherman, 53, 5.7%)
Pr	Sjöman/båtsman (seaman/boatsman, 287, 12.1%)	Timmerman (woodworker, 248, 10.5%)	Skräddare (tailor, 145, 6.1%)	Skomakare (shoemaker, 133, 5.6%)	Smed (smith, 130, 5.4%)
P	Kvinnsperson/kvinnsfolk (a) (female person/female people, 192, 52.2%)	Fattighjon (poor person, 59, 16.0%)	Fattig (poor, 49, 13.3%)	Hospitalshjon (hospitalized poor person, 22, 6.0%)	Spinnhushjon (imprisoned poor person, 16, 4.3%)

Notes: Title/occupation in original 18th century Swedish, also English translation, number of observations, and percentage of group observations in parentheses, for explanation of socio-economic groups, see Table 4, (a) though this may not sound like a title that would directly indicate a poor person it was used as a derogatory term for a woman of low social status (the Swedish Academy Dictionary, SAOB), (b) the words “danneman” and “mannen” indicated someone trustworthy and most likely of similar position as a burgher (SAOB), Source: Death and burial registers, Riksarkivet.se (full source see p.54)

5 Methods

As previously mentioned, this study uses a logit model (5.1), utilizing the data gathered from the death and burial records, but also estimates the population size (5.2) for the total population as well as for specific age groups and gender in order to form more complete descriptive statistics for the period. In addition, a filter method is being used to find years which are affected by high prices that diverges from the normal trend over time (5.3).

5.1 The Logit Model

The multivariate, binary, logit model is shown in Equation 1, where in the full model the categorized, independent variables are: Socio-economic group (SEG), Age (A), Gender (G), Month (M), and City (C) and where i represent individuals (Kleinbaum & Klein, 2010; Ruist, 2021; Stock & Watson, 2020). The main variable of interest is of course SEG, and the other variables act both as controls and ways of breaking down the population into smaller groups.

Each control variable is believed to reduce bias in the model. Age groups and men/women could for example have specific mortality patterns unrelated to which socio-economic group an individual belong to. Though this seems likely for age groups, considering that infants and the elderly had higher mortality than other age groups it seems more uncertain, though fully possible, concerning men/women (Campbell et al. 2004). Also month and city are valid controls. Seasonal mortality could raise the death rates for all socio-economic groups and certain cities seem to have had, in general, higher mortality than others (Kaukiainen, 1984; Sharlin, 1978).

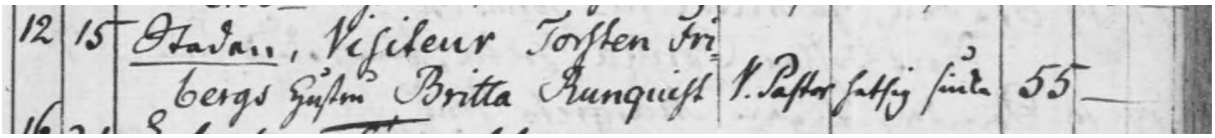
The dependent variable Crisis needs to be explained. It is a dummy variable where deaths occurring during years of high prices (see definition in chapter 5.3) will be given a 1 while deaths happening in the years 1768-70 will be given a 0. Using the period 1768-70 as a base, representing low/normal prices (see Figures 5 and 6) and death rates has similarly been done by Post (1990) in a more descriptive study of the food crises progression and severeness through Europe in the early 1770s. Furthermore, u_i, β_0, and β_1-β_5 represents the error term, intercept,

and parameter coefficients, respectively. Coefficients/variables in bold indicate factors with a vector of categorical outcomes.

$$P(Crisis_i = 1|SEG_i, G_i, A_i, M_i, C_i) = \frac{1}{1 + e^{-(\beta_0 + \boldsymbol{\beta_1 SEG_i} + \beta_2 G_i + \boldsymbol{\beta_3 A_i} + \boldsymbol{\beta_4 M_i} + \boldsymbol{\beta_5 C_i})}} + u_i \qquad (1)$$

All variables relate to an individual's death as for example the woman in Figure 4, who was the wife of a visitor and died in June, 1772, in Karlstad of a fierce disease at the age of 55, would be categorized as dying during a high price year (see Figure 3), Crisis=1, and categorized into socio-economic group A (SEG), age category 5 for people ages 45-59 (A), gender category female (G), month category June (M), and city category Karlstad (C). She would further be categorized as dying of a disease with variable/uncertain nutritional connection (see Table 3: "hetsig sjuka").

Figure 4: Death and burial notation in Karlstad, 1772



Notes: Notation describes the death and burial of Britta Runquist, who lived in the city of Karlstad and was the wife of visitor Torsten Friberg and died of a fierce disease at the age of 55 in the month of June, 1772, Source: Death and burial registers, Karlstad parish, Riksarkivet.se (full source see p.54)

But what does the model actually show? To start with, the probabilities estimated by the model is transformed into odds ratios (Kleinbaum & Klein, 2010). The odds ratios, ratio implying two values being divided by each other, is the odds of dying (based on dead individuals) between a socio-economic group and the reference socio-economic group (here A, Administration) during years of high prices divided by the odds of dying between a socio-economic group and the reference socio-economic group during the reference period 1768-70, given that control variables stay constant.[4]

Expressed differently, the odds ratio is the difference in risk of dying between a socio-economic group and the reference socio-economic group during a year of high prices relative to the difference in risk of dying between the two groups during years with normal levels of mortality (1768-70), given that control variables stay constant. This means that the odds ratios show how much the relative risk of dying increased/decreased between two groups during

[4] Odds are the relationship between two probabilities. For example, if 6 people die in group A and 4 people die in group B (making the total 10 people) then the odds of someone dying in group A is: $\frac{P}{1-P} = \frac{0.6}{1-0.6} = 1.5$.

short-term economic stress, in line with what the study wants to find. Values above 1 indicate a higher risk during economic fluctuations relative to the period 1768-70 and values below 1 the opposite.

All odds are however solely based on dead individuals. This means that if the population size of one of the socio-economic groups for example increased from the period 1768-70 to a year of high prices and as a consequence had increasing numbers of deceased individuals this could cause the odds ratio to show a high value, even though the relative mortality between the two groups has not changed, making the estimate biased. However, an alternative model based on for example survival analysis would require a much higher degree of data transcription and processing and so be both very time consuming and expensive. The model used here offers a possibility of finding a result within the scope of a master thesis. It should not either be assumed that population size changed that much during this somewhat short period of 6 years.

In Table 6 the population estimates are listed, based on the Tabular Commissions Population tables and own calculations (see chapter 5.2). Though not accounting for socio-economic groups, the values for gender and age groups show remarkable stability over time. When comparing the average value for the period 1768-70 with the high mortality years 1771-73 individually in the second part of the table, all values except for some outliers among new-borns and the older part of the population show a population within 10 % of the 1768-70 average.

Table 6: Population estimates divided by year, gender, and age

Population	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***
Men	12,087	12,095	12,028	11,898	11,676	11,309
Women	14,675	14,631	14,555	14,516	14,404	14,088
New-borns	886	837	895	803	750	636
1-14	7,623	7,313	7,161	7,114	6,983	6,630
15-24	5,472	5,411	5,315	5,215	5,107	5,045
25-44	8,181	8,493	8,580	8,424	8,228	8,078
45-59	2,982	3,192	3,359	3,485	3,593	3,591
60 and over	1,294	1,362	1,468	1,587	1,646	1,579
Total	26,138	26,398	26,465	26,395	26,092	25,354
Population	***1768-70 (A) Average***	***1771/(A)***	***1772/(A)***	***1773/(A)***		
Men	12,070	0.986	0.967	0.937		
Women	14,620	0.993	0.985	0.964		
New-borns	873	0.920	0.859	0.729		
1-14	7,366	0.966	0.948	0.900		
15-24	5,399	0.966	0.946	0.934		
25-44	8,418	1.001	0.977	0.960		
45-59	3,178	1.097	1.131	1.130		
60 and over	1,374	1.154	1.198	1.149		
Total	26,333	1.002	0.991	0.963		

Notes: For available census years see Table 14, Appendix A, remaining estimates made with the balancing equation (Wachter, 2014) and an age group adapted balancing equation, see text, Source: Death and burial registers, Riksarkivet.se; The TABVERK database (the Demographic Database), http://rystad.ddb.umu.se:8080/Tabellverket/Tabverk, based on the Tabular Commissions Population and Mortality tables, scanned by CEDAR, Umeå University (full source see pp.53-54)

That the number of new-borns decreased during harsh times is unsurprising as people generally adapted their birth patterns to economic fluctuations (Galloway, 1988). These outliers do not impair the model but is simply an indication of the need for caution when interpretating the results.

Besides the dependant variable Crisis another variable named Crisis lag will be tested in regressions using the exact same model and with almost the exact same interpretation. The only difference is that Crisis lag does not indicate a year of high prices but the year after a year with high prices as mortality often increased more substantially the year after a price increase (Galloway, 1987; Livi-Bacci, 1989).

The logit model comes with a few assumptions of which some deserves discussion. Firstly, the observations need to be independent of each other (Kleinbaum & Klein, 2010). In other words, how likely is it that the death of one individual is connected to the death of another? In epidemics, though far less died than were infected, it seems reasonable that some correlation could occur, especially between families living close to each other. However, as diseases are categorized, some of this correlation should likely be removed as all diseases within a category are unlikely to be connected to each other.

Secondly, the variables should not be to highly correlated, risking multicollinearity (Kleinbaum & Klein, 2010). As most variables show general and highly different characteristics of people it seems unlikely that this should pose a problem for the model. Lastly, logistical models need a somewhat large sample in order to make accurate predictions (Kleinbaum & Klein, 2010). Though this could be a problem it is something that will also be weight in when discussing significance of the results of individual regressions and odds ratios.

5.2 Estimating Populations and Mortality

Since the population size was not recorded every year in the cities, the study uses the balancing equation in order to estimate the population per year and city for men/women and for different age groups (Wachter, 2014). Total population is estimated by adding all age groups together.[5] The balancing equation is relatively straight forward as births and deaths in the relevant year are added/subtracted to the population size from the end of the last year and then adjusted by net migration to fit the next census estimate. This is the way the formula is used when

[5] Total population could have been estimated in other ways such as adding men and women together or making similar estimates for the total population but all methods give very similar results.

calculating population estimates for men/women. For age groups it becomes a little bit more complicated. Starting with the population size for the age group at the end of the last year, the estimates are made by subtracting deaths occurring during the year, then adjust for the fact that some people grow old enough to join the age group from a younger age group and that some will leave for an older age group and lastly adjust for net migration.

For years before a census the calculations are simply reversed and for years that are not between two censuses in the period 1767-73, net migration is by necessity overlooked. The infant population is however calculated by simply subtracting deaths from births in the current year. The calculated age groups are however too small to use in the study and are therefore aggregated into the 6 groups: Infants, 1-14, 15-24, 25-44, 45-59, and 60 and over.

These end of the year estimates for men/women, age groups, and in total are then converted to mid-year estimates as it is common practice to estimate mortality rates based on the mid-period population (Wachter, 2014). Mortality rates are simply calculated by dividing the number of deceased with the mid-year populations. Mortality for socio-economic groups can however only be calculated for certain years/cities using the available censuses (see Table 14, Appendix A), and hence it has instead utilized the end of the year population value.

Death records transcribed from the death and burial registers have been used to the furthest extent possible as these data are considered a more reliable source than the Tabular Commission (see discussion in 4.1.1-4.1.2). Mortality rates are therefore calculated using a combination of data transcribed from the death and burial registers and from the Tabular Commission. Again, it should be stressed that the population values and mortality rates gained from these calculations should be seen as indicative and not in any sense absolute.

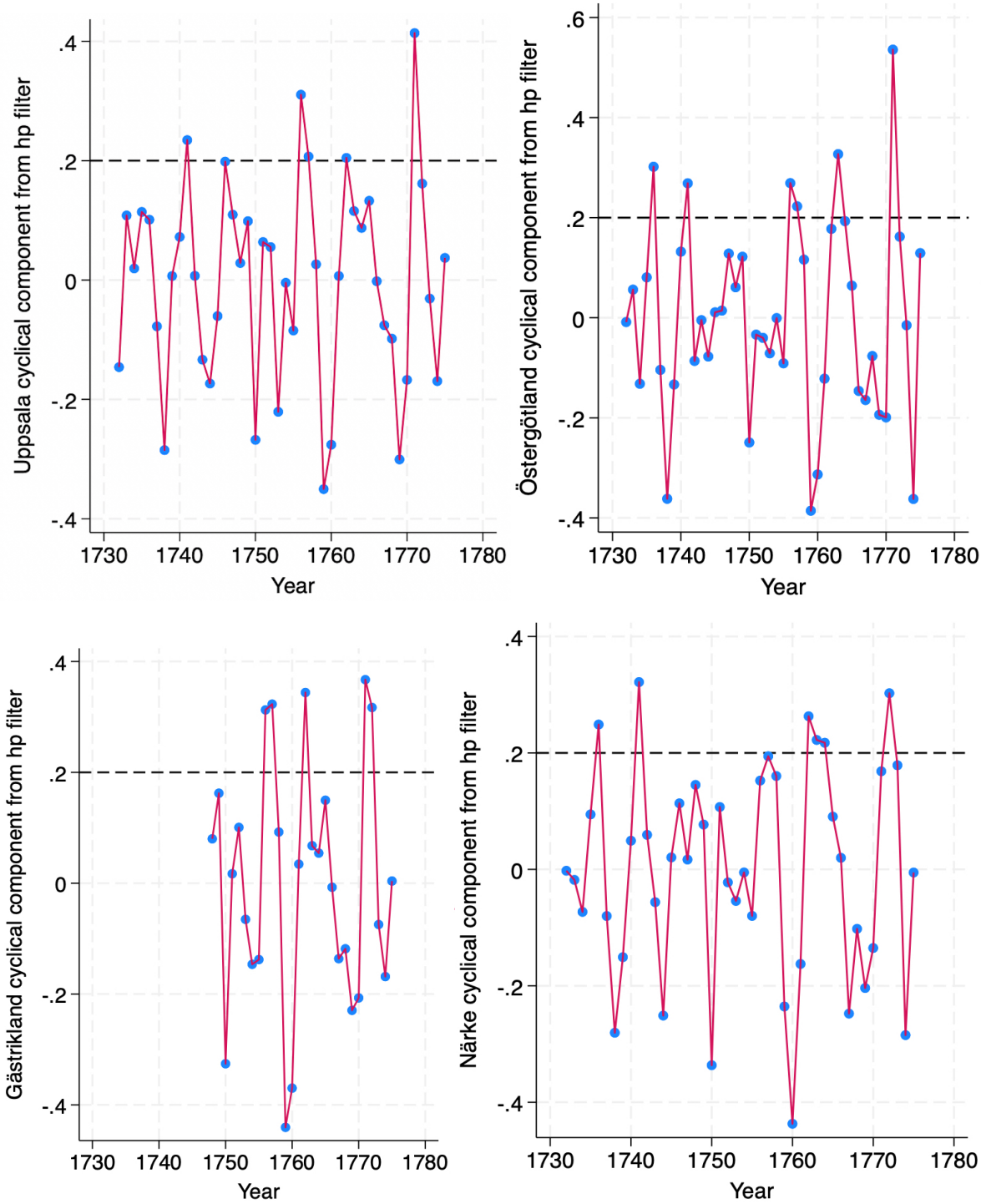
5.3 Estimating Years with High Prices

In order to differentiate years with high prices from years with “normal” prices, a trend needs to be established to remove the normal increase caused by inflation of prices and wages (Jörberg, 1972b; Söderberg, 1987). This means that the longer the time series is, the better, in order to accurately distinguish the long-term trend. Luckily, from 1732-75, rye prices were measured in the same currency, Daler silver coins per barrel of grains (Jörberg, 1772a).

Though the series available for use is somewhat shorter for the counties Gästrikland, Hälsingland, Jönköping, and Kalmar (as the Hodrick-Prescott filter, see below, requires

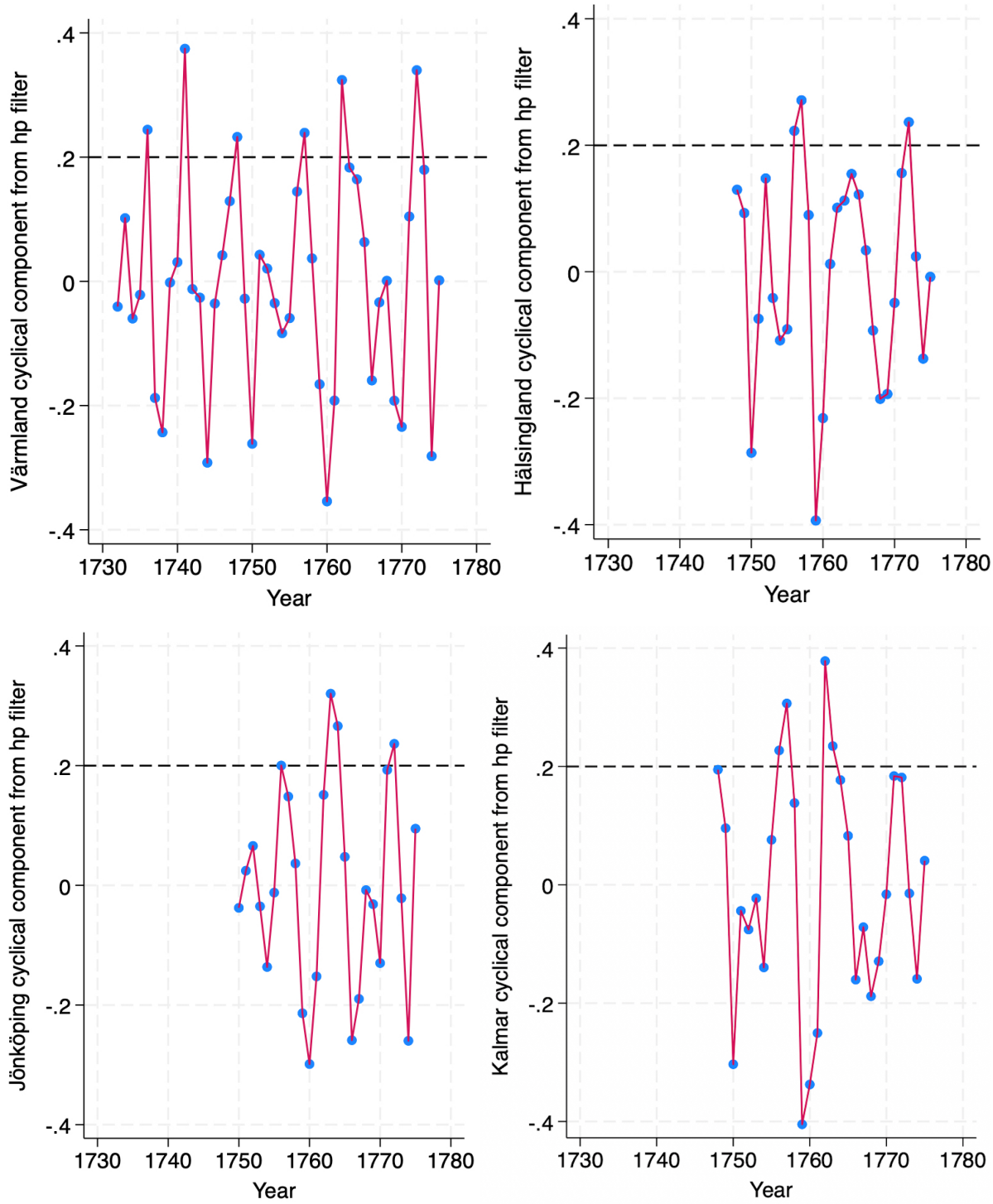
complete series) due to some missing data (see Table 15, Appendix A) it is a relatively long period and should somewhat accurately reveal the long-term trend.

Figure 5: Deviation/Cyclical component from trend for Uppsala, Östergötland, Gästrikland, and Närke counties



Notes: Deviation expressed in log, roughly indicating percentual difference, dashed line indicate lower limit for high price year (log 0.2), price data concerns rye prices in Daler silver coins per barrel of grains, for complete price data see Table 15, Appendix A, Source: Jörberg, 1972a

Figure 6: Deviation/Cyclical component from trend for Värmland, Hälsingland, Jönköping, and Kalmar counties



Notes: Deviation expressed in log, roughly indicating percentual difference, dashed line indicate lower limit for high price year (log 0.2), price data concerns rye prices in Daler silver coins per barrel of grains, for complete price data see Table 15, Appendix A, Source: Jörberg, 1972a

But what is a "high" price? Any level chosen will be somewhat arbitrary but considering that Dribe et al. (2017) uses the limit of 0.3 log units increase in rye prices (roughly 35 %) to define the more severe food shortage event "famine", it seems reasonable to use 0.2 log units (roughly

22 %) above normal to define a year of very high, but not extreme, prices. In order to find these years, the log prices (log is used to achieve the easier interpretation of percentages) are run through a Hodrick-Prescott high-pass filter which removes the time trend and produces a cyclical component, showing the deviation from the normal increasing trend over time (Ravn & Uhlig, 2002). The trend is also smoothed using a smoothing parameter of 6.25 (Dribe et al. 2017; see motivation for annual data in Ravn & Uhlig, 2002).

These cyclical components are shown in Figures 5 and 6, where a dotted line is also set at the threshold of log 0.2. Towards the end of the series one can easily observe the years of high prices, some more extreme such as Östergötland in 1771 and some more moderate such as Hälsingland in 1772.

6 Empirical Analysis

In the empirical analysis the results will be presented (6.1) after which a discussion on these findings will follow (6.2).

6.1 Results

The results section is divided into two parts. Firstly, some descriptive statistics will be presented, generally describing the patterns in mortality concerning the 8 cities. Secondly, there is a section for regressions, trying to find a generalizable relationship between short-term economic stress and social class mortality during the harvest failure of 1771-72. The results from the descriptive part will be compared to the findings of the regressions as a way of verifying the results.

6.1.1 The General Pattern - Descriptive Statistics

Starting with the crude death rate per city and year (Figure 7), as high prices set in (see Figure 3 for review on when the cities had high prices) for Uppsala, Norrköping, and Gävle in 1771, mortality really only increased in Gävle and continued to be high there as the high prices continued in 1772. For the remaining four cities affected by high prices; Örebro, Karlstad, Hudiksvall, and Jönköping, prices rose in 1772 and mortality subsequently increased sharply in 1773 in Örebro and Hudiksvall. Though the prices were not that high yet in 1771, Karlstad suffered high mortality in both 1772 and 1773 while Kalmar, where prices never reached the threshold defined by the study as high prices, also had high mortality in 1773.

The highest mortality by far is found in Karlstad (120 deaths per thousand) and Hudiksvall (112 deaths per thousand) in 1773, showing perhaps the difficulty of living in a city far to the north or inland (Lappalainen, 2014). The average mortality for all cities (excluding Kalmar) for years defined as “normal” (1768-70) lies at 32 deaths per thousand which is very close to the national average of roughly 28-29 per thousand between 1761-80 (National Central Bureau of

Statistics, 1969). The difference most likely reflects the general tendency among pre-industrial cities of having a higher mortality than rural areas (Alfani & Murphy, 2017; Sharlin, 1978).

Figure 7: Crude death rate per thousand for the period 1768-73

Notes: Total number of observations (registered deaths): 5,950, for values see Table 17, Appendix B, Source: Death and burial registers, Riksarkivet.se; The TABVERK database (the Demographic Database), http://rystad.ddb.umu.se:8080/Tabellverket/Tabverk, based on the Tabular Commissions Population and Mortality tables, scanned by CEDAR, Umeå University (full source see pp.53-54)

When observing mortality more generally for men/women and different age groups without regard to the individual cities a somewhat clearer picture emerges. In Table 7 the mortality for men and women are presented separately for the six years and also based on whether the year was a year of high prices (signifying the variable "Crisis" described in chapter 5.1) or the year after a year with high prices (signifying the variable "Crisis lag"). Mortality is clearly increasing during 1772-73 and when comparing the mortality between "normal years" and years of high prices (see (3) and (6)) there is a clear difference both for men and women where the high price years has 30/33 % higher mortality, respectively.

The difference is however considerably larger for the year after a year of high prices (a lagged year) where men/women have a 70/89 % higher mortality then during 1768-70, respectively. As is shown in (4) and (7), where the relative values found in (3) and (6) are divided with the relative values for men, women have a tendency towards higher mortality during the price increases than men, something that is consistent with the findings of for example Alter and Oris (2000).

Table 7: Crude death rate per thousand and mortality rates per thousand for men and women

Crude death rate/gender	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***	***Total***
Crude death rate	31.2	33.8	30.0	31.3	43.7	58.5	37.9
Men	34.7	35.6	34.4	34.9	45.9	63.9	41.3
Women	26.8	31.4	26.0	28.2	41.9	53.6	34.5
Crude death rate/ gender	***(1) 1768-70***	***(2) Year with rye prices over log 0.2 (≈ 22%)***	***(3) (2)/(1)***	***(4) (3)/(3A)***	***(5) Year after year with rye prices over log 0.2 (≈ 22%)***	***(6) (5)/(1)***	***(7) (6)/(6A)***
Crude death rate	31.7	39.1	1.235		53.5	1.689	
Men	33.2	43.1	1.297 (3A)	1.000	56.4	1.699 (6A)	1.000
Women	26.9	35.8	1.330	1.025	50.8	1.889	1.112

Notes: Total number of observations (registered deaths): 5,950, an extended table (Table 18) for gender specific mortality rates per city and year can be found in Appendix B, Source: Death and burial registers, Riksarkivet.se; The TABVERK database (the Demographic Database), http://rystad.ddb.umu.se:8080/Tabellverket/Tabverk, based on the Tabular Commissions Population and Mortality tables, scanned by CEDAR, Umeå University (full source see pp.53-54)

The same pattern regarding years of high prices versus lagged years can also be seen when dividing the mortality into different age categories (Table 8). Perhaps unsurprisingly, the highest mortality for all years is found among infants and people age 60 and over. Being the most vulnerable citizens, these groups did not just face the largest risk of dying during normal years but also when prices soared and food became scarce (see for example Livi-Bacci, 1989; Oris et al. 2004; Tsuya et al. 2004). Interestingly however is that the increase is not proportional compared to other age groups and the risk of dying increases substantially more for people aged 1-59 in the year following a year of high prices (6).

Table 8: Mortality rates per thousand for age groups

Age Category	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***	***Total***
Infants	268.6	308.2	291.6	272.7	348.0	402.5	310.6
1-14	26.2	33.9	17.3	19.4	33.9	68.3	32.7
15-24	5.1	6.3	6.6	7.7	8.8	16.3	8.4
25-44	14.1	11.9	14.1	16.0	20.2	27.2	17.2
45-59	30.5	25.1	28.9	27.6	45.6	53.7	35.7
60 and over	104.4	116.0	97.4	118.5	157.3	169.1	128.7
Age Category	***(1) 1768-70***	***(2) Year with rye prices over log 0.2 (≈ 22%)***	***(3) (2)/(1)***	***(4) (3)/(3A)***	***(5) Year after year with rye prices over log 0.2 (≈ 22%)***	***(6) (5)/(1)***	***(7) (6)/(6A)***
Infants	281.7	301.8	1.071 (3A)	1.000	367.8	1.306 (6A)	1.000
1-14	24.7	32.0	1.297	1.211	52.4	2.121	1.624
15-24	5.7	6.8	1.192	1.113	13.4	2.347	1.797
25-44	12.9	17.7	1.368	1.278	27.1	2.100	1.609
45-59	25.7	37.6	1.460	1.363	53.1	2.063	1.580
60 and over	106.8	154.3	1.444	1.348	169.8	1.589	1.217

Notes: Total number of observations (registered deaths): 5,886, an extended table (Table 19) for age group specific mortality rates per city and year can be found in Appendix B, Source: Death and burial registers, Riksarkivet.se; The TABVERK database (the Demographic Database), http://rystad.ddb.umu.se:8080/Tabellverket/Tabverk, based on the Tabular Commissions Population and Mortality tables, scanned by CEDAR, Umeå University (full source see pp.53-54)

Infants also have the lowest increase in mortality during a year of high prices, closely followed by people age 15-24 (3). What is observed is an effect of the aforementioned fact that infants and elderly consistently had high mortality, causing the possible increase during food shortages

to be narrower than for the "stronger" age groups, something that many similar studies have likewise shown (Alter & Oris, 2000; Bengtsson, 1999; Campbell et al. 2004; Galloway, 1987).

In the same way as was done in Table 7 for men/women, the relative values are compared in (4) and (7) by dividing the values from (3)/(6) by the value for infants (3A)/(6A). Though all groups see large increases both in the year of high prices and especially in the lagged year, the relative increase for people age 1-59 is much higher in the year following a year of high prices than for infants and people age 60 and over and show quite similar values within the narrower age groups 1-14, 25-44, and 45-59. Observing the gender and age group pattern for individual cities (see Table 18 and 19, Appendix B) it also becomes relatively clear that though some differences exist (see small discussion in Appendix B) the pattern does not seem to be dependent on individual cities but is quite general. It should of course be remembered however that large cities such as Norrköping has a much larger impact on the values than for example the small city Hudiksvall.

Compared to Kalmar, the average values for gender are lower both in 1768-70 and 1773 and the same goes for many of the values for individual age groups (see Table 18/19, Appendix B). Though this could simply indicate a city specific pattern of higher mortality in Kalmar, it could also indicate that diseases spread throughout the country during the period had a bigger impact than the economic hardships and malnutrition (Larsson, 2006).

Moving on to the main focus of this study, in Table 9 the average mortality for certain years and cities (see Appendix B, Table 20, for values per city and year and a discussion concerning these values representability) is presented for the socio-economic groups discussed earlier (chapter 4.2). As discussed in chapter 5.2, mortality is found by combining death records from the death and burial registers with censuses from the Tabular Commissions Population tables. Since only a few years are covered by the censuses (see Table 14, Appendix A) and does not always match the years 1768-70 or years when the individual cities had high prices (or the year after they had high prices), the values fail to fully represent average mortality.[6] Furthermore, due to the fact that the groups in the censuses does not completely match the HISCO scheme (see Table 16, Appendix A), there is a risk that the mortality found fails to somewhat accurately represent the mortality for each group. There are however certain elements that rings true with what is known about historical groups in cities which give some credibility to the findings.

For example, in the last column (8), where the mortality for each group during the "normal" years of 1768-70 is divided with the mortality for group A, it is found that service and

[6] For example, the values for (5) are based only on data for Norrköping and Gävle in 1772 and Gävle and Örebro in 1773. See notes for Table 9 for further info on which cities/years that are included in the different values.

agricultural workers (but also for example guards) have lower mortality than people within group A. Though this can be questioned regarding the service workers it is commonly agreed that farmers, even those residing close enough to be part of the city parish, had lower mortality as they had better access to food and lived less densely than people in the city "core" and thus was less exposed to diseases (Edvinsson & Lindkvist, 2011; Jennings et al. 2017; Scalone, 2014).

Table 9: Mortality rates per thousand for socio-economic groups

Socio-economic group	***(1) 1768-70***	***(2) Year with rye prices over log 0.2 (≈ 22%)***	***(3) (2)/(1)***	***(4) (3)/(3A)***	***(5) Year after year with rye prices over log 0.2 (≈ 22%)***	***(6) (5)/(1)***	***(7) (6)/(6A)***	***(8) (1)/(1A)***
A	27.8 (1A)	61.7	2.222 (3A)	1.000	52.7	1.898 (6A)	1.000	1.000
M	17.9	24.5	1.371	0.617	24.1	1.349	0.710	0.644
S	12.4	34.9	2.814	1.266	34.9	2.820	1.485	0.446
Pr	40.0	63.9	1.600	0.720	65.2	1.631	0.859	1.439
P	26.1	83.2	3.185	1.433	45.8	1.753	0.924	0.941

Notes: Total number of observations (registered deaths): 1,699, for socio-economic groups see Table 4, an extended table (Table 20) for socio-economic group specific mortality rates per city and year can be found in Appendix B, cities/years included in (1): Uppsala, 1770 and Gävle, Örebro, Karlstad, Hudiksvall, and Jönköping (Kristine) in 1769, (2): Gävle, Örebro, Karlstad, Hudiksvall, and Jönköping (Kristine) in 1772, (5): Norrköping (Olai) and Gävle in 1772 and Gävle and Örebro in 1773, Source: Death and burial registers, Riksarkivet.se; The TABVERK database (the Demographic Database), http://rystad.ddb.umu.se:8080/Tabellverket/Tabverk, based on the Tabular Commissions Population and Mortality tables, scanned by CEDAR, Umeå University (full source see pp.53-54)

Furthermore, it seems highly reasonable, as shown by the relative mortality increase for each group in (3), that people labelled poor, from now on referred to simply as poor, were the first to suffer when prices soared, causing their mortality to increase much more than other groups in a year of high prices and demonstrating how close to subsistence some groups were (Clark, 2007; Fogel, 2004). The same can be said about group S in the year following a year of high prices (6). It is probable that as prices rose, some employers would terminate the contracts with their service staff, causing an increasing part of this group to experience malnutrition. This might have, together with disease, caused mortality to increase with some lag. It should of course be remembered that this group had a very low mortality for 1768-70, causing the increase to seem higher than what it might mean in absolute numbers of dead individuals. Again, it should also be stressed that the values found is merely indicative as they represent only a few available years and cities.

6.1.2 A General Relationship? - The Logit Model

So far, the evidence found through the descriptive statistics seem to more or less conform to what could be expected for different demographic and occupational groups. But what about the

logit model? In Table 10 five different regressions is presented (see Table 21, Appendix C for full table) for the dependent variable Crisis which, again, represent a binary dummy variable which takes on the value 1 for a death occurring at years of high prices and 0 for deaths occurring in the reference period 1768-70 for all cities except for Kalmar (as Kalmar lacks years with high prices).

Table 10: Logistic regressions with dependent variable Crisis

Variable	***1***	***2***	***3***	***4***	***5***
Socio-economic group (Reference: A)					
M	0.80	0.79	0.78	0.78	0.63**
	(0.12)	(0.12)	(0.12)	(0.12)	(0.10)
S	1.14	1.14	1.10	1.08	1.21
	(0.16)	(0.16)	(0.15)	(0.15)	(0.18)
Pr	0.84	0.84	0.87	0.86	0.95
	(0.10)	(0.10)	(0.10)	(0.10)	(0.12)
P	1.20	1.19	1.23	1.22	1.51*
	(0.22)	(0.22)	(0.23)	(0.23)	(0.29)
Gender (Reference: Male)					
Female		1.03	1.00	1.02	1.00
		(0.08)	(0.08)	(0.09)	(0.09)
Age group (Reference: Infants)					
1-14			1.39**	1.39**	1.39**
			(0.16)	(0.16)	(0.17)
15-24			1.05	1.03	1.05
			(0.24)	(0.24)	(0.25)
25-44			1.55**	1.51**	1.63***
			(0.21)	(0.20)	(0.23)
45-59			1.82***	1.80***	1.71***
			(0.26)	(0.26)	(0.26)
60 and over			1.92***	1.94***	1.66***
			(0.23)	(0.24)	(0.21)
Controls					
Month				X	X
City					X
Observations	2,719	2,719	2,719	2,719	2,719
Pseudo R-squared	0.0036	0.0037	0.0143	0.0213	0.0616
Exponentiated coefficients; Standard errors in parentheses					
** p<0.05, ** p<0.01, *** p<0.001*					

Notes: Full table (Table 21) can be found in Appendix C, for explanation of socio-economic groups, see Table 4, "X" indicate that control is used, Source: Death and burial registers, Riksarkivet.se (full source see p.54)

As was discussed in chapter 5.1, seen as the regressions are logistic, they have a different interpretation than normal ordinary least square regression. An example can therefore be appropriate, such as the odds ratio for merchants and burghers in the fifth regression. The highly significant value, 0.63, indicate that group M on average had a 37 % lower risk of dying during a year of high prices than the reference group, administration, relative to the number of dead individuals in the two groups in the period 1768-70, given that all other variables; gender, age, month, and city, stays constant. The regression does however not show if this is because group M has fewer people dying than group A in a year of high prices or because there are more people dying in the period 1768-70 for group M. The interpretation is either way the desired. Relative to 1768-70, fewer people are dying in group M than in group A in a year of high prices.

No significant values are found before city is introduced as control but the values for both socio-economic group as well as gender and age groups are similar to those found in the descriptive statistics, showing that while the poor have the highest risk, servants and agricultural workers also have higher risk than those occupying occupations in administration and as professionals. Though showing somewhat different values, all odds ratios for socio-economic groups stay on the same side of 1.00 across the different regressions, showing a consistent pattern. Men and women seem to have very similar risks of death, consistent with what was found in Table 7 and the highest risks among the age groups are from ages 25 and upwards in agreement with the results in Table 8.

In chapter 5.1 the justification of the control variables was discussed. But how well are the control variables reducing bias? Seen as differences between men/women seem to have been very small, this variable adds little to the overall efficiency. Both age group and month raises the pseudo R-squared somewhat but causes only minor changes in the odds ratios for the socio-economic groups.[7] However, the largest changes comes when the city specific effects are removed in the fifth regression. It is not difficult to see why. First of all, Gävle has two years of high prices, clearly distinguishing the city from the rest. Secondly, the response in mortality from the period 1768-70 to the years of high prices is very different from city to city (see Figure 7), where Karlstad and Gävle (in the second year of high prices) has considerably higher mortality than in 1768-70 while Norrköping (Olai) and Örebro only sees moderate changes.

These findings give credibility to the model and builds courage to continue to the lagged regressions. In Table 11 (see Table 22, Appendix C for full table), the dependent is changed to Crisis lag, which, as explained in 5.1, have ones for deaths occurring during years after a year of high prices and zeros for deaths happening in the years 1768-70. The regressions show similar results as what was found for years of high prices. When using all controls, the groups that suffer the highest relative risk compared to the reference, administration, is again servants/agriculture and the poor while the opposite is found for merchants/burghers. Production workers have only very small differences in risk compared to group A and the differences are not significantly different from zero.

Though the result does not comply with what was found for the poor in the descriptive statistics, it certainly does so for group S and M but also regarding gender and to some extent the age groups. The results for both gender and age groups are again in line with what was found in Table 7 and 8 though the highest odds ratios have moved slightly upward to people

[7] The pseudo R-squared is not the same as the regular R-squared but is still a value between 0 and 1 and does allow for a similar interpretation of performance (Stock & Watson, 2020).

age 25-59. Theoretically, this makes sense as these were groups who normally had low mortality and were increases quickly become noticeable. It also follows what has been found empirically by for example Campbell et al. (2004) and Lust et al. (2023).

Table 11: Logistic regressions with dependent variable Crisis lag

Variable	***1***	***2***	***3***	***4***	***5***
Socio-economic group (Reference: A)					
M	0.88	0.87	0.86	0.85	0.62**
	(0.12)	(0.12)	(0.12)	(0.12)	(0.09)
S	1.34*	1.32*	1.27	1.26	1.42*
	(0.17)	(0.17)	(0.16)	(0.16)	(0.19)
Pr	0.82	0.82	0.83	0.83	0.96
	(0.09)	(0.09)	(0.09)	(0.09)	(0.11)
P	1.09	1.06	1.13	1.10	1.38
	(0.19)	(0.18)	(0.20)	(0.20)	(0.26)
Gender (Reference: Male)					
Female		1.16	1.15	1.15	1.13
		(0.09)	(0.09)	(0.09)	(0.09)
Age group (Reference: Infants)					
1-14			1.65***	1.65***	1.56***
			(0.18)	(0.18)	(0.18)
15-24			1.60*	1.57*	1.54*
			(0.31)	(0.31)	(0.31)
25-44			1.73***	1.73***	1.78***
			(0.22)	(0.22)	(0.23)
45-59			2.01***	1.98***	1.83***
			(0.27)	(0.27)	(0.26)
60 and over			1.69***	1.69***	1.38*
			(0.20)	(0.20)	(0.17)
Controls					
Month				X	X
City					X
Observations	2,967	2,967	2,967	2,967	2,967
Pseudo R-squared	0.0059	0.0069	0.0172	0.0213	0.0813
Exponentiated coefficients; Standard errors in parentheses					
** p<0.05, ** p<0.01, *** p<0.001*					

Notes: Full table (Table 22) can be found in Appendix C, for explanation of socio-economic groups, see Table 4, "X" indicate that control is used, Source: Death and burial registers, Riksarkivet.se (full source see p.54)

Seen as the full regression seem to yield the most significant results, going forward those controls will be used in all regressions were applicable. In Table 12 (see Table 23, Appendix C for full table) the dependent is once again Crisis, but each regression has now been limited to a certain age group (regression 1-4) or group of diseases (5-6). The age group 15-24 is omitted due to a low number of observations and the groups 25-44 and 45-59 are combined to represent adults. The fifth regression only includes individuals who died from diseases which are clearly influenced by nutrition (see Table 3 for categorization of diseases) while the sixth regression also includes those dying from diseases which have a more variable or uncertain connection to the nutritional state of the person.

Though none of the results regarding socio-economic groups within the age group regressions reaches significance, they do show some interesting values. Increases in risk in group S seem somewhat concentrated to infants and children while the ages 1-14 and 25-59

receives the highest values for the poor. Group P does however have high values across all these regressions.

Merchants and burghers continue to have consistently low values and it seems indeed as if Sjoberg (1960) might have a point regarding institutions such as guilds and family networks. As times became really harsh, possibly costing the life of a parent, these institutions might have tried to protect its members, connected here to merchants as well as many within the group production, lowering the relative risk of death for these groups compared to those working in service, agriculture, or who simply were poor.

More interesting however is the relatively high value for infant girls as well as for infants with parents working in production (Pr). This goes against the expectation (discussed in chapter 3) of a low socio-economic differentiated infant response and could simple be due to the somewhat more unstable population estimates found for infants (see chapter 5.1).

Table 12: Logistic regressions with dependent variable Crisis divided by age and disease group

Variable	***1***	***2***	***3***	***4***	***5***	***6***
	Infants	*Children (1-14)*	*Adults (25-59)*	*Elderly (60 and over)*	*Clear influence*	*Clear/variable influence*
Socio-economic group (Reference: A)						
M	0.69	0.53	0.86	0.56	0.71	0.98
	(0.24)	(0.18)	(0.27)	(0.20)	(0.24)	(0.27)
S	1.25	1.41	1.05	1.15	1.17	1.36
	(0.42)	(0.45)	(0.29)	(0.36)	(0.35)	(0.33)
Pr	1.31	0.63	1.09	0.84	0.86	1.06
	(0.33)	(0.16)	(0.25)	(0.24)	(0.23)	(0.23)
P	1.27	1.64	1.68	1.31	2.52*	3.13**
	(0.47)	(0.80)	(0.73)	(0.52)	(1.14)	(1.16)
Gender (Reference: Male)						
Female	1.27	1.08	0.97	0.89	0.83	0.97
	(0.22)	(0.20)	(0.16)	(0.18)	(0.16)	(0.15)
Age group (Reference: Infants)						
1-14					1.78	1.88*
					(0.62)	(0.55)
15-24					0.85	1.16
					(0.50)	(0.49)
25-44					2.04*	2.46**
					(0.70)	(0.69)
45-59					2.28*	2.31**
					(0.80)	(0.67)
60 and over					2.55**	2.51**
					(0.91)	(0.77)
Controls						
Month	X	X	X	X	X	X
City	X	X	X	X	X	X
Observations	760	641	692	520	622	932
Pseudo R-squared	0.0670	0.1176	0.0555	0.0526	0.1310	0.1039
Exponentiated coefficients; Standard errors in parentheses						
** p<0.05, ** p<0.01, *** p<0.001*						

Notes: Full table (Table 23) can be found in Appendix C, for explanation of socio-economic groups, see Table 4, for explanation of disease categories, see Table 3, "X" indicate that control is used, Source: Death and burial registers, Riksarkivet.se (full source see p.54)

Regarding diseases, the pattern is very clear. The ones most at risk of both malnutrition and exposure to disease, the poor, reaches very high levels compared to group A both when only

looking at diseases clearly influenced by nutritional level as well as when those diseases, more variably influenced by nutrition is included. Group S also continue to have higher values than A, M, and Pr. All age groups except for 15-24 reaches high odds ratios compared to infants but as the analysis now is on a quite detailed level and the number of observations per group is starting to get rather low, one should be careful with making strong interpretations.

More detailed analysis show that tuberculosis and other respiratory diseases make up approximately 50 % of causes of death within the group with clear nutritional influence. As tuberculosis thrived in cramped conditions and cold climate and mortality seems to have been higher during the spring (see Appendix C for further seasonal analysis) it is possible that part of the pattern found earlier in Table 10 is due to differences in mortality concerning this type of diseases (Appleby, 1975; Mackenbach, 2020).

Very similar patterns can also be distinguished when doing the same regressions but with the dependent variable Crisis lag instead (Table 13, see Table 24, Appendix C for full table). The children of servants and agricultural workers keep having a clearly higher risk of mortality than administration, merchants, and production workers. The poor also continue the previous pattern of having the highest relative risk in the ages 1-14 and 25-59. Concerning the diseases, they keep exhibiting a similar pattern for group S and P but now the values for production workers are also starting to increase. Group A and M are however continuously at low risk of dying in a year after a year of high prices relative to the other three groups.

Deeper analysis of the diseases reveals that typhus seems to be responsible to a large share of all deaths (57 %) in the lagged year among diseases which are clearly and/or variably influenced by nutrition (regression 6). Though notations concerning typhus is tricky, it seems reasonable that the disease had a clear presence considering the large number of similar notations in a very short period of time (Larsson, 2006; Mackenbach, 2020). The odds ratios for the age groups also lend evidence in support of this hypotheses. Not counting infants, the lowest risks relative to the period 1768-70 is found for children age 1-14. Though likely equally infected as adults during an outbreak of typhus, children have a tendency to survive the disease in larger numbers (Appleby, 1975).

For diseases which are clearly related to nutrition a different pattern can be observed where children age 1-14 and the elderly (60 and over) have the highest relative risk of dying during a year after a year of high prices. Looking into the diseases reveal a large share of deaths (44 %) attributed to dysentery, which, in sharp contrast to typhus, affect society's weak and fragile the most, causing mortality to increase especially for young and old (Castenbrandt, 2012; Larsson, 2006; see also discussion on seasonal patterns in Appendix C).

Table 13: Logistic regressions with dependent variable Crisis lag divided by age and disease group

Variable	***1***	***2***	***3***	***4***	***5***	***6***
	Infants	*Children (1-14)*	*Adults (25-59)*	*Elderly (60 and over)*	*Clear influence*	*Clear/variable influence*
Socio-economic group (Reference: A)						
M	0.67	0.68	0.63	0.53	0.88	0.65
	(0.21)	(0.22)	(0.19)	(0.19)	(0.34)	(0.18)
S	1.53	2.27**	1.35	1.26	2.41*	1.63*
	(0.44)	(0.71)	(0.33)	(0.41)	(0.84)	(0.37)
Pr	0.94	0.89	0.96	1.15	1.83	1.19
	(0.21)	(0.22)	(0.21)	(0.34)	(0.59)	(0.24)
P	0.79	2.35	1.78	1.26	3.12	3.19***
	(0.27)	(1.10)	(0.70)	(0.51)	(1.81)	(1.11)
Gender (Reference: Male)						
Female	1.21	1.17	1.15	1.05	0.95	1.11
	(0.19)	(0.21)	(0.18)	(0.21)	(0.19)	(0.15)
Age group (Reference: Infants)						
1-14					2.73**	2.14**
					(1.02)	(0.61)
15-24					2.25	3.45***
					(1.15)	(1.20)
25-44					2.25*	3.29***
					(0.85)	(0.91)
45-59					2.50*	3.45***
					(0.97)	(0.98)
60 and over					3.94***	3.58***
					(1.57)	(1.07)
Controls						
Month	X	X	X	X	X	X
City	X	X	X	X	X	X
Observations	795	728	780	534	616	1,119
Pseudo R-squared	0.0381	0.1876	0.0845	0.0703	0.2182	0.1682
Exponentiated coefficients; Standard errors in parentheses						
** p<0.05, ** p<0.01, *** p<0.001*						

Notes: Full table (Table 24) can be found in Appendix C, for explanation of socio-economic groups, see Table 4, for explanation of disease categories, see Table 3, "X" indicate that control is used, Source: Death and burial registers, Riksarkivet.se (full source see p.54)

It seems indeed as if a large part of the found gradient for the poor and those in the group service and agriculture compared to other groups is due to diseases connected to nutrition, something that will be thoroughly discussed in the next chapter.

6.2 Discussion

Starting with general patterns, both descriptive statistics and regressions indeed point towards a gradient where the poor (especially in the year of high prices) and individuals with service/guard/agricultural occupations (more pronounced in the year after a year of high prices) suffered relatively higher number of deaths during economic fluctuations than the more well-off, in accordance with studies such as Alter and Oris (2000), Campbell et al. (2004), Bengtsson (1999), and Scalone (2014).

Comparing results between studies are often difficult as different classifications and groupings are used. However, in similarity with Scalone (2014), the most vulnerable groups

seem to be people without occupation or people with low-skill occupations. Furthermore, looking at the more well-off, the consistently low odds ratios for merchants and burghers follow patterns found by Campbell et al. (2004) concerning the Italian middle class. It also agrees with the very harsh division made by Alter and Oris (2000) between functionary (upper classes) and labourers (lower classes) which similarly indicate the more favourable position of higher socio-economic groups.

The findings also fit within the larger context of the period. As general responses seem to have become less common during the 19th century, this study show that a clear gradient can still be found in the end of the 1700s. Though studies concerned with the 19th century such as Lust et al. (2023), Klesment and Lust (2021), Söderberg (1984), and Kaukiainen (1984) are more involved with rural areas it is safe to assume that similar improvements regarding nutrition and health where also made in cities (Livi-Bacci, 1998; Wiesner-Hanks et al. 2018).

Furthermore, though insignificant, the results did indicate that group S had its highest ratios for infants and children age 1-14 while poor people had it in the ages 1-59. The same has been found concerning children by Bengtsson (1999) and while their results are far from single directed, Alter and Oris (2004) likewise finds higher relative risk among labourers concerning infants and children age 1-14. So does Jennings et al. (2017) but as their result only divide between people with agricultural/non-agricultural occupations it is difficult to say if the gradient is comparable. It does however indicate that food most likely affected one's chance of survival, more in line with the resistance than the migration mechanism.

Something that is supported further by the findings of Dribe et al. (2010) concerning the importance of the estate, compared to individual farms, as short-term protection against food shortages. That people such as the poor and servants, having less capital and assets, would have a higher risk of death during short-term economic stress also falls in line with findings by Bengtsson and Dribe (2005, p.362) concerning the landless: "…they died of any common disease due to low resistance, which implies that they were malnourished". This idea, that malnutrition and lower resistance could indeed be more important than the spread of diseases in explaining excess mortality during short-term economic stress is also greatly supported by the results concerning diseases.

The very high differences concerning diseases with clear and variable nutritional connection such as typhus, dysentery, and tuberculosis between socio-economic groups makes it seem fully possible that these variances might be related to a lower resistance to diseases due to malnutrition among the lower socio-economic classes. Epidemics were sweeping through the country from West to East during the 1770s harvest failure, having every opportunity to spread

and cause death indiscriminately in the cities (Castenbrandt, 2012; Larsson, 2006). Still, the poor suffered most. The result is supported by similar findings by Luque de Haro et al. (2021) and though richer individuals might have been equally infected they seem do have died relatively less.

The lag in highest relative risk between those in service/agriculture and the poor further enhances the conclusion that low resistance were to blame for high death rates. As people had less and less funds and perhaps even lost their job due to the economic fluctuations, they grew continuously hungry and in combination with disease, succumbed to death.

6.2.1 Internal and External Validity

How reliable is the results though? Starting with internal validity, variables such as marital status could for example be related to both which socio-economic group one belongs to and the risk of death through economic assets, family networks, and likelihood of moving during economic fluctuations, causing some bias in the results. Furthermore, as have been consistently stressed, the model does not take into consideration population size but only the relationship between number of dead individuals. Though the descriptive statistics in large supports the findings in the regressions, it is still a less reliable model than for example survival analysis.

Moving on to external validity, Bengtsson and Broström (2011) argue that individual periods of mortality crises can be misleading and cause overestimation of the gradient. The harvest failure in 1771-72 was severe compared to many other mortality crises of the 18th century and it is indeed likely that the differences between socio-economic groups found in this study is higher than what would be found if one investigated all crises of the period. They might however reflect the general responses and somewhat accurately show the direction of the gradient.

7 Conclusions

The aim of this thesis was to examine to what extent socio-economic status was correlated with mortality in Swedish pre-industrial cities during short-term economic stress. The results indeed indicate that one's socio-economic status likely affected the relative risk of death during the economic fluctuations of the harvest failure of 1771-72.

Similar studies concerned with the 18th century has found a general trend in favour of more well-off individuals and people more protected through availability of food such as farmers. This is further supported by this study as the poor and those working in service and agriculture, including occupations such as maid and guard, faced a higher relative risk of death than groups of higher socio-economic status both in a year of high prices and in the year after a year of high prices, relative to the difference in risk during the base period 1768-70. The timing however differs as both descriptive statistics on mortality rates and logistic regressions indicate that the poor reacted quickly, reaching the highest relative risk of death in the year of high prices while those in service and agriculture instead faced the highest risk in the year after a year of high prices.

This supports the theory that mortality during short-term economic stress was linked to the nutritional state of the individual through lower resistance to diseases. Indeed, when moving more into detail, it is found that the connection between low socio-economic status and high relative risk of death is even stronger for diseases such as dysentery, typhus, and tuberculosis, which are connected to the nutritional state of the individual.

This thesis adds to the discussion made in previous research both through the use of new material and by further extending the knowledge concerning differentiated responses of socio-economic groups during short-term economic stress in pre-industrial, 18th century cities. Considerable amounts of data in the death and burial registers are however still unexplored and there is much more that can be learned about the period but especially about cities, giving room for future studies.

References

Alfani, G. & Murphy, T. E. (2017). Plague and Lethal Epidemics in the Pre-Industrial World, *The Journal of Economic History*, vol. 77, no. 1, pp.314-343, https://doi.org/10.1017/S0022050717000092

Alfani, G. & Ó Gráda, C. (2017). Famines in Europe: An Overview, in G. Alfani & C. Ó Gráda (eds), *Famine in European History*, Cambridge: Cambridge University Press, pp.1-24

Alter, G. & Oris, M. (2000). Mortality and Economic Stress: Individual and household responses in a nineteenth-century Belgian village, in T. Bengtsson & O. Saito (eds), *Population and Economy: From hunger to modern economic growth*, Oxford: Oxford University Press, pp.335-370

Andersson Palm, L. (2000). Folkmängden i Sveriges socknar och kommuner 1571-1997: Med särskild hänsyn till perioden 1571-1751 (Population in Sweden´s Parishes and Municipalities 1571-1997: With special regard to the period 1571-1751), Göteborg: L Palm, Historiska institutionen, Göteborgs Universitet

Andersson, Tommy (2021). Urbana dödsfällor?: En jämförande demografisk studie av stad/landsbygd i Sverige år 1750-1800 med hänsyn till teorin "urban graveyard" (Urban Death-Traps?: A comparative demographic study of urban/rural areas in Sweden in the years 1750-1800 with regard to the "urban graveyard" theory), BA thesis, Department of Historical Studies, University of Gothenburg, https://gupea.ub.gu.se/handle/2077/70727 [Accessed 28 December 2023]

Appleby, A. B. (1975). Nutrition and Disease: The case of London, 1550-1750, *The Journal of Interdisciplinary History*, vol. 6, no. 1, pp.1-22, https://www.jstor.org/stable/202822

Appleby, A. B. (1979). Grain Prices and Subsistence Crises in England and France, 1590-1740, *The Journal of Economic History*, vol. 39, no. 4, pp.865-887, https://www.jstor.org/stable/2120334

Bengtsson, T. (1999). The Vulnerable Child. Economic Insecurity and Child Mortality in Pre-Industrial Sweden: A case study of Västanfors, 1757-1850, *European Journal of Population*, vol. 15, no. 2, pp.117-151, https://doi.org/10.1023/a:1006215701608

Bengtsson, T. & Broström, G. (2011). Famines and Mortality Crises in 18th to 19th Century Southern Sweden, *Genus*, vol. 67, no. 2, pp.119-139, https://www.jstor.org/stable/10.2307/genus.67.2.119

Bengtsson, T. & Dribe, M. (2000). Risk Management in the Family. Demographic Responses to Short-Term Economic Stress in Southern Sweden during the Agricultural Transformation, 1829-1865 [pdf], https://www.researchgate.net/profile/Tommy-Bengtsson/publication/228860595_Risk_Management_in_the_Family_Demographic_Responses_to_Short-term_Economic_Stress_in_Southern_Sweden_During_the_Agricultural_Transformation_1829-/links/56cd5c2708ae059e3750e500/Risk-Management-in-the-Family-Demographic-Responses-to-Short-term-Economic-Stress-in-Southern-Sweden-During-the-Agricultural-Transformation-1829.pdf

Bengtsson, T. & Dribe, M. (2005). New Evidence on the Standard of Living in Sweden During the Eighteenth and Nineteenth Centuries: Long-term development of the demographic response to short-term economic stress, in R. C. Allen, T. Bengtsson & M. Dribe (eds), *Living Standards in the Past: New perspectives on well-being in Asia and Europe*, Oxford: Oxford Academic, pp.341-372

Bengtsson, T. & Dribe, M. (2006). Deliberate Control in a Natural Fertility Population: Southern Sweden, 1766-1864, *Demography*, vol. 43, no. 4, pp.727-746, https://www.jstor.org/stable/4137215

Bengtsson, T. & Jörberg, L. (1975). Market Integration in Sweden During the 18th and 19th Centuries: Spectral analysis of grain prices, *Economy and History*, vol. XVIII, no. 2, pp.93-106

Bengtsson, T. & Ohlsson, R. (1985). Age-Specific Mortality and Short-Term Changes in the Standard of Living: Sweden, 1751-1859, *European Journal of Population*, vol. 1, no. 4, pp.309-326, https://www.jstor.org/stable/20164374

Bengtsson, T. & van Poppel, F. (2011). Socioeconomic Inequalities in Death from Past to Present: An introduction, *Explorations in Economic History*, vol. 48, no. 3, pp.343-356, https://doi.org/10.1016/j.eeh.2011.05.004

Campbell, C., Lee, J. Z., Bengtsson, T., Broström, G., Rettaroli, R. & Tsuya, N. O. (2004). Economic Stress and Mortality, in J. Z. Lee, T. Bengtsson & G. Alter (eds), *Life under Pressure: Mortality and living standards in Europe and Asia, 1700-1900*, Cambridge: The MIT Press, pp.61-84

Castenbrandt, Helene (2012). Rödsot i Sverige 1750-1900: En sjukdoms demografiska och medicinska historia (Dysentery in Sweden 1750-1900: The demographic and medical history of a disease), PhD thesis, Department of Historical Studies, Universtity of Gothenburg, https://gupea.ub.gu.se/handle/2077/30195 [Accessed 16 May 2024]

CEDAR. (2018). Tabellverket: Svensk befolkningsstatistik 1749-1859: Beskrivning av Tabellverket samt databasen TABVERK vid CEDAR/DDB (The Tabular Commission: Swedish population statistics 1749-1859: Description of the Tabular Commission and the database TABVERK at CEDAR/DDB) [pdf], https://www.umu.se/globalassets/organisation/fakulteter/samfak/enheten-for-demografi-och-aldrandeforskning-vid-umea-universitet/databaser/cedar-tabellverket-och-databasen-tabverk.pdf

Clark, G. (2007). A Farewell to Alms: A brief economic history of the world, Princeton: Princeton University Press

DDSS (Demographic Database of Southern Sweden). (n.d.). Hjälpmedel – Dödsorsaker och sjukdomsnamn – förr och nu (Tools – Causes of Death and Disease Names – Past and Present), http://www.ddss.nu/means/causeOfDeath?stat=1 [Accessed 17 May 2024]

Deaton, A. (2016). On Death and Money: History, facts and explanations, *JAMA*, vol. 315, no. 16, pp.1703-1705, https://doi.org/10.1001/jama.2016.4072

Dribe, M. (2003). Liv och rörelse: Familj och flyttningar i 1800-talets svenska bondesamhälle (Life and Movement: Family and migration in 19th century Swedish peasant society), Hedemora: Gidlunds Förlag

Dribe, M., Olsson, M. & Svensson, P. (2010). Economic Crisis, Manorialism, and Demographic Response: Southern Sweden in the preindustrial period, in S. Kurosu, T. Bengtsson & C. Campbell (eds), *Demographic Responses to Economic and Environmental Crises*, Chiba: Reitaku University, pp.17-47

Dribe, M., Olsson, M. & Svensson, P. (2017). Nordic Europe, in G. Alfani & C. Ó Gráda (eds), *Famine in European History*, Cambridge: Cambridge University Press, pp.185-211

Edvinsson, S. & Lindkvist, M. (2011). Wealth and Health in 19th Century Sweden: A study of social differences in adult mortality in the Sundsvall region, *Explorations in Economic History*, vol. 48, no. 3, pp.376-388, https://doi.org/10.1016/j.eeh.2011.05.005

Fogel, R. W. (1986). Nutrition and the Decline in Mortality since 1700: Some additional preliminary findings, National Bureau of Economic Research, working paper, no. 1802, National Bureau of Economic Research and the Center for Population Economics of the University of Chicago

Fogel, R. W. (2004). The Escape from Hunger and Premature Death, 1700-2100: Europe, America and the third world, Cambridge: Cambridge University Press

Fridlizius, G. (1984). The Mortality Decline in the First Phase of the Demographic Transition: Swedish experiences, in T. Bengtsson, G. Fridlizius & R. Ohlsson (eds), *Pre-Industrial Population Change*, Lund: Studentlitteratur, pp.71-114

Galloway, P. R. (1985). Annual Variations in Deaths by Age, Deaths by Cause, Prices, and Weather in London 1670 to 1830, *Population Studies*, vol. 39, no. 3, pp.487-505, https://www.jstor.org/stable/2174107

Galloway, P. R. (1987). Differentials in Demographic Responses to Annual Price Variations in Pre-Revolutionary France: A comparison of rich and poor areas in Rouen, 1681 to 1787,

European Journal of Population, vol. 2, no. 3/4, pp.269-305, https://www.jstor.org/stable/20164414

Galloway, P. R. (1988). Basic Patterns in Annual Variations in Fertility, Nuptiality, Mortality, and Prices in Pre-Industrial Europe, *Population Studies*, vol. 42, no. 2, pp.275-303, https://doi.org/10.1080/0032472031000143366

Gary, K. & Olsson, M. (2019). Men at Work: Real wages from annual and casual labour in southern Sweden 1500-1850, Lund Papers in Economic History, General Issues, Department of Economic History, working paper, no. 2019:194, Lund University

Jennings, J. A., Quaranta, L. & Bengtsson, T. (2017). Inequality and Demographic Response to Short-Term Economic Stress in North Orkney, Scotland, 1855-1910: Sector differences, *Population Studies*, vol. 71, no. 3, pp.313-328, https://doi.org/10.1080/00324728.2017.1346196

Johannisson, K. (1994). Livets gränser: Födelse, sjukdom och död 1750-1900 (The Limits of Life: Birth, illnes and death 1750-1900), in G. Broberg, U. Wikander & K. Åmark (eds), *Svensk historia underifrån (Swedish History from below)*, Stockholm: Ordfront, pp.125-147

Jörberg, L. (1972a). A History of Prices in Sweden 1732-1914, vol. 1, Lund: CWK Gleerup

Jörberg, L. (1972b). A History of Prices in Sweden 1732-1914, vol. 2, Lund: CWK Gleerup

Kaukiainen, Y. (1984). Harvest Fluctuations and Mortality in Agrarian Finland (1810-1870), in T. Bengtsson, G. Fridlizius & R. Ohlsson (eds), *Pre-Industrial Population Change*, Lund: Studentlitteratur, pp.235-254

Kjeldstadli, K. (1992). Det förflutna är inte vad det en gång var (The Past is Not What it Once Was), 1:14 edn, Translated by S.-E. Torhell, 1998, Lund: Studentlitteratur

Kleinbaum, D. G. & Klein M. (2010). Logistic Regression: A self-learning text, 3rd edn, New York: Springer

Klesment, M. & Lust, K. (2021). Short-Term Economic Stress and Mortality Differentials in Rural Estonia, 1834-1884, *Scandinavian Economic History Review*, vol. 69, no. 1, pp.22-40, https://doi.org/10.1080/03585522.2020.1739121

Lantmäteriet. (n.d.). Sverige och Finland (Sweden and Finland), Historiska kartor (Historical Maps), https://historiskakartor.lantmateriet.se/hk/viewer/internal/RK@21/4c4d535f524b2f3231/lms2/LMS/Norra%20delen%20inf%C3%A4lld/SVERIGE%20OCH%20FINLAND [Accessed 18 May 2024]

Lappalainen, M. (2014). Death and Disease During the Great Finnish Famine 1695-1697, *Scandinavian Journal of History*, vol. 39, no. 4, pp.425-447, https://doi.org/10.1080/03468755.2014.937740

Larsson, Daniel (2006). Den dolda transitionen: Om ett demografiskt brytningsskede i det tidiga 1700-talets Sverige (The Hidden Transition: A demographic long-term change in early 18th century Sweden), PhD thesis, Department of Historical Studies, Universtity of Gothenburg, https://gupea.ub.gu.se/handle/2077/16842 [Accessed 20 December 2023]

Larsson, D. (2019). Diseases in Early Modern Sweden, *Scandinavian Journal of History*, vol. 45, no. 4, pp.407-432, https://doi.org/10.1080/03468755.2019.1659178

Lindberg, E. (2007). Mercantilism and Urban Inequalities in Eighteenth-Century Sweden, *Scandinavian Economic History Review*, vol. 55, no. 1, pp.1-19, https://doi.org/10.1080/03585520701234134

Linde, M. (2012). Sverige 1750: Åkerbruk, boskapsskötsel, befolkning: Rapport för Vetenskapsrådets projekt Databasen Sverige 1570-1805: Befolkning, jordbruk, jordägande (Sweden 1750: Agriculture, livestock, population: Report for the Swedish Research Council´s project Database Sweden 1570-1805: Population, agriculture, land ownership) [pdf], https://gupea.ub.gu.se/bitstream/handle/2077/31619/gupea_2077_31619_4.pdf?sequence=4&isAllowed=y

Lindkvist, T. & Sjöberg, M. (2019). Det Svenska samhället: Klerkernas och adelns tid: 800-1720 (Swedish Society: The era of the clergy and nobility: 800-1720), 6:1 edn, Lund: Studentlitteratur

Livi-Bacci, M. (1989). Population and Nutrition: An essay on European demographic history, Translated by T. Croft-Murray, 1991, Cambridge: Cambridge University Press

Livi-Bacci, M. (1998). The Population of Europe, Translated by C. De Nardi Ipsen & Carls Ipsen, 1999, Oxford: Blackwell Publishers Limited

Luque de Haro, V. A., Pujadas-Mora, J. M. & García-Gómez, J. J. (2021). Inequality in Mortality in Pre-Industrial Southern Europe during an Epidemic Episode: Socio-economic determinants (eighteenth – nineteenth centuries Spain), *Economics and Human Biology*, vol. 40, pp.1-17, https://dx.doi.org/10.1016/j.ehb.2020.100941

Lust, K., Klesment, M. & Jaddla, H. (2023). Social Inequalities in Famine Mortality in the Manorial System of the Tsarist Russian Province of Livland in the Mid-1840s, *The Economic History Review*, vol. 76, no. 4, pp.1333-1356, https://doi.org/10.1111/ehr.13246

Mackenbach, J. P. (2020). A History of Population Health: Rise and fall of disease in Europe, Leiden: Brill Rodopi

May, R. M. & Anderson, R. M. (1979). Population Biology of Infectious Diseases: Part II, *Nature*, vol. 280, pp.455-461, https://www.nature.com/articles/280455a0

National Central Bureau of Statistics. (1969). Historical Statistics of Sweden: Part 1. Population: Second edition. 1720-1967, 2nd edn, Stockholm: AB Allmänna Förlaget

Ó Gráda, C. (2009). Famine: A short story, Princeton: Princeton University Press

Oris, M., Derosas, R., Breschi, M, Alter, G., Bengtsson, T., Campbell, C., Kurosu, S. & Manfredini, M. (2004). Infant and Child Mortality, in J. Z. Lee, T. Bengtsson & G. Alter (eds), *Life under Pressure: Mortality and living standards in Europe and Asia, 1700-1900*, Cambridge: The MIT Press, pp.359-398

Persson, Bodil E. B. (2001). Pestens gåta: Farsoter i det tidiga 1700-talets Skåne (The Riddle of the Plague: Plagues in Early 18th century Scania), PhD thesis, Department of Historical Studies, Lund University, https://portal.research.lu.se/sv/publications/pestens-gåta-farsoter-i-det-tidiga -1700-talets-skåne [Accessed 16 May 2024]

Persson, K. G. (1999). Grain Markets in Europe, 1500-1900: Integration and deregulation, Cambridge: Cambridge University Press

Post, J. D. (1990). The Mortality Crises of the Early 1770s and European Demographic Trends, *The Journal of Interdisciplinary History*, vol. 21, no. 1, pp.29-62, https://www.jstor.org/stable/204917

Prado, S., Lundh, C., Collin, K. & Enflo, K. (2021). Labour and the ´Law of One Price´: Regional wage convergence of farm workers in Sweden, 1757-1980, *Scandinavian Economic History Review*, vol. 69, no. 1, pp.41-62, https://doi.org/10.1080/03585522.2020.1740776

Ravn, M. O. & Uhlig, H. (2002). On Adjusting the Hodrick-Prescott Filter for the Frequency of Observations, *The Review of Economics and Statistics*, vol. 84, no. 2, pp.371-376, https://www.jstor.org/stable/3211784

Ruist, J. (2021). Statistik och regression i praktiken (Statistics and Regression in Practice), Lund: Studentlitteratur

Scalone, F. (2014). Effects of Nutritional Stress and Socio-Economic Status on Maternal Mortality in Six German Villages, 1766-1863, *Population Studies*, vol. 68, no. 2, pp.217-236, https://doi.org/10.1080/00324728.2013.821153

Schön, L. (2013). Vår världs ekonomiska historia: Den industriella tiden (The Economic History of Our World: The industrial age), 2:5 edn, Lund: Studentlitteratur

Scrimshaw, N. S. (1983). The Value of Contemporary Food and Nutrition Studies for Historians, *The Journal of Interdisciplinary History*, vol. 14, no. 2, pp.529-534, https://www.jstor.org/stable/203720

Sharlin, A. (1978). Natural Decrease in Early Modern Cities: A reconsideration, *Past & Present*, no. 79, pp.126-138, https://www.jstor.org/stable/650251

Sjoberg, G. (1960). The Preindustrial City: Past and present, New York: The Free Press, Collier-Macmillan Limited

Stock, J. H. & Watson, M. W. (2020). Introduction to Econometrics, 4th edn, Harlow: Pearson Education Limited

Söderberg, J. (1984). Interrelationships Between Short-Term Economic and Demographic Fluctuations in a Period of Crisis: South-eastern Sweden, 1866-1872, in T. Bengtsson, G. Fridlizius & R. Ohlsson (eds), *Pre-Industrial Population Change*, Lund: Studentlitteratur, pp.255-276

Söderberg, J. (1987). Real Wage Trends in Urban Europe, 1730-1850: Stockholm in a comparative perspective, *Social History*, vol. 12, no. 2, pp.155-176, https://www.jstor.org/stable/4285596

Tsuya, N. O., Nystedt, P., Manfredini, M., Neven, M. & Campbell, C. (2004). Old-Age Mortality, in J. Z. Lee, T. Bengtsson & G. Alter (eds), *Life under Pressure: Mortality and living standards in Europe and Asia*, *1700-1900*, Cambridge: The MIT Press, pp.399-429

Utterström, G. (1957). Jordbrukets Arbetare: Levnadsvillkor och arbetsliv på landsbygden från frihetstiden till mitten av 1800-talet (Agricultural Workers: Living conditions and working life in the countryside from the Age of freedom to the mid-1800s), 2nd part, Stockholm: Tidens Förlag

Wachter, K. W. (2014). Essential Demographic Methods, Cambridge: Harvard University Press

Westberg, A. (2021). Principles of Coding Swedish Historic Occupations [pdf], https://swedpop.se/wp-content/uploads/2021/06/Principles-of-Coding-Swedish-Historic-Occupations.pdf

Wiesner-Hanks, M. E., Buckley Ebrey, P., Beck, R. B., Dávila, J., Haru Crowston, C. & Mckay, J. P. (2018). A History of World Societies, 11th edn, Boston: Bedford/St. Martin´s

Sources

Printed Sources

Umeå University (CEDAR)

The TABVERK database (The Demographic database), http://rystad.ddb.umu.se:8080/Tabellverket/Tabverk, based on the Tabular Commission, Population and Mortality tables, scanned by CEDAR, Umeå University

Gävle city parish

Population tables 1769-73

Mortality tables 1767-72

Hudiksvall city parish

Population tables 1769-72

Mortality tables 1767-73

Jönköping Eastern city parish Kristine

Population tables 1769-72

Mortality tables 1767-73

Kalmar cathedral/city parish

Population tables 1769-72

Mortality tables 1767-73

Karlstad parish

Population tables 1769-72

Mortality tables 1767-73

Norrköping city parish 1

Population tables 1772-73

Norrköping Saint Olai city parish

Mortality tables 1767-72

Uppsala cathedral/city parish

Population tables 1767-73

Mortality tables 1767-73

Örebro city and rural parish

Population tables 1769-73

Örebro city parish

Mortality tables 1767-73

Unprinted sources

The National Archives in Härnösand: Gävle Holy Trinity Congregation Church Archive, retrieved from https://riksarkivet.se

Death and burial register for Gävle city parish, 1753-69 and 1770-89

The National Archives in Härnösand: Hudiksvall Congregation Church Archive, retrieved from https://riksarkivet.se

Death and burial register for Hudiksvall city parish, 1716-1801

The National Archives in Uppsala: Uppsala Cathedral Congregation Church Archive, retrieved from https://riksarkivet.se

Death and burial register for Uppsala cathedral/city parish, 1741-76

The National Archives in Uppsala: Örebro Nikolai Congregation Church Archive, retrieved from https://riksarkivet.se

Death and burial register for Örebro city parish, 1768-83

The National Archives in Vadstena: Jönköping Kristina Congregation Church Archive, retrieved from https://riksarkivet.se

Death and burial register for Jönköping Eastern city parish Kristina, 1698-1801

The National Archives in Vadstena: Kalmar Congregation Church Archive, retrieved from https://riksarkivet.se

Death and burial register for Kalmar cathedral/city parish, 1749-99

The National Archives in Vadstena: Norrköping Saint Olai Congregation Church Archive, retrieved from https://riksarkivet.se

Death and burial register for Norrköping Saint Olai city parish, 1768-86

The Värmland Archive: Karlstad City Congregation Church Archive, retrieved from https://riksarkivet.se

Death and burial register for Karlstad parish, 1758-97

Appendix A: Additional Tables

Table 14: Years with available censuses from the Tabular Commission

Year	*Uppsala*	*Norrköping (Olai)*	*Gävle*	*Örebro*	*Karlstad*	*Hudiksvall*	*Jönköping (Kristine)*	*Kalmar*
1767	X							
1769			X(a)	X(a)	X(a)	X(a)	X(a)	X
1770	X(a)							
1772		X(c)	X(b,c)	X(b)	X(b)	X(b)	X(b)	X
1773	X	X	X(c)	X(c)				

Notes: "X" indicate available year, "a", "b", and "c" indicate year within the period 1768-70, year with high prices, and year after year with high prices, respectively, Source: The TABVERK database (the Demographic Database), http://rystad.ddb.umu.se:8080/Tabellverket/Tabverk, based on the Tabular Commissions Population tables, scanned by CEDAR, Umeå University (full source see p.53)

Table 15: Rye prices (Daler silver coins per barrel of grains) for counties from 1732-1775 (adapted from Jörberg, 1972a)

Year	*Uppsala*	*Östergötland*	*Gästrikland*	*Närke*	*Värmland*	*Hälsingland*	*Jönköping*	*Kalmar*
1732	4.16	5	4.1	5	6.16	4.1	.	4.16
1733	6	5.21	5	5.1	7.1	4	6	4.16
1734	6	4.21	5.1	5	6	.	5	4.16
1735	7	5.11	6.8	6.1	6.21	5.21	6	5.16
1736	7.1	6.21	7.17	7.21	8.1	6.21	6	5
1737	6	4	6.8	5.16	5.26	5	4	4.16
1738	5	3.11	5	4.29	5.16	4.3	5.16	3.16
1739	7.1	4.22	6	5.21	7.1	5	5	4
1740	8.1	6.21	8	7	8	6.1	6.16	6
1741	10	8	.	10	12	.	.	6
1742	8.1	6.11	8	8	8.22	5	6.16	6
1743	7.1	7.11	7.1	7.21	8	7	.	6
1744	7	7	6	6	6.1	5.1	.	6
1745	8.21	8	8	8.1	8.1	6	.	7
1746	11.1	8.21	9.1	9.1	9.1	8	.	7
1747	10.21	9.11	.	8.26	10.16	.	.	.
1748	9.1	8.11	9.1	9.16	11.12	9.1	.	9
1749	9.21	8	9.1	8.16	8.16	8	.	7
1750	6	5.11	5.21	5.16	6.16	5.1	5.16	4.16
1751	8.11	6.11	7.21	8	8.24	6.21	6.16	5.16
1752	8	6.11	8	7.16	8.16	8	7.16	5.16
1753	6.21	6.21	7.11	7.24	8	7	7.16	6
1754	8.21	7.21	7.11	8.11	8.1	7.1	7.16	6.16
1755	8.21	7.21	8	8.11	9	8	9	9
1756	13.11	11.21	14	11	12	12.1	12.16	12
1757	12.16	11.11	15	12	14	13.5	12.16	14
1758	10.11	10	12	11.8	11.8	11.5	11.16	12
1759	7	6.11	7.1	8.1	10	7.26	9	7
1760	8.1	7.11	8.21	7.16	9	9.26	9	8
1761	12.21	10	14.1	11	12.21	13.5	12	10
1762	17	16	22	20.16	24	17	19	22
1763	17	21	18	22	23.1	19.16	25	21
1764	17	19	18	22.8	23.21	21	24	20
1765	17.25	16	19	19.16	20	20	18	17
1766	14	12	15	16.16	14.7	17.16	12	12
1767	12	11.11	12.21	11.16	15.4	14	12	12
1768	11.16	12	12	12.24	15.1	12	14.1	10.21
1769	9.16	11.11	11	11.16	12.24	12.24	14	11
1770	11.21	12	12.21	12.8	12.14	15.1	13.21	13.1
1771	22	27.22	24	19	18.21	20.16	19.1	17.21
1772	18	19	24	23	24.1	23.16	20.21	18
1773	15	15.26	16	20.16	20.21	19	15.18	15
1774	13	10.17	14	12	12	16	11.5	13
1775	16	16	16	15	15	18	16	16

Notes: Dots indicate missing values, Source: Jörberg, 1972a

Table 16: Occupational/social division from the Tabular Commissions Population tables, grouped by HISCO standard and socio-economic groups

Occupation/social status	***HISCO***	***Socio-economic group***
1. a. Ridderskap och Adel	2	A
1. b. Ungdom öfver 15 år	2	A
1. c. Barn under 15 år	2	A
2. a. Prästerskap, Academie- och Schola-Stater	1	A
2. b. Ungdom öfver 15 år	1	A
2. c. Barn under 15 år	1	A
3. a. Ståndes-Personer och theras vederlikar	3	A
3. b. Crono-Betjänter, Fogdar, Länsmän &c.	3	A
3. c. Ungdom öfver 15 år	3	A
3. d. Barn under 15 år	3	A
4. a. Ståndens hederligare Betjänter	3	A
4. b. Ståndens Laquajer och Tjänstefolk öfver 15 år	5	S
4. c. Ståndens Laquajer och Tjänstefolk under 15 år	5	S
5. a. Magistrat i Städerne	1	A
5. b. Grosseurer	4	M
5. c. Krämare	4	M
5. d. Hökare och Små-Krämare	4	M
5. e. Bodsvänner och Ungdom öfver 15. år	4	M
5. f. Barn under 15. år	4	M
6. a. Fabriqueurer	2	A
6. b. Ungdom och Arbetare öfver 15 år	9	Pr
6. c. Barn under 15 år	9	Pr
7. a. Ämbets- och Handtvärks-folk	7/8/9	Pr
7. b. Gesäller	7/8/9	Pr
7. c. Lärogåssar öfver 15 år	7/8/9	Pr
7. d. Barn under 15 år	7/8/9	Pr
8. Ringare Borgerskap, Försvars- och Fördelskarlar	4	M
9. Rätters, Staters, Kyrko- och Stads-Betjänter	3/5	A/S
10. a. Friskt inhyses folk i Städerne	10	P
10. b. Friskt Bräkligt, dock ej Hospitals-Hjon	10	P
11. Resande och Främlingar	10	P
12. Skeppare och Sjöfarit folk	0	A
13. a. Handtvärkares och ringare Borgerskapets samt Betjänters Barn öfver 15 år	3/4/5/7/8/9	A/M/S/Pr
13. b. Handtvärkares och ringare Borgerskapets samt Betjänters Barn under 15 år	3/4/5/7/8/9	A/M/S/Pr
14. a. Samtelige Borgerskapets och Betjänters Tjänstefolk öfver 15 år	5	S
14. b. Samtelige Borgerskapets och Betjänters Tjänstefolk under 15 år	5	S
15. Större och mindre Seminanter på Landet	6	S
16. a. Tårpare med utsäde	6	S
16. b. Tårpare utan utsäde	6	S
17. a. Friskt Inhyses- och Gatuhus- folk på Landet	10	P
17. b. Friskt Bräkligt, dock ej Almoso-Hjon	10	P
18. a. Gärningsmän och Sokne-Handtvärkare	7/8/9	Pr
18. b. Andre Handtvärkare på Landet	7/8/9	Pr
19. Ryttare, Dragoner, Soldater och Båtsmän	5	S
20. Strandsittjare och sjöfarit friskt folk, dock ej Hemmansbrukare	9	Pr
21. a. Handtvärkare vid Bärgvärken	7	Pr
21. b. Bruksfolk vid Bärgvärken	7	Pr
22. Mölnare	7	Pr
23. a. Menige Almogens Barn och Tjänstefolk, öfver 15 år	6	S
23. b. Menige Almogens Barn och Tjänstefolk, under 15 år	6	S
24. Fattiga Präst-Änkor	1	A
25. Gammalt afskedat Krigsfolk utan Krigsmanshus	5	S
26. a. Värkeligen intagne i Hospitaler	10	P
26. b. Värkeligen intagne i Fattighus	10	P
27. a. Eländige utom Hospitaler ell. Fattighus	10	P
27. b. Galne och ursinnige utan Hospital	10	P
28. Bräklige af fallande sot och smittosam sjukdom	10	P
29. Lägrade Qvinfolk	10	P
30. Rasp- och Spinhusfolk	10	P
31. Lifsfångar på Fästningar och Slått	10	P
32. Främmande Religions-Förvanter	10	P

Notes: Occupations fitted to HISCO, with the additional group 10 (people listed as poor), and further reduced to socio-economic groups (see Table 4 for explanation), occupations/social statuses that have several HISCO groups/socio-economic groups listed to them has been divided between the groups based on percentual occurrence in other occupations, Source: The TABVERK database (the Demographic Database), http://rystad.ddb.umu.se:8080/Tabellverket/Tabverk, based on the Tabular Commissions Population tables, scanned by CEDAR, Umeå University (full source see p.53)

Appendix B: Mortality Estimates

Table 17: Crude death rate per thousand, separated by year and city

Year	*Uppsala*	*Norrköping (Olai)*	*Gävle*	*Örebro*	*Karlstad*	*Hudiksvall*	*Jönköping (Kristine)*	*Kalmar*
1768	31.2	25.1	21.4	35.5	41.9	26.2	46.3	38.5
1769	37.6	36.7	17.6	29.5	48.1	40.6	22.1	49.9
1770	28.2	31.6	22.3	23.5	38.8	22.9	30.7	43.3
1771	44.6	30.7	18.8	29.2	57.0	12.7	27.5	32.8
1772	34.8	37.8	52.9	32.9	87.9	30.0	46.1	42.3
1773	36.0	46.5	46.3	82.8	117.4	106.6	31.7	74.1

Notes: Total number of observations (registered deaths): 5,950, Source: Death and burial registers, Riksarkivet.se; The TABVERK database (the Demographic Database), http://rystad.ddb.umu.se:8080/Tabellverket/Tabverk, based on the Tabular Commissions Population and Mortality tables, scanned by CEDAR, Umeå University (full source see pp.53-54)

Some interesting patterns appear when observing mortality for men and women and age groups divided not only by year but also by city (Table 18 and 19). As was observed in Table 7, mortality is generally higher for men than women but the ratio does not hold consistently. For Jönköping, Karlstad, and Gävle the difference for most years is low while for example Kalmar and Uppsala have more pronounced rates in favour of females.

Small differences in favour of women are not unexpected but large differences such as Uppsala, Karlstad, or Kalmar in 1773 could have had severe effects on the demographic structure after a crisis causing birth and nuptiality rates to stay low even though the mortality crisis was over (Campbell et al. 2004; Wachter, 2014). If these effects also were more severe for people of lower socio-economic class it is possible that part of the trend towards higher birth rates among the more well-off was because of short-term economic stress (Bengtsson & Dribe, 2006). Such effects have however not been found by aggregated studies such as Galloway (1988).

Table 18: Mortality rates per thousand for men and women, separated by year and city

Uppsala	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***	***Norrköping (Olai)***	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***
Men	37.4	38.9	33.1	45.3	38.6	48.1	*Men*	26.7	35.6	37.9	35.7	36.7	53.6
Women	26.1	36.0	23.7	44.0	31.8	26.7	*Women*	19.8	33.3	22.2	25.4	35.9	46.3
Gävle	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***	***Örebro***	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***
Men	22.3	19.0	23.9	21.6	56.0	54.7	*Men*	37.5	32.1	27.9	30.4	37.7	82.2
Women	20.2	16.2	21.0	16.5	50.6	39.1	*Women*	33.6	27.3	19.8	28.2	28.7	83.2
Karlstad	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***	***Hudiksvall***	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***
Men	47.0	49.9	42.4	60.0	90.2	127.4	*Men*	32.5	36.5	18.1	11.9	23.7	104.8
Women	36.4	46.1	37.1	57.1	87.4	107.9	*Women*	20.0	43.3	27.0	13.5	35.5	106.9
Jönköping (Kristine)	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***	***Kalmar***	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***
Men	56.4	23.0	30.5	34.0	48.4	34.9	*Men*	42.6	56.5	50.4	34.8	41.8	81.1
Women	37.7	21.7	30.1	23.2	42.6	31.3	*Women*	34.6	44.2	37.4	31.4	42.8	67.5

Notes: Total number of observations (registered deaths): 5,938, Source: Death and burial registers, Riksarkivet.se; The TABVERK database (the Demographic Database), http://rystad.ddb.umu.se:8080/Tabellverket/Tabverk, based on the Tabular Commissions Population and Mortality tables, scanned by CEDAR, Umeå University (full source see pp.53-54)

Some rates also stick out concerning the age groups. Karlstad's infant mortality as well as among those age 60 and over in 1773 is remarkably high, though many cities has very high infant mortality rates for this year. It is further interesting, however that also Norrköping has very high infant mortality in 1773, considering that the city had high prices in 1771 and in sharp contrast to the development in Uppsala.

Table 19: Mortality rates per thousand for age groups, separated by year and city

Uppsala	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***
Infants	239.7	181.0	172.4	218.2	217.8	156.6
1-14	12.9	34.2	19.5	36.2	31.3	34.6
15-24	8.7	15.8	5.3	7.0	8.4	4.8
25-44	13.3	12.1	17.9	26.8	15.0	20.1
45-59	35.7	37.7	13.2	40.7	31.4	48.9
60 and over	82.2	130.0	92.1	165.3	152.9	169.5
Norrköping (Olai)	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***
Infants	307.1	427.2	377.5	319.8	389.4	533.7
1-14	10.5	33.1	20.7	24.9	17.4	60.1
15-24	7.2	5.9	5.4	8.3	10.1	17.7
25-44	16.7	18.4	16.6	17.0	23.8	15.3
45-59	21.5	25.4	28.5	23.1	41.1	34.7
60 and over	55.4	86.0	54.3	77.0	102.4	80.9
Gävle	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***
Infants	164.2	203.5	272.0	165.5	403.7	195.9
1-14	17.2	9.0	14.7	1.9	61.8	36.5
15-24	4.1	3.3	2.4	1.3	8.2	12.9
25-44	9.0	1.2	3.7	6.8	12.3	25.8
45-59	17.4	9.9	26.3	24.1	50.0	59.7
60 and over	197.5	221.4	151.2	127.3	177.2	161.1
Örebro	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***
Infants	196.4	287.0	255.6	297.0	306.8	506.7
1-14	33.6	19.6	9.0	17.5	21.7	126.5
15-24	3.0	7.4	7.2	7.0	8.2	14.9
25-44	20.7	12.2	12.0	16.1	19.2	42.8
45-59	30.3	23.5	26.7	17.1	26.8	65.1
60 and over	161.8	116.9	94.0	119.4	134.5	242.4
Karlstad	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***
Infants	392.2	350.9	315.8	509.1	549.0	783.8
1-14	56.8	55.7	31.2	20.1	76.6	106.5
15-24	7.0	2.3	11.6	21.2	16.8	22.3
25-44	9.4	21.5	21.9	42.0	40.0	77.6
45-59	52.3	34.7	25.8	65.8	96.7	138.6
60 and over	94.2	186.3	91.5	152.1	322.3	386.9
Hudiksvall	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***
Infants	179.5	454.5	147.1	129.0	153.8	565.2
1-14	17.4	49.4	17.8	3.6	21.1	182.3
15-24	0.0	11.5	0.0	5.4	0.0	56.0
25-44	2.9	8.6	5.8	0.0	15.0	56.3
45-59	27.6	21.1	10.4	0.0	27.7	52.1
60 and over	173.8	82.8	157.1	101.0	149.9	151.7
Jönköping (Kristine)	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***
Infants	313.4	181.8	320.5	309.9	361.1	261.5
1-14	76.3	24.4	10.6	23.8	35.0	25.3
15-24	0.0	3.6	7.2	3.6	1.8	11.1
25-44	13.2	5.5	17.1	10.4	20.7	15.3
45-59	34.8	22.1	29.0	18.2	55.2	25.9
60 and over	120.7	78.3	145.2	121.4	275.3	163.0
Kalmar	***1768***	***1769***	***1770***	***1771***	***1772***	***1773***
Infants	355.4	376.1	283.5	252.5	305.3	430.1
1-14	17.3	73.5	16.0	16.1	31.2	89.0
15-24	5.2	5.2	14.1	11.1	11.6	18.1
25-44	18.9	14.1	20.1	9.0	17.1	25.2
45-59	45.7	32.2	65.9	36.8	58.0	55.7
60 and over	106.0	55.8	121.2	143.2	96.2	219.5

Notes: Total number of observations (registered deaths): 5,886, Source: Death and burial registers, Riksarkivet.se; The TABVERK database (the Demographic Database), http://rystad.ddb.umu.se:8080/Tabellverket/Tabverk, based on the Tabular Commissions Population and Mortality tables, scanned by CEDAR, Umeå University (full source see pp.53-54)

Though not unknown, it is noteworthy how low mortality in the age group 15-24 was both in good and bad years (see national average rates for different age groups in National Central Bureau of Statistics, 1969). Surviving the infant year and child diseases, most prominently smallpox, was indeed a gateway to also surviving young adulthood. With this background, the mortality increase in Hudiksvall in 1773 must have been calamitic.

Regarding socio-economic groups, though the aggregated values found in Table 9 seem somewhat accurate, when mortality rates for socio-economic groups (Table 20) is divided by city and year, a different pattern emerges. The values for poor people in Kalmar and Karlstad in 1772 seem impossibly high and could be caused by the fact that population was recorded in the end of the year and did not account for migration. With high immigration among poor individuals who then died within the city, the mortality would also increase (Galloway, 1985) In addition, the general pattern of quite high mortality among administration and low values for merchant and burghers does not seem justified either. Most likely this is due to small group samples, causing values to spread rapidly. The most stable and possibly accurate values seem to be among production workers and to some extend also amid those in service and agriculture.

Table 20: Mortality rates per thousand for socio-economic groups, separated by year and city

City/Year	***A***	***M***	***S***	***Pr***	***P***
Uppsala *- 1770*	38.4	13.5	21.4	33.2	129.0
- 1773	50.4	18.9	19.6	55.2	139.5
Norrköping (Olai) *- 1772*	25.0	7.4	39.1	41.3	53.4
- 1773	29.5	8.5	43.2	54.8	71.3
Gävle *- 1769*	19.0	18.5	6.3	29.5	13.0
- 1772 (high prices)	60.7	33.0	35.3	123.0	29.4
- 1773	51.3	40.2	27.9	85.5	43.0
Örebro *– 1769*	28.6	14.0	11.9	51.4	19.1
- 1772 (high prices)	68.6	4.5	30.3	36.4	18.1
- 1773	118.4	17.6	36.6	95.6	37.0
Karlstad *– 1769*	55.4	17.8	14.6	66.3	64.7
- 1772 (high prices)	84.5	41.3	30.0	92.7	264.7
Hudiksvall *– 1769*	34.6	26.4	20.1	88.2	0.0
- 1772 (high prices)	30.8	7.7	66.5	55.1	52.6
Jönköping (Kristine) *- 1769*	10.7	19.0	8.5	27.0	15.9
- 1772 (high prices)	54.3	28.1	34.1	36.3	138.6
Kalmar *- 1769*	98.3	17.0	28.5	77.7	11.7
- 1772	57.9	10.6	24.9	53.4	175.0

Notes: Total number of observations (registered deaths): 2,131, for socio-economic groups, see Table 4, Source: Death and burial registers, Riksarkivet.se; The TABVERK database (the Demographic Database), http://rystad.ddb.umu.se:8080/Tabellverket/Tabverk, based on the Tabular Commissions Population and Mortality tables, scanned by CEDAR, Umeå University (full source see pp.53-54)

Appendix C: Regressions

Table 21: Logistic regressions with dependent variable Crisis (full table)

Variable	***1***	***2***	***3***	***4***	***5***
Socio-economic group (Reference: A)					
M	0.80	0.79	0.78	0.78	0.63**
	(0.12)	(0.12)	(0.12)	(0.12)	(0.10)
S	1.14	1.14	1.10	1.08	1.21
	(0.16)	(0.16)	(0.15)	(0.15)	(0.18)
Pr	0.84	0.84	0.87	0.86	0.95
	(0.10)	(0.10)	(0.10)	(0.10)	(0.12)
P	1.20	1.19	1.23	1.22	1.51*
	(0.22)	(0.22)	(0.23)	(0.23)	(0.29)
Gender (Reference: Male)					
Female		1.03	1.00	1.02	1.00
		(0.08)	(0.08)	(0.09)	(0.09)
Age group (Reference: Infants)					
1-14			1.39**	1.39**	1.39**
			(0.16)	(0.16)	(0.17)
15-24			1.05	1.03	1.05
			(0.24)	(0.24)	(0.25)
25-44			1.55**	1.51**	1.63***
			(0.21)	(0.20)	(0.23)
45-59			1.82***	1.80***	1.71***
			(0.26)	(0.26)	(0.26)
60 and over			1.92***	1.94***	1.66***
			(0.23)	(0.24)	(0.21)
Month (Reference: January)					
February				1.59*	1.73*
				(0.35)	(0.39)
March				1.52	1.66*
				(0.34)	(0.38)
April				1.84**	2.01**
				(0.39)	(0.43)
May				1.75**	1.98**
				(0.36)	(0.42)
June				2.14***	2.34***
				(0.45)	(0.51)
July				1.74*	1.97**
				(0.38)	(0.44)
August				1.76**	1.78**
				(0.37)	(0.39)
September				2.28***	2.25***
				(0.48)	(0.50)
October				1.81**	1.80**
				(0.39)	(0.40)
November				1.33	1.25
				(0.28)	(0.28)
December				1.43	1.36
				(0.31)	(0.30)
City (Reference: Gävle)					
Karlstad					0.44***
					(0.07)
Hudiksvall					0.28***
					(0.06)
Örebro					0.31***
					(0.05)
Uppsala					0.34***
					(0.05)
Norrköping (Olai)					0.24***
					(0.03)
Jönköping (Kristine)					0.40***
					(0.06)
Observations	2,719	2,719	2,719	2,719	2,719
Pseudo R-squared	0.0036	0.0037	0.0143	0.0213	0.0616
Exponentiated coefficients; Standard errors in parentheses					
** p<0.05, ** p<0.01, *** p<0.001*					

Notes: For explanation of socio-economic groups, see Table 4, Source: Death and burial registers, Riksarkivet.se (full source see p.54)

Table 22: Logistic regressions with dependent variable Crisis lag (full table)

Variable	***1***	***2***	***3***	***4***	***5***
Socio-economic group (Reference: A)					
M	0.88	0.87	0.86	0.85	0.62**
	(0.12)	(0.12)	(0.12)	(0.12)	(0.09)
S	1.34*	1.32*	1.27	1.26	1.42*
	(0.17)	(0.17)	(0.16)	(0.16)	(0.19)
Pr	0.82	0.82	0.83	0.83	0.96
	(0.09)	(0.09)	(0.09)	(0.09)	(0.11)
P	1.09	1.06	1.13	1.10	1.38
	(0.19)	(0.18)	(0.20)	(0.20)	(0.26)
Gender (Reference: Male)					
Female		1.16	1.15	1.15	1.13
		(0.09)	(0.09)	(0.09)	(0.09)
Age group (Reference: Infants)					
1-14			1.65***	1.65***	1.56***
			(0.18)	(0.18)	(0.18)
15-24			1.60*	1.57*	1.54*
			(0.31)	(0.31)	(0.31)
25-44			1.73***	1.73***	1.78***
			(0.22)	(0.22)	(0.23)
45-59			2.01***	1.98***	1.83***
			(0.27)	(0.27)	(0.26)
60 and over			1.69***	1.69***	1.38*
			(0.20)	(0.20)	(0.17)
Month (Reference: January)					
February				1.15	1.20
				(0.22)	(0.24)
March				1.01	0.99
				(0.20)	(0.20)
April				1.55*	1.61*
				(0.28)	(0.30)
May				1.15	1.19
				(0.21)	(0.23)
June				1.16	1.22
				(0.22)	(0.24)
July				1.11	1.15
				(0.21)	(0.23)
August				1.48*	1.36
				(0.26)	(0.26)
September				1.40	1.24
				(0.26)	(0.25)
October				0.98	1.04
				(0.19)	(0.21)
November				1.03	1.09
				(0.19)	(0.21)
December				1.17	1.28
				(0.22)	(0.25)
City (Reference: Gävle)					
Karlstad					0.42***
					(0.06)
Hudiksvall					0.65*
					(0.11)
Örebro					0.44***
					(0.06)
Uppsala					0.21***
					(0.03)
Norrköping (Olai)					0.23***
					(0.03)
Jönköping (Kristine)					0.17***
					(0.03)
Observations	2,967	2,967	2,967	2,967	2,967
Pseudo R-squared	0.0059	0.0069	0.0172	0.0213	0.0813
Exponentiated coefficients; Standard errors in parentheses					
** p<0.05, ** p<0.01, *** p<0.001*					

Notes: For explanation of socio-economic groups, see Table 4, Source: Death and burial registers, Riksarkivet.se (full source see p.54)

Table 23: Logistic regressions with dependent variable Crisis divided by age and disease groups (full table)

Variable	***1***	***2***	***3***	***4***	***5***	***6***
	Infants	*Children (1-14)*	*Adults (25-59)*	*Elderly (60 and over)*	*Clear influence*	*Clear/variable influence*
Socio-economic group (Reference: A)						
M	0.69	0.53	0.86	0.56	0.71	0.98
	(0.24)	(0.18)	(0.27)	(0.20)	(0.24)	(0.27)
S	1.25	1.41	1.05	1.15	1.17	1.36
	(0.42)	(0.45)	(0.29)	(0.36)	(0.35)	(0.33)
Pr	1.31	0.63	1.09	0.84	0.86	1.06
	(0.33)	(0.16)	(0.25)	(0.24)	(0.23)	(0.23)
P	1.27	1.64	1.68	1.31	2.52*	3.13**
	(0.47)	(0.80)	(0.73)	(0.52)	(1.14)	(1.16)
Gender (Reference: Male)						
Female	1.27	1.08	0.97	0.89	0.83	0.97
	(0.22)	(0.20)	(0.16)	(0.18)	(0.16)	(0.15)
Age group (Reference: Infants)						
1-14					1.78	1.88*
					(0.62)	(0.55)
15-24					0.85	1.16
					(0.50)	(0.49)
25-44					2.04*	2.46**
					(0.70)	(0.69)
45-59					2.28*	2.31**
					(0.80)	(0.67)
60 and over					2.55**	2.51**
					(0.91)	(0.77)
Month (Reference: January)						
February	1.39	3.34*	1.14	2.04	1.64	1.88
	(0.57)	(1.87)	(0.56)	(0.90)	(0.86)	(0.77)
March	0.76	4.39**	1.92	1.07	2.42	2.64*
	(0.38)	(2.23)	(0.89)	(0.49)	(1.20)	(1.01)
April	1.36	4.64**	2.14	1.36	2.32	2.54*
	(0.55)	(2.37)	(0.95)	(0.64)	(1.12)	(0.94)
May	1.33	4.11**	1.51	2.21	2.02	2.19*
	(0.56)	(2.00)	(0.67)	(0.97)	(0.96)	(0.80)
June	2.09	3.80*	2.09	2.24	3.04*	2.80**
	(0.84)	(2.05)	(0.93)	(1.01)	(1.50)	(1.04)
July	1.52	3.45*	2.05	1.70	2.05	1.97
	(0.62)	(1.70)	(0.99)	(0.85)	(1.12)	(0.79)
August	1.19	6.09***	1.08	1.12	1.23	1.78
	(0.49)	(2.93)	(0.52)	(0.55)	(0.62)	(0.67)
September	1.77	5.96***	2.13	1.44	1.64	2.08
	(0.71)	(2.92)	(1.03)	(0.69)	(0.88)	(0.86)
October	1.47	2.90*	1.37	2.18	0.90	1.62
	(0.63)	(1.44)	(0.66)	(0.99)	(0.50)	(0.66)
November	0.60	1.93	1.65	1.41	0.75	1.21
	(0.26)	(0.98)	(0.79)	(0.63)	(0.42)	(0.49)
December	0.99	2.99*	0.82	1.29	0.98	1.50
	(0.43)	(1.52)	(0.40)	(0.60)	(0.54)	(0.62)
City (Reference: Gävle)						
Karlstad	0.34**	0.19***	0.50*	0.85	1.62	0.68
	(0.12)	(0.06)	(0.16)	(0.30)	(0.54)	(0.18)
Hudiksvall	0.16**	0.10***	0.44	0.50	0.36	0.46
	(0.09)	(0.05)	(0.20)	(0.20)	(0.20)	(0.19)
Örebro	0.28***	0.15***	0.35**	0.55	0.59	0.38***
	(0.09)	(0.06)	(0.11)	(0.18)	(0.19)	(0.11)
Uppsala	0.37**	0.23***	0.36***	0.38**	0.28***	0.23***
	(0.11)	(0.08)	(0.10)	(0.11)	(0.10)	(0.06)
Norrköping (Olai)	0.22***	0.18***	0.22***	0.30***	0.23***	0.16***
	(0.05)	(0.05)	(0.06)	(0.09)	(0.07)	(0.04)
Jönköping (Kristine)	0.42**	0.19***	0.53*	0.76	0.89	0.48**
	(0.14)	(0.06)	(0.17)	(0.26)	(0.29)	(0.13)
Observations	760	641	692	520	622	932
Pseudo R-squared	0.0670	0.1176	0.0555	0.0526	0.1310	0.1039
Exponentiated coefficients; Standard errors in parentheses						
** p<0.05, ** p<0.01, *** p<0.001*						

Notes: For explanation of socio-economic groups, see Table 4, for explanation of disease categories, see Table 3, Source: Death and burial registers, Riksarkivet.se (full source see p.54)

Table 24: Logistic regressions with dependent variable Crisis lag, divided by age and disease groups (full table)

Variable	***1***	***2***	***3***	***4***	***5***	***6***
	Infants	*Children (1-14)*	*Adults (25-59)*	*Elderly (60 and over)*	*Clear influence*	*Clear/variable influence*
Socio-economic group (Reference: A)						
M	0.67	0.68	0.63	0.53	0.88	0.65
	(0.21)	(0.22)	(0.19)	(0.19)	(0.34)	(0.18)
S	1.53	2.27**	1.35	1.26	2.41*	1.63*
	(0.44)	(0.71)	(0.33)	(0.41)	(0.84)	(0.37)
Pr	0.94	0.89	0.96	1.15	1.83	1.19
	(0.21)	(0.22)	(0.21)	(0.34)	(0.59)	(0.24)
P	0.79	2.35	1.78	1.26	3.12	3.19***
	(0.27)	(1.10)	(0.70)	(0.51)	(1.81)	(1.11)
Gender (Reference: Male)						
Female	1.21	1.17	1.15	1.05	0.95	1.11
	(0.19)	(0.21)	(0.18)	(0.21)	(0.19)	(0.15)
Age group (Reference: Infants)						
1-14					2.73**	2.14**
					(1.02)	(0.61)
15-24					2.25	3.45***
					(1.15)	(1.20)
25-44					2.25*	3.29***
					(0.85)	(0.91)
45-59					2.50*	3.45***
					(0.97)	(0.98)
60 and over					3.94***	3.58***
					(1.57)	(1.07)
Month (Reference: January)						
February	1.14	1.60	0.88	2.10	1.43	1.06
	(0.42)	(0.73)	(0.35)	(1.05)	(0.71)	(0.39)
March	0.73	1.39	0.77	1.29	0.86	0.89
	(0.31)	(0.60)	(0.32)	(0.65)	(0.43)	(0.31)
April	1.16	2.10	1.00	3.64**	1.16	1.32
	(0.42)	(0.87)	(0.38)	(1.72)	(0.54)	(0.42)
May	1.22	1.29	0.83	1.73	0.32*	0.95
	(0.45)	(0.52)	(0.31)	(0.86)	(0.18)	(0.30)
June	0.72	1.55	0.93	2.42	0.78	1.44
	(0.30)	(0.70)	(0.36)	(1.19)	(0.41)	(0.46)
July	0.84	0.87	1.01	3.61*	0.88	1.36
	(0.32)	(0.37)	(0.42)	(1.83)	(0.50)	(0.46)
August	1.04	1.93	0.75	3.00*	3.18**	1.63
	(0.37)	(0.74)	(0.30)	(1.46)	(1.38)	(0.51)
September	0.65	1.74	1.24	2.64	2.13	1.51
	(0.27)	(0.72)	(0.51)	(1.32)	(0.98)	(0.52)
October	1.45	1.46	0.53	1.63	1.26	1.02
	(0.55)	(0.63)	(0.23)	(0.85)	(0.66)	(0.37)
November	0.80	1.30	0.79	2.43	0.95	0.81
	(0.29)	(0.56)	(0.33)	(1.14)	(0.47)	(0.28)
December	1.28	1.79	0.74	2.36	0.78	1.21
	(0.46)	(0.81)	(0.30)	(1.13)	(0.41)	(0.42)
City (Reference: Gävle)						
Karlstad	0.63	0.21***	0.38***	0.60	0.06***	0.27***
	(0.21)	(0.07)	(0.11)	(0.21)	(0.03)	(0.07)
Hudiksvall	0.62	0.58	0.67	0.34**	2.25*	1.42
	(0.25)	(0.21)	(0.25)	(0.14)	(0.88)	(0.44)
Örebro	0.61	0.38**	0.39***	0.37**	0.56	0.41***
	(0.18)	(0.12)	(0.11)	(0.12)	(0.19)	(0.10)
Uppsala	0.39**	0.14***	0.15***	0.23***	0.13***	0.09***
	(0.12)	(0.05)	(0.04)	(0.07)	(0.05)	(0.03)
Norrköping (Olai)	0.38***	0.07***	0.21***	0.37***	0.24***	0.12***
	(0.09)	(0.02)	(0.05)	(0.10)	(0.07)	(0.03)
Jönköping (Kristine)	0.34**	0.05***	0.15***	0.32**	0.31**	0.15***
	(0.12)	(0.02)	(0.06)	(0.13)	(0.13)	(0.05)
Observations	795	728	780	534	616	1,119
Pseudo R-squared	0.0381	0.1876	0.0845	0.0703	0.2182	0.1682
Exponentiated coefficients; Standard errors in parentheses						
** p<0.05, ** p<0.01, *** p<0.001*						

Notes: For explanation of socio-economic groups, see Table 4, for explanation of disease categories, see Table 3, Source: Death and burial registers, Riksarkivet.se (full source see p.54)

The results regarding season (month) are quite interesting. In Table 24 for the year after a year of high prices, the highest relative risk compared to January is found in August-September for those dying of a disease which is clearly influenced by the individual's nutritional level (5). This is in line with seasonal patterns of mortality for dysentery, found by Castenbrandt (2012) for early 19th century Sweden, and which is also included in the disease category (see Table 3) and cause of death for a large share of individuals (44 %) in the category in a year after a year of high prices.

In contrast, for the year of high prices (Table 23), the highest relative risk of death for the corresponding regression occurs in March-July. However, further investigation reveals that during these years it is not dysentery but tuberculosis and respiratory diseases that causes most deaths (50 %) within the disease category. Why did people die more from tuberculosis than dysentery in the year of high prices? Tuberculosis is a disease that not only is closely connected to nutrition but spreads much more easily among people living in close quarters and one that was endemic in pre-industrial cities (Mackenbach, 2020). It is possible that as people started to suffer from malnutrition and roomed to the cities, a combination caused the number of deaths to increase rapidly. However, it has been suggested by Appleby (1975) that harsh winters (putting strains on the respiratory system) might have been more related to increases in tuberculosis mortality than food shortages. As was describe in chapter 2, Sweden suffered harsh winters in both 1770/71 and especially in 1771/72 (most cities had high prices in 1772) which might be part of the reason for the seasonal pattern.