Why is infant mortality higher in the US than in Europe?*

Alice Chen	Emily Oster	Heidi Williams
USC	Brown University and NBER	MIT and NBER

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Abstract

The US has higher infant mortality than peer countries. In this paper, we combine micro-data from the US with similar data from four European countries to investigate this US infant mortality disadvantage. The US disadvantage persists after adjusting for potential differential reporting of births near the threshold of viability. While the importance of birth weight varies across comparison countries, relative to all comparison countries the US has similar neonatal (<1 month) mortality but higher postneonatal (1-12 months) mortality. We document similar patterns across Census divisions within the US. The postneonatal mortality disadvantage is driven by poor birth outcomes among lower socioeconomic status individuals.

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1 Introduction

In 2013, the US infant mortality rate (IMR) ranked 51st internationally, comparable to Croatia, despite an almost three-fold difference in GDP per capita.[1] One way to quantify the magnitude of this infant mortality disadvantage is to consider that the US IMR is about 3 deaths per 1000 greater than in Scandinavian countries. Aggregating 4 million annual US births and taking a standard value of life estimate of US$7 million (Viscusi and Aldy, 2003) suggests that reducing the US IMR to that of Scandinavian countries would be worth on the order of US$84 billion annually. By this metric, it would be "worth it" to spend up to $21,000 on each live birth to lower the infant mortality risk to the level in Scandinavia.

While the US IMR disadvantage is widely discussed and quantitatively important, the determinants of this disadvantage are not well understood, hindering policy efforts.[2] A key constraint on past research has been the lack of comparable micro-datasets across countries. Cross-country comparisons of aggregate infant mortality rates provide very limited insight, for two reasons. First, a well-recognized problem is that countries vary in their reporting of births near the threshold of viability. Such reporting differences may generate misleading comparisons of how infant mortality varies across countries. Second, even within a comparably-reported sample, the observation that mortality rates differ one year post-birth provides little guidance on what factors are driving the US disadvantage. As a specific example, although a large literature has documented significant inequality in infant mortality outcomes across socioeconomic groups within the US (i.e. Currie, Shields and Price 2007; Case, Lubotsky and Paxson 2002; Miller 2003), it is less clear how much of the cross-country US IMR disadvantage is explained by higher levels of inequality within the US.

We begin in this paper by relaxing this data constraint. We combine US natality micro-data with similar micro-data from Finland and Austria. In addition, we use data from the UK and Belgium which can be restricted to a comparably-reported sample and reported in aggregated cells based on birth weight and age at death. Using these data, we provide a detailed accounting of the US IMR disadvantage relative to these European comparisons, quantifying the importance of differential reporting, some conditions at birth (specifically, birth weight and gestational age), neonatal mortality (deaths in the first month), and postneonatal mortality (deaths in months 1 to 12). To the best of our knowledge, cross-country micro-data has not previously been used to undertake this type of exercise.

This exercise yields a number of findings. First, consistent with past evidence (MacDorman and Mathews, 2009), differential reporting of births cannot offer a complete explanation for the US IMR disadvantage. However, accounting for differential reporting is quantitatively important. Compared to the average of the five European countries we analyze, limiting to a comparable sample lowers the apparent US IMR disadvantage from 2.5 deaths

[1] Croatia's IMR in 2013 was 5.96, relative to 5.9 in the US; GDP per capita was $18,100 in Croatia and $50,100 in the US (CIA, 2013).

[2] Economists have not written much on cross-country differences in infant mortality; when they have, it has often focused (most notably, Waldmann (1992)) on the relationship with income levels and income inequality across countries. The proximate causes of the US infant mortality disadvantage have been of more interest in the public health literature.

per 1000 births to 1.5 deaths. This finding highlights the importance of conducting cross-country comparisons in a setting where reporting differences can be addressed, which is typically not possible in the types of aggregate statistics compiled by the World Health Organization and the World Development Indicators (World Health Organization, 2006; World Bank, 2013).

Second, we explore the importance of differences in health at birth. Worse health at birth is widely cited as *the* major driver of the US IMR disadvantage (MacDorman and Mathews, 2009; National Research Council, 2013; Wilcox et al., 1995); we are able to investigate this issue after restricting attention to our comparably-reported sample. Consistent with past evidence that has focused on comparing the US with Scandinavian countries, we find that birth weight can explain around 75% of the US IMR disadvantage relative to Finland or Belgium. However, birth weight can only explain 30% of the US IMR disadvantage relative to Austria or the UK. Moreover, even normal birth weight infants have a substantial IMR disadvantage - 2.3 deaths per 1000 in the US, relative to 1.3 in Finland, 1.5 in Austria, 1.6 in the UK and 2.0 in Belgium.

Third, our data allow us to distinguish between neonatal and postneonatal deaths in our comparably-reported sample. The neonatal/postneonatal distinction is informative because the relevant causes of death during these two time periods are quite different (Rudolph and Borker 1987). Previous comparisons of neonatal and postneonatal mortality in aggregate data (such as Kleinman and Kiely (1990)) are difficult to interpret given the differential reporting concern: specifically, in an unrestricted sample the US has much higher neonatal mortality than any of the European comparisons we analyze (World Health Organization, 2006), whereas our comparably-reported sample suggests that differences in reporting could be driving nearly all of that pattern.

In our comparably-reported sample, the US neonatal mortality disadvantage is quantitatively small and appears to be fully explained by differences in birth weight. In contrast, the US has a substantial disadvantage relative to all comparison countries during the postneonatal period even in our comparably-reported sample and even conditional on circumstances at birth. A simple illustration for the three countries with micro-data (the US, Finland and Austria) can be seen in Figure 2, which shows the cumulative probability of death over the first year. The infant mortality rate in the US is higher at all ages, but this difference accelerates after the first month of life. Importantly, this excess postneonatal mortality does not appear to be driven by the US "delaying" neonatal deaths: the postneonatal disadvantage appears strongly even among normal birth weight infants and those with high APGAR scores.

Hence, our cross-country analysis points to the importance of the postneonatal period as a driver of the US disadvantage and, on its own, may suggest support for policies which target this period of life. In the second part of the paper, we expand our analysis to consider geographic variation in infant mortality *within* the US, focusing on the nine US Census divisions. If the lowest mortality Census division (the North East) were a country on its own, it would have a mortality rate very similar to Austria.. In contrast, the worst off Census division (East South Central) has a one-year mortality rate twice as high as the North East. Replicating our cross-country decomposition across US Census regions again uncovers an important role for the postneonatal

period: only 38% of deaths in the lowest-mortality Census division occur in the postneonatal period, but deaths during this period account for 67% of the geographic differences in mortality. Reducing postneonatal mortality in each Census division to the level observed in the lowest-mortality division would reduce mortality rates, on average, by 0.72 deaths per 1000 births.

In the final section of the paper, we use a subset of the cross-country data, together with the within-US variation, to analyze the socioeconomic profile of the postneonatal mortality gaps. It is well known that infant mortality in the US varies strongly across socioeconomic groups (as documented by, for example, Case et al. (2002)). Given this, a natural question is whether the US IMR disadvantage relative to Europe is accounted for by higher cross-group IMR inequality in the US relative to Europe, or whether even highly advantaged Americans are in worse health than their counterparts in peer countries (as National Research Council 2013 argues). We can ask a similar question about the cross-regional differences in the US. Our demographic data in Europe are limited to Austria and Finland so we focus on those two countries as our comparison.

We first approach this question non-parametrically by estimating birthweight-adjusted postneonatal death rates by country (or Census division) and demographic group. We find that infant mortality differences, both across countries and across regions within the US, are driven by lower socioeconomic status groups. To give a concrete example: among the most educated group (college educated in the US or Austria, upper white collar worker in Finland) we find that the US has excess postneonatal mortality of 0.04 deaths per 1000 compared to Finland, and 0.27 deaths per 1000 compared to Austria. However, among the lowest education group, the US has excess postneonatal mortality of 1.3 deaths relative to Finland, and 1.8 relative to Austria. A similar pattern appears across Census regions within the US.

We then take a slightly more parametric approach and define a high socioeconomic status group in each country based on education and other demographic characteristics. Infant mortality rates for mothers in our advantaged group are statistically indistinguishable in the US and elsewhere. However, there are very large differences across countries in infant mortality rates for mothers outside of this group. We see similar patterns across Census regions within the US. Effectively, either across countries or across regions within the US, we see that the observed geographic variation in postneontal mortality is heavily driven by variation in health gradients across socioeconomic groups.[3] Notably, when we look at neonatal mortality we do not draw the same conclusions, suggesting that the inequalities we observe emerge especially strongly during the postneonatal period.

[3]Given that one of the most striking facts about infant mortality in the US is the disparity in mortality between black and white infants, it is important to note that the facts we document in this paper are essentially unchanged if we exclude US blacks from the sample. The literature investigating the black-white IMR gap has generally concluded that differential health at birth can account for the vast majority of the black-white gap, and that differences in postneonatal mortality are both less important and can be accounted for by differences in background characteristics (Miller 2003; Elder, Goddeeris and Haider 2011). In contrast, our findings suggest that differences in postneonatal mortality account for as much or more of the US IMR disadvantage relative to Europe than do differences in health at birth, and that these differences in postneonatal mortality are not eliminated by conditioning on a set of (albeit, limited) background characteristics. Taken together, the prior literature and our analysis thus suggest that the mechanisms explaining the black-white IMR gap within the US may be different from the mechanisms explaining the US IMR disadvantage relative to Europe.

The final question we investigate is to what extent the differences in postneonatal mortality gradients by location reflect differences in resource gradients. That is, are the poor are more resource-poor in some regions than others, or is it that the relationship between resources and mortality differs across locations? We address this question as follows. Although data availability constraints prevent us from linking individuals in our birth data to their household income, we link individuals to a measure of the average income in their geographic area for individuals with their demographic profile (age, education, race, marital status). We are able to do this for the US and Finland, in both cases using Census data.[4] Using these linked data to divide births into income decile groups, and comparing across countries or across regions within a group, our analysis suggests that income per se explains very little of the difference either between the US and Finland, or across regions within the US. It is true, for example, that high postneonatal mortality regions in the US are also those with lower income on average. However, infants in these regions are more likely to die during the postneonatal period even compared to households with similar income levels in regions with lower mortality. Our decomposition suggests that income differences actually exacerbate the IMR gap between the US and Finland (since the US is on average richer), and explain only about 30% of the differences across areas in the US.

This paper relates to two earlier literatures, one in medicine and one in economics. In the medical literature, most analyses have focused on differences in health at birth as the key explanation for the US IMR disadvantage (MacDorman and Mathews 2009; National Research Council 2013; Wilcox et al. 1995). As we note above, our data suggest this explanation is incomplete and that excess postneonatal mortality may be equally important. Consistent with that finding, Kleinman and Kiely (1990) document that the US had a disadvantage in aggregate postneonatal mortality during the 1980s. This suggests that the disparities in postneonatal mortality we document are long-standing, although those authors did not have access to international micro-data, which limits their ability to analyze comparably reported samples.

In the economics literature, this paper relates closely to the work of Case et al. (2002) who use various US survey datasets to investigate the changing relationship between health status and family income as children age (examining age ranges starting at 0-3 and ending at 13-17). They document that health erodes more quickly with age for children from lower socioeconomic status families; as in our study, this fact is not altered by conditioning on measures of health at birth. Currie and Stabile (2003) document a similar finding in Canadian survey data, as do Case et al. (2008) (revisiting an earlier analysis by Currie et al. (2007)) in UK data.[5] Our analysis suggests that the health gradient in the US largely emerges after the first month of life, which accords with Case and coauthors' conclusion that the gradient increases with age in the US. However, our data from Europe provide stark evidence that no similar gradient emerges during the first year of life in those countries.

In terms of policy implications, these new facts together suggest that a sole focus on improving health at birth (for example, through expanding access to prenatal care) will be incomplete, and that policies which target

[4] Unfortunately, similar data for Austria are not easily available.

[5] A broader literature has examined the relationship between health and socioeconomic status at older ages, such as Ford et al. (1994) and Power and Matthews (1997).

disadvantaged groups during the postneonatal period may be a productive avenue for reducing infant mortality in the US. Further, our income evidence suggests that simply increasing resources may not be sufficient to achieve this goal. As we discuss more in the conclusion, one policy lever deserving of future research attention is home nurse visiting programs, which have been shown to reduce postneonatal mortality rates in randomized trials (Olds et al. 2007).

2 Data

2.1 Data description

Birth, death and demographic data

Our cross-country analysis relies on two types of data. For the US, Austria and Finland, we have access to micro-data. The US data come from the National Center for Health Statistics (NCHS) birth cohort linked birth and infant death files. Austrian data are provided by Statistics Austria, and Finnish data are extracted from the Finland Birth Registry and Statistics Finland. As in prior research that has focused on comparing the mortality outcomes of US infants with infants from Scandinavian countries such as Norway (Wilcox et al. 1995), Finland provides a sense of "frontier" infant mortality rates. We chose Austria as a second point of comparison because of the availability of micro-data. Notably, over the time period of our study, Austria's IMR is similar to much of continental Europe.

The data for each of these three countries consists of a complete Census of births from years 2000-2005, linked to infant deaths occurring within one year of birth.[6] While birth and death certificates in the US and Finnish data are centrally linked, we link the Austrian records using a unique identifier constructed from the thirty-six variables common to both the birth and death records.[7] Each country's birth records provide information on a rich set of covariates, including the infant's conditions at birth (such as birth weight and gestational age), and some information on demographics of the mother. For infants who die within one year of birth, we observe age and cause of death.[8] We exclude from our analyses observations which are missing data on birth weight or gestational age (1.0% in the US, none in Austria, 0.4% in Finland). For the analysis of variation by socioeconomic status we exclude observations which are missing any of our socioeconomic status covariates (2.2% in US, none in Austria, 10.9% in Finland). The higher share in Finland is primarily due to

[6] The years 2000 – 2005 are the most recent available years with full data from all three countries from which we were able to obtain micro-data.

[7] All deaths are matched to a unique birth in the data.

[8] To code cause of death as consistently as possible across years, we use the NCHS General Equivalence Mappings (GEMs) to cross-walk across ICD9 and ICD10 codes. After converting all ICD9 codes to ICD10 codes, we use the NCHS recode of the ICD10 – specified in the NCHS birth cohort linked birth and infant death documentation – to consistently code causes of death across all countries and all years. The GEM files are available here: `ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Publications/ICD10CM/2010/2010_DiagnosisGEMs.zip`. For Austria, causes of death prior to 2002 are ICD9 codes, and from 2002-2005 are ICD10 codes. For Finland, causes of death are ICD10 codes. For the US, the original cause of death variable is the NCHS ICD10 recode. A handful of observations have multiple matches from the ICD9 coding to the NCHS ICD10 recode; for these observations, we randomly select one NCHS recode value from the set of possible matches.

missing occupation data.

To complement this three-country comparison, we use the best available - albeit more aggregated - data from two additional countries: the UK and Belgium. It is possible to do the core of our analysis with somewhat aggregated data: we require that the data be limited to our comparable sample (as discussed in Section 3.1, this is singleton births at or after 22 weeks of gestation and at least 500 grams in birth weight), and that birth and death counts be reported by 500 gram birth weight bins and detailed ages at death.

Data from the UK were generated through a special request to the UK Office of National Statistics. They limited the data to singleton births, at or after 22 weeks of gestation and at least 500 grams in birth weight and provided us with data on births by 500 gram bins matched to deaths at less than one day, 1 day to 1 week, 1 week to 1 month, 1 to 3 months, 3 to 6 months and 6 to 12 months. The birth weight cells are capped at 4000 grams.

Data for Belgium were downloaded from online records through the Centre for Operational Research in Public Health. Data are provided in 100 gram bins with counts of births and deaths and the ability to limit to singleton births. Belgian reporting standards limit the data to gestational ages of at or after 22 weeks, and the birth weight cells allow us to restrict attention to births at least 500 grams in birth weight. Information is provided on deaths in the first week, 1 week to 1 month, 1 to 6 months and 6 to 12 months.

For the within-US analysis we use the same NCHS linked files described above. These analyses use data from 2000 through 2003; the 2004 and 2005 NCHS data do not report sufficient geographic detail to be useful for this analysis.[9]

Income data

In Section 5 we present analyses that rely on having some measure of household income matched to the birth data. Unfortunately it is not possible to directly match household income to the natality files in the US, or in any of the European countries. As an alternative, we match to income measures based on sub-national geographic groups crossed with demographics. We are able to do this for Finland and for the US; the data for the US can be used to extend the income analysis to within-US cross-region comparisons.

For the US, we use income data from the IPUMS combined for 2000 and 2005. We generate measures of median income for bins defined by the following characteristics of the mother: public use microdata area (PUMA), ten year age groups (<30, 31-40, 41-50, over 50), education (less than high school, high school degree, some college, college degree or more), marital status (married or not) and race. We link PUMAs to counties using a cross-walk, since county is reported in the NCHS files. In some cases, the NCHS files do not report county (small counties within a state are jointly reported). In these cases we create a "residual" geography for each state which aggregates the median income for PUMAs associated with counties which are not reported

[9]Specifically, the 2004 and 2005 data do not report state or county so we cannot use them for the income analysis. Rather than changing samples, we simply exclude these years from the main analysis as well.

individually in the NCHS files. We collapse the IPUMS data to these geographic-demographic cells and merge with the NCHS data at the cell level. For the within-US comparisons we collapse to median income. When we compare the US to Finland we collapse to median income, adjusted to after-tax income for the US using the NBER TaxSim algorithm for comparability with our Finnish data (which reports after-tax income).

For Finland, we use data for 2000 through 2005 provided by Statistics Finland based on their household budget survey. The data are provided in summary cells of mothers' characteristics: region, education (basic, upper secondary and lower tertiary, undergraduate or more), ten year age groups and marital status. The income measure provided is median after-tax income. We merge these data with the Finnish birth data, matching the three education bins to the three occupation bins available in the Finnish birth data.

2.2 Summary statistics

Summary statistics are shown in Table 1 for our cross-country data and Table 2 for our cross-Census division data. As expected, Table 1 documents that the US has the highest mortality among the countries considered. Panel A reports mortality, gestation (for Finland, Austria and the US), and birth weight in our restricted sample of singleton births at least 22 weeks of gestation and weighing at least 500 grams (this sample restriction is discussed in more detail in Section 3.1). This sample restriction lowers the death rates in all five countries. In terms of birth weight, arguably the most reliable estimate of conditions at birth (Dietz et al. 2007), the US looks similar to Austria, the UK and Belgium. Finland has much higher average birth weight than any of the other countries, with infants an average of 200 grams heavier than elsewhere.

In Panel B we focus on the sub-sample for which we observe demographics and provide summary statistics on demographic covariates (available only for the US, Austria and Finland). This further sample restriction does not substantially change death rates, birth weight or gestational age. Mother's age is lowest in the US at 27 years, and closer to 29 years in Austria and Finland. Fifteen percent of births in the US are to black mothers; race is reported only in the US. The share of births to married women is approximately 60 to 65 percent in all three countries. Twenty-six percent of women in the US have a college degree or more, versus 12% in Austria. For Finland, we observe only occupation rank: we consider "upper white collar" workers as the highest socioeconomic status group; they make up 22% of the sample.

Table 2 shows the same summary statistics across Census divisions within the US. There is wide variation in death rates, birth weight and demographics across divisions. The North East has the lowest mortality rates and the highest birth weights.

3 Results: United States versus Europe

Our accounting exercise investigates four potential sources of the US IMR disadvantage: reporting, birth weight, neonatal mortality and postneonatal mortality.

3.1 Reporting differences

A well-known issue with cross-country comparisons of infant mortality is possible reporting differences for infants born near the threshold of viability. Extremely preterm births recorded as a live birth in some places may be considered miscarriages or stillbirths in other countries (Golding 2001; Graafmans et al. 2001; Sachs et al. 1995; Wegman 1996). Since survival before 22 weeks or under 500 grams is very rare, categorizing these births as live births would inflate reported infant mortality rates (which are reported as a share of live births).

Past literature (notably MacDorman and Mathews (2009)) has addressed this concern by limiting the sample to infants born after 22 weeks of gestation. Although previous literature has largely focused on the fact that this restriction does not substantially change the rank of the US IMR relative to other countries, it is nonetheless quite quantitatively important. This can be seen by comparing the first and second bars for Austria and Finland in Figure 1. The first bar shows the excess deaths in the US relative to other countries in the full sample. The second bar limits to infants born at or after 22 weeks of gestation. The US disadvantage declines once we impose this additional restriction.

Our data allow us to address two related issues which prior literature has not explored. First, many countries also have reporting requirements related to birth weight and may not report infants under 500 grams as live births (MacDorman and Mathews 2009). Second, the presence of assisted reproductive technologies has increased the frequency of multiple births, which have higher mortality rates. Because the use of assisted reproductive technologies is a choice that we need not aim to fix via changes in policy or behavior, it seems appropriate to limit the sample to singleton births. The third column within each country in Figure 1 adds both of these sample restrictions. Adding these restrictions we are also able to look at the comparison with the UK and Belgium.

The US disadvantage shrinks further with these additional restrictions. Overall, limiting to a sample of singleton births at birth weights and gestational ages where reporting is not a concern reduces the excess US infant mortality in both magnitude and share terms. In the unrestricted samples, the US excess mortality ranges from 1.4 to 3.6 deaths per 1000, or between a 27% and a 110% increase in death rates relative to the European baseline. In the restricted sample, the magnitude range is 1.1 to 2.1 excess deaths per 1000 births, or between a 27% to 76% increase. However, even in this restricted sample there is significant excess mortality in the US.

3.2 Conditions at birth

In contrast to the dismissal of reporting differences as a complete explanation, past literature has argued that high preterm birth rates in the US are the major contributor to higher infant mortality rates (MacDorman and Mathews, 2009; Wilcox et al., 1995). This literature has generally compared the US to Scandinavian countries, which have among the lowest infant mortality rates in Europe, and has generally focused on gestational age (which is more readily available in aggregate datasets) rather than birth weight. Our data are able to expand

this previous literature in two ways. First, incorporate comparisons with Austria, the UK and Belgium, which are more representative of the European distribution but still much better off than the US. Second, we add comparisons based on birth weight, which is typically more precisely measured than gestational age (Dietz et al. 2007).

As noted in the summary statistics, in our comparably-reported sample birth weight (and gestational age) in the US is worse than in Finland but close to the other countries considered. For the three countries with micro-data, Appendix Figures A.1a and A.1b show the full distribution of birth weight and gestational age. Similar to our observation based on the means, the most striking feature of these distributions is the difference between Finland and either the US or Austria.[10]

To be more concrete, we consider how the US disadvantage relative to the comparison countries changes once we adjust for birth weight; this is done by comparing Columns (1) and (2) of Table 3. Each panel of this table compares the US to each European country in our data separately. The first column estimates regressions which limit to the comparable sample but include no covariates, only an indicator variable for the US. The coefficients therefore represent the baseline difference in infant mortality between the US and the other countries considered. In Column (2) of each panel we add birth weight controls (specifically, indicator variables for 500 gram birth weight bins). The coefficient in this column therefore represents the US infant mortality disadvantage once we adjust flexibly for birth weight. Conceptually, this follows the previous literature by calculating the excess mortality in the US if the birth weight distribution were the same as in Europe (MacDorman and Mathews 2009). Relative to this existing literature, we adjust more precisely with birth weight bins rather than just indicators for normal or low birth weight (or indicators for preterm versus full term). The reduction in the coefficient moving from Column (1) to Column (2) in each panel tells us the share of the mortality difference across countries which is accounted for by birth weight.

The importance of birth weight varies across the comparison country. Birth weight accounts for about 75% of the gap between the US and Finland (Panel A) or between the US and Belgium (Panel D). However, it only accounts for about 30% of the gap between the US and Austria or the UK. This evidence confirms existing arguments that birth weight matters for the US infant mortality disadvantage, although it suggests that the prior literature's focus on Scandinavian countries may have overstated the importance of this explanation.

Even without this calibration, simple summary statistics make it clear that the conditions-at-birth explanation is incomplete. Among normal birth weight infants in the US, the infant mortality rate is 2.3 deaths per 1000 births, versus just 1.3 for Austria, 1.5 for Finland, 1.6 for the UK and 2.0 for Belgium.

[10] Although the US and Austria look almost identical in this figure, in fact Austria has a slightly more favorable birth weight distribution. This is driven by differences in the two countries in the lowest birth weight categories - under 1000 grams - which are too small to see in the distribution but matter for survival.

3.3 Timing of the US IMR disadvantage: Neonatal and postneonatal mortality

We turn now to examine the timing of the US IMR disadvantage. It is here that the value of having disaggregated data – ideally, micro-data – becomes even clearer. The previous literature has been unable to compare mortality timing within the first year across countries in non-aggregate data which is crucial in light of the reporting differences highlighted above. In unrestricted 2005 data from the World Development Indicators, neonatal mortality in the European countries considered varied from 2.1 per 1000 live births (Finland) to 3.5 (the UK), whereas the US reports a neonatal mortality rate of 4.5 (World Bank, 2013). Postneonatal mortality differs less in this sample: 2.3 per 1000 live births in the US, versus a range of 1.3 to 2.0 in the European countries. However, differences in reporting could be an important driver of these trends - particularly for neonatal mortality - and from a policy perspective it is also important to understand whether these differences persist when comparing across infants with the same measured health at birth.

For the three countries with detailed micro-data, it is possible to show evidence on the timing of the US IMR disadvantage graphically. Figures 2 and 3 document the cumulative probability of death by age by country.[11] In the full comparably-reported sample (Figure 2) the US 1-day IMR (in deaths per 1000 live births) is 0.23 higher than Austria and 0.40 higher than Finland. Within the first week these differences increase only slightly – to 0.31 and 0.48. However, between 1 month and 1 year these differences accelerate: the differences at 1 year are 1.70 and 2.00 for the comparisons with Austria and Finland, respectively.

This postneonatal mortality disadvantage is even more striking in Figure 3, which graphs the cumulative probability of death over the first year separately for normal (>=2500 grams) and low (<2500 grams) birth weight infants. As expected, within each group mortality rates at 1 year in the US are higher than in Austria and Finland. Figure 3a clearly suggests that the US IMR disadvantage arises in the postneonatal period: the US has virtually identical mortality rates to Austria and Finland up to 1 month, and then much higher mortality after 1 month. The pattern of mortality differences among low birth weight infants in Figure 3b looks very similar to Figure 3a, the only difference being that the US actually seems to have *lower* mortality than Finland during the first month of life.

Columns (3) through (5) of Table 3 quantify the patterns in these figures, and adds analyses of the UK and Belgium data. In these estimates we focus on cross-country differences in marginal (non-cumulative) death rates at various ages over the first year, and condition on detailed measures of birth weight (as in Column (2), we use 500 grams bins).[12]

We estimate impacts in three timing bins: <1 week, 1 week to 1 month, and 1-12 months. The US has, on average, a mortality advantage in the earliest period. Over the first week of life, the US has significantly lower mortality rates than Finland or Belgium, and is roughly even with Austria and the UK. The first-week

[11] It is not possible to add the UK or Belgium to these graphs since the data on timing are not as fine. We will be able to use data from these countries in the tables when we aggregate to the first week, one week to one month and one to 12 months.

[12] Replacing the 500 gram birth weight bins with 100 gram birth weight bins yields virtually identical results.

differences with respect to Finland and Belgium are reasonably large: a survival advantage of 0.3 deaths per 1000 births in the US. However, in the postneonatal period (from 1 month to 1 year) the US has a significant disadvantage relative to any of the comparison countries. The excess mortality in this period ranges from 0.45 deaths per 1000 (relative to Belgium) to 1.1 deaths per 1000 (relative to Austria). This postneonatal period explains between 30 and 65% of the overall US IMR disadvantage (i.e. as shown in Column (1)), comparable on average to the importance of birth weight.

There are of course a number of open questions about these timing of death results, some of which we can address with the microdata from Finland and Austria. Appendix Table A.1 documents a series of robustness checks. The pattern we observe is not driven by very small infants: in Appendix Table A.1 (row 2) we show similar patterns if we exclude births less than 1000 grams. These patterns are also not driven by differences in average demographics across the three countries: in Appendix Table A.1 (row 3) we replicate these regressions controlling for maternal age, child sex and maternal demographics, with identical conclusions.

One possible theory is that the observed elevation in postneonatal mortality is driven by a delay of deaths in the US. If hospitals in the US are better at keeping very low birth weight newborns alive for a slightly longer period of time, this could show up in the data as low neonatal mortality and excess postneonatal mortality. It is clear from the fact that we see elevated US infant mortality at one year that this is not a complete explanation. In addition, this type of substitution will be less important among groups which have low rates of neonatal mortality, such as normal birth weight infants or infants with a high APGAR score. Yet these groups also have much elevated postneonatal mortality, as can be seen in Figure 3 for normal birth weight infants, and row 4 of Appendix Table A.1 for infants with APGAR scores of 9 or 10. This suggests that this concern is unlikely to be quantitatively important.

The next section will focus on decomposing these results by demographic group, but it is important to note that our estimates are not driven by the mortality outcomes of black infants (who have long been observed to have relatively poor birth outcomes in the US): Appendix Table A.1 (row 5) excludes blacks from our US sample, and a similar postneonatal disadvantage is still evident.[13]

Relative to the average death rates, the US disadvantage in the postneonatal period is very large. Over the period from 1 to 12 months, the death rate in Austria was 0.81 per 1000. Based on the coefficients, the predicted death rate in the US given the same birth weight distribution would be 1.89 per 1000 births, more than twice as large. This is especially striking since Austria is very close to the US on birth weight distribution (see Appendix Figure A.1b) and also quite similar on neonatal mortality. Effectively, despite starting with very similar birth weight and very similar neonatal mortality outcomes, Austria vastly outpaces the US starting at 1 month of age.

[13]An additional possibility is that the results could be driven by first births, if first-time mothers are less informed about appropriate care for newborns. The data suggest this explanation does not account for the patterns in the data: Appendix Table A.1 (row 6) excludes first births, and the resulting estimates are quite similar. Finally, row 7 of Appendix Table A.1 adds multiple births back into the sample, with again very similar results.

Together, this evidence suggests that aggregate comparisons are misleading. Whereas in the aggregate data the US disadvantage appears to be more important during the neonatal period than during the postneonatal period, in fact the opposite appears to be true.

3.4 Causes of death

A natural question, following on the results above, is which causes of death account for the US disadvantage in the postneonatal period. In the Austrian, US and Finnish data we observe cause of death codes. A central issue – difficult to resolve – is differences in cause of death coding across countries. For example, Austria codes many postneonatal deaths as being due to low birth weight; virtually no deaths in either the US or Finland use this code during this time period. In all three countries a very large share of deaths – perhaps as much as a third – are in small categories which aggregate to "other" but are not very informative on their own. Further, because correct coding of SIDS deaths is difficult (Kim et al. 2012; Pearson et al. 2011) this cause may be difficult to interpret.

With these caveats, Table 4 shows postneonatal death rates in six cause of death categories. We calculate the postneonatal death rate (per 1000) for each cause group for each country and then calculate the US-Finland difference and the US-Austria difference. We also calculate the percent increase over the Finnish or Austrian death rate.

These cause of death results are similar for Austria and Finland. In raw difference terms SIDS and other sudden deaths are the most important, although this is largely because these causes account for the largest number of deaths. Accidents seem to play an important role in both raw and share terms. As a share, deaths from assault and respiratory infections (largely pneumonia) are much higher in the US, although these represent a small number of deaths. Taken together, there is no clear smoking gun from this table.

4 Results: Within-US evidence

Our analysis thus far suggests that postneonatal mortality plays an important role in driving differences between the US and a number of countries in Europe. In this section we ask whether this result is paralleled when we consider geographic variation within the US.

We begin by noting, based on the summary statistics in Table 2, that there is tremendous variation in infant mortality rates across the US. This is true even though the geographic units we consider are Census divisions, which are quite broad; it would be even more true if we considered state- or county-level variation. Considering the comparable sample reported in Panel A of Table 2, one-year infant mortality in the North East is 3.16 deaths per 1000 live births, whereas in the East South Central region (Oklahoma, Arkansas, Louisiana and Texas) this figure is 6.30 per 1000. Both the North East and the Pacific divisions have overall infant mortality rates within the distribution of the European countries considered. If the North East were a country, it would be similar to

Austria.

As a first look at the role of timing, we replicate Figures 2 and 3 for the Census divisions in Figures 4 and 5. As with the cross-country data, it is evident that the gaps across divisions grow in the postneonatal period. In the overall sample, if we compare the lowest mortality (North East) to the highest mortality (East South Central) divisions, we find that between one day and one week of life, the difference in mortality rates only grows by 0.40 deaths per 1000 births. Between 1 and 12 months, this difference increases by 2.41 deaths per 1000 births.

Table 5 replicates Table 3 but with indicator variables for Census division rather than country. The omitted division is the North East. Column (1) estimates the baseline differences across divisions and Column (2) adds controls for birth weight. Columns (3) through (5) retain the birth weight controls and estimate effects by timing of death within the first year. Similar to the cross-country analysis, we would like to use these estimates to make summary statements about the importance of birth weight, and the relative importance of the various periods within the first year. To do this, we use the coefficient estimates in Table 5 to calculate the share of the cross-division differences which are explained by various factors. We calculate these shares for each division pair, and then average to produce an overall conclusion about the importance of each.

We consider first birth weight, comparing Columns (1) and (2) of Table 5. The importance of birth weight varies across the division-pairs. For some division-pairs controlling for birth weight increases the baseline gap. In others, the gap is in the opposite direction once we control for birth weight. As a summary measure, we calculate the share of the cross-division variation accounted for by birth weight differences for the median division-pair. This figure is 45%.

Turning to the timing of deaths in Columns (3) through (5), a simple analysis of the coefficient magnitudes suggests that the postneonatal period accounts for a larger share of differences than the earlier periods; the coefficient magnitudes are much larger. By comparing Column (2) to Columns (3) through (5) we can assess what share of the birth-weight adjusted gaps are accounted for by the first week of life, one week to one month of life and the postneonatal period. These figures are shown in the last row of Table 5. The first week of life accounts on average for about 17% of the gap, the period from a week to a month accounts for 16% and the postneonatal period accounts for 67%. The second-to-last row reports the share of deaths which occur in this period in the North East Census division, as a point of reference. A comparison of the two final rows makes clear that the postneonatal period accounts for an outsize share of the cross-division gap relative to its importance in the first year.

The relative performance of US Census divisions is similar across the first year of life. That is, unlike the European comparisons, we do not see evidence that the worst off areas do *better* early on. However, similar to the European comparison, we find the postneonatal period accounts for an outsize share of the geographic differences. As one summary statistic, lowering the postneonatal mortality rate of all Census divisions to the level experienced by the best-off division would reduce infant mortality in the US by 0.75 deaths per 1000 births.

5 Demographics of postneonatal disadvantage

It is well known that – relative to Europe – the US has higher inequality on many metrics (Bertola and Ichino, 1995). Similarly, there is significant variation across the US in the extent of income inequality by region (Frank, 2009). Given these patterns, a natural question is whether the variation across countries and across regions is explained by worse outcomes among relatively disadvantaged households in the US relative to Europe (or in some Census divisions relative to others).[14] For example, a key focus of a recent National Research Council report was the question of whether even highly advantaged Americans are in worse health than their counterparts in peer countries, or whether worse average health outcomes in the US only reflect higher levels of health inequality (National Research Council, 2013).

In this section we focus on the postneonatal period and explore the demographics of the variation in this outcome. We first simply document the variation in postneonatal mortality across demographic groups, which provides a broad sense of which demographic groups are most important in accounting for mortality variation across space. We then put somewhat more structure on the question by defining an "advantaged" group in each country/region and asking - akin to the question in the National Research Council report - whether there is variation across regions even among a relatively more advantaged group. As we will see, these estimates suggest that disadvantaged groups account for an outsized share of the cross-regional differences in postneonatal mortality rates. We then explore the extent to which these mortality gaps are a result of differences in resources (i.e. income) across region, as opposed to differences which arise after holding income constant.

The cross-country analysis in this section focuses on the US, Finland and Austria; our data from the UK and Belgium unfortunately do not provide tabulations by socioeconomic status so we are not able to use these data in these analyses. In addition, as noted in the data section, our income data are available only for the US and Finland. We will therefore document the income analysis only comparing the US and Finland, and within the US.

5.1 Postneonatal mortality by demographic group

We begin by investigating how postneonatal mortality rates vary by demographic group. Figure 6a documents postneonatal death rates by education/socioeconomic status group, for which we observe four groups in the US and Austria and three groups in Finland. In the US, this is based on education: (1) less than a high school degree, (2) a high school degree, (3) some college and (4) college degree or more. In Austria, we also use educational data: (1) compulsory school, (2) vocational school, (3) high school with A-levels and (4) university or teaching college. In Finland, the groups are defined based on occupation: (1) blue collar, (2) lower white collar and (3) upper white collar or entrepreneur. The steeper socioeconomic gradient observed in postneonatal

[14] A large literature – see, for example Avendano (2012) – has estimated the cross-country relationship between income inequality and infant mortality, tending to find a strong positive cross-sectional correlation that is not always robust to alternative specifications (such as country fixed effect models).

mortality within the US is striking relative to the socioeconomic gradients observed in Austria or Finland. Notably, the within-US gradient is not simply due to high mortality rates in the least educated group; there is wide variation across the distribution; in contrast, to the extent that there is any inequality by socioeconomic status in Austria or Finland, it appears to be driven by the lowest education or occupation group. Similar findings emerge in Figure 6b across regions within the US.

What this analysis does not directly address is the question of whether there are groups in the US that do as well as comparable groups in Europe. That is: do the most advantaged groups in the three countries – or in the nine Census divisions – look similar? To investigate this question, we focus attention on an "advantaged" demographic: mothers who are high education/occupation, married and white (US) or non-immigrant (Austria).[15] We then compare the mortality profile of this group, and the corresponding less advantaged group, across the three countries. It is worth noting in this analysis that the comparison with Austria is likely to be the most informative because in both the US and Austria we have data on education; in Finland, we use occupation as a proxy for educational level, which is likely to be correlated with education but is less comparable.

We show visual evidence on the cross-country/cross-group comparison in Figure 7, which shows cumulative deaths rates in the three countries for the two education/occupation groups. In Figure 7a, the advantaged individuals, there appears to be virtually no difference in death rates. In contrast, for the lower portion of the distribution (Figure 7b) the US death rate is much higher. In the postneonatal period the death rate for this group in the US is 2.4 per 1000, versus 0.83 in Austria and 0.97 in Finland.

We explore this in regression form by estimating regressions analogous to those in Column (5) of Table 3 but including an interaction between an indicator variable for the US and an indicator variable for our advantaged definition. We can then test whether individuals in the advantaged group have higher mortality in the US than elsewhere. This estimation is presented in Table 6. Panel A considers postneonatal mortality. Relative to both Austria (Column (1)) and Finland (Column (2)) the main effect of US is large and positive and the interaction is large and negative. The advantaged group in the US cannot be statistically distinguished from the advantaged group in either of the comparison countries.[16]

Although the primary focus in this section is on postneonatal mortality, in Panel B we demonstrate that the US *does not* show excess inequality in neonatal mortality. The main effect of the US in both columns is negative, indicating that disadvantaged groups in the US do *better* than their counterparts in Europe conditional on circumstances at birth (this is marginally significant for Finland). The interaction effect is small, statistically insignificant, and of differing sign across columns.

Table 7 documents an analogous set of estimates across Census divisions within the US. Column (1) focuses on postneonatal mortality. The first set of coefficients, which estimate the differences across the advantaged and

[15] This group accounts for 22% in the US, 7% in Austria and 16% in Finland.

[16] Appendix Tables A.2 and A.3 present analogous results after varying the definition of advantaged. Appendix Table A.2 uses only the education/occupation variable and A.3 uses education/occupation and married (but not race). The results are very similar. In particular, leaving race out of the definition makes virtually no difference, reinforcing our earlier argument that our estimates do not appear to be driven by black/white differences in the US.

non-advantaged group, suggests large differences across Census divisions.[17] The negative interaction coefficients suggest that these differences shrink considerably (at least relative to the North East) when we look at the advantaged group. At the bottom of the table we provide a summary measure of the average difference across all division-pairs in the advantaged and non-advantaged groups. The average difference for the advantaged group is 0.16 deaths per 1000; for the non-advantaged, it is 0.55 per 1000. Another way to summarize these estimates is to note that the maximum difference among the non-advantaged group is 1.6 excess deaths per 1000 births (East South Central versus North East), whereas the maximum difference for the advantaged group is 0.4 deaths per 1000.

As a comparison, Column 2 of this table estimates the same regressions for neonatal mortality. As in our comparison with Europe, across US regions we observe much less variation in neonatal mortality relative to postneonatal mortality. Perhaps more notable, however, is that the neonatal mortality gaps across advantaged and non-advantaged groups are virtually identical across Census divisions.

Overall, this evidence suggests that the observed higher US postneonatal mortality relative to Europe is due entirely, or almost entirely, to higher mortality among disadvantaged groups. Focusing on the cross-country results, well-off individuals in all three countries have similar infant mortality rates. Another way to state this is in the context of within country inequality. In both Finland and Austria, postneonatal mortality rates are extremely similar across groups with varying levels of advantage, either unconditionally or (more starkly) conditional on detailed birth weight. In contrast, there is tremendous inequality within the US, with lower socioeconomic status groups experiencing much higher postneonatal mortality rates.

5.2 The role of income differences

One explanation for the excess variation across groups in the US (or within the poorer Census divisions) is excess variation in income. Income *per se* has been shown to impact birth weight, although impacts on infant mortality are less clear (see, e.g., Currie and Cole 1993; Baker 2008; Almond, Hoynes and Schanzenbach 2011; Hoynes, Miller and Simon 2012). More generally, Cutler and Lleras-Muney (2010) document evidence that income plays a role in accounting for some of the education-health gradient in both the US and the UK. If the poor in the US are worse off than the poor elsewhere, then it is possible this drives some of the effects we observe.[18] On the other hand, it is possible that these differences arise even within groups with similar incomes. If this is the case, it would suggest that excess postneonatal mortality in the US is not a direct issue of income.

Ideally, we would address this question with individual-level data on income linked to birth outcomes. Unfortunately, such data are not accessible. As an alternative, we investigate this question using more aggregated data from the US and Finland. Note that we are more confident in using these data for within-US comparisons, given that our income data are more comparable within the US.

[17] This analysis uses a linear probability model; results are similar with a probit approach.

[18] A related issue is that some authors have argued income inequality per se drives poor US birth outcomes (Reagan et al. 2007), although the most recent evidence on this suggests it is probably not a robust relationship (Aizer, Higa and Winkler 2013).

We approach this analysis, in both the cross-country and within-US case, by dividing individuals into deciles based on the mean income by their demographic cell. We then estimate the postneonatal mortality differences across countries and - separately - the average difference across division-pairs in postneonatal mortality for each income decile. To the extent that differences in income drive the postneonatal mortality differences across areas, we should see limited differences in postneonatal mortality within income groups.

The results are shown in Table 8. They do not suggest similar mortality rates within income groups, at least not for low income individuals. When we compare the US to Finland we find continued evidence of significantly elevated mortality rates in the US even among groups with comparable income. For example, in the second income decile, the US has a postneonatal mortality rate of 1.2 deaths per 1000 more than Finland, despite virtually identical median incomes in this group across countries. Consistent with our earlier evidence, at the higher income levels there is no statistically significant postneonatal mortality gap across countries.

The GDP per capita in Finland is, on average, lower than the US. As a result, if the US adopted the Finnish income distribution, along with the US schedule of postneonatal mortality by income, infant mortality would actually be expected to increase. These cross-country results are, however, somewhat difficult to interpret given the vast differences in non-cash welfare provision by each country, which are not included in our income measures.

Comfortingly, the estimates from our within-US analysis, shown in the right panel Table 8, confirm the broad conclusions from our cross-country analysis. Even within fairly narrow income bins, there is large variation across Census divisions. In the poorest income decile, the average difference across division-pairs is 1 death per 1000. Among the higher income groups there is less variation, consistent with the overall more limited variation in higher socioeconomic status groups demonstrated in Table 7.

We can summarize the importance of income in two ways. First, we estimate our basic regressions (i.e. Column (5) of Table 5) but include detailed controls for income (we use $1000 income bins); only 20% of the average division-pair gap is closed by the addition of these controls. Second, we ask what reduction in postneonatal mortality would be achieved if all Census divisions were endowed with the income distribution of the richest Census region (the North East); we estimate that this would close 30% of the postneonatal mortality gap. Overall, this discussion suggests variation in postneonatal mortality rates across areas does not appear to be due to differences in income per se; notably, this is largely consistent with an existing literature that finds that increasing resources *per se* does not have detectable effects on infant mortality in the US (Baker 2008; Almond et al. 2011; Currie and Cole 1993; Hoynes et al. 2012).

6 Discussion and conclusion

Our ultimate goal in understanding the US infant mortality disadvantage relative to Europe is to better understand what policy levers might be effective in reducing infant mortality in the US. Our results on neonatal

mortality strongly suggest that differential access to technology-intensive medical care provided shortly after birth is unlikely to explain the US IMR disadvantage. This conclusion is, perhaps, surprising in light of evidence that much of the decline in infant mortality in the 1950 to 1990 period was due to improvement in NICU technology (Cutler and Meara, 2000). However, a variety of evidence suggests that access to technology-intensive post-birth medical care should affect mortality risks during the neonatal period, rather than during the post-neonatal period: median time spent in the NICU is 13 days (March of Dimes 2011), and this care is thought to primarily affect neonatal mortality (see, for example, Rudolph and Borker (1987), Budetti et al. (1981), and Shaffer (2001)). Consistent with this assertion, Almond et al. (2010) analyze the mortality consequences of incremental increases in medical expenditures for at-risk infants (including NICU admission as well as other expenditures), and find that the mortality benefits of additional medical care are concentrated in the first 28 days of life. Our results suggest that if anything the US has a mortality *advantage* during the neonatal period.

Instead, the facts documented here suggest that, in general, policy attention should focus on either preventing preterm births or on reducing postneonatal mortality. Although the former has received a tremendous amount of policy focus (MacDorman and Mathews 2009; Wilcox et al. 1995), the latter has to the best of our knowledge received very little attention. Our estimates suggest that decreasing postneonatal mortality in the US to the level in Austria would lower US death rates by around 1 death per 1000. Applying a standard value of a statistical life of US$7 million, this suggests it would be worth spending up to $7000 per infant to achieve this gain. If policies were able to focus on individuals of lower socioeconomic status – given our estimates that advantaged groups do as well in the US as elsewhere – even higher levels of spending per mother targeted would be justified.

Identifying particular policies that could be effective in achieving these gains is beyond the scope of this paper and is an area that deserves more research attention. That said, one policy worth mentioning is home nurse visits. Both Finland and Austria, along with much of the rest of Europe, have policies which bring nurses or other health professionals to visit parents and infants at home. These visits combine well-baby checkups with caregiver advice and support. Notably, in light of our income results, these policies do not focus on alleviating resource constraints per se but rather on providing information and support targeted to mothers and infants. While such small scale programs exist in the US, they are far from universal, although provisions of the Affordable Care Act have expanded them to some extent. Randomized evaluations of such programs in the US have shown evidence of mortality reductions, notably from causes of death we identify as important such as SIDS and accidents (Olds et al. 2007). To the extent that programs of this type are among the few available policy levers that focus on providing support to mothers and infants in the period after they are out of the hospital system, our evidence suggests they may be a clear place for future research.

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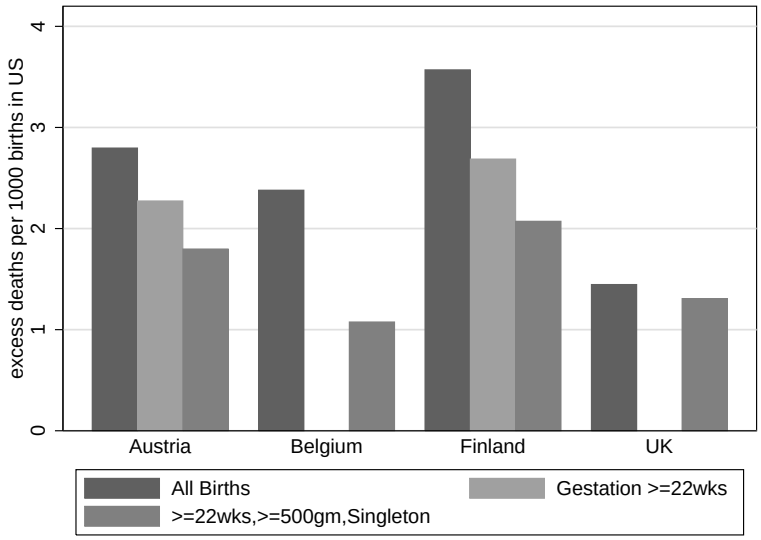
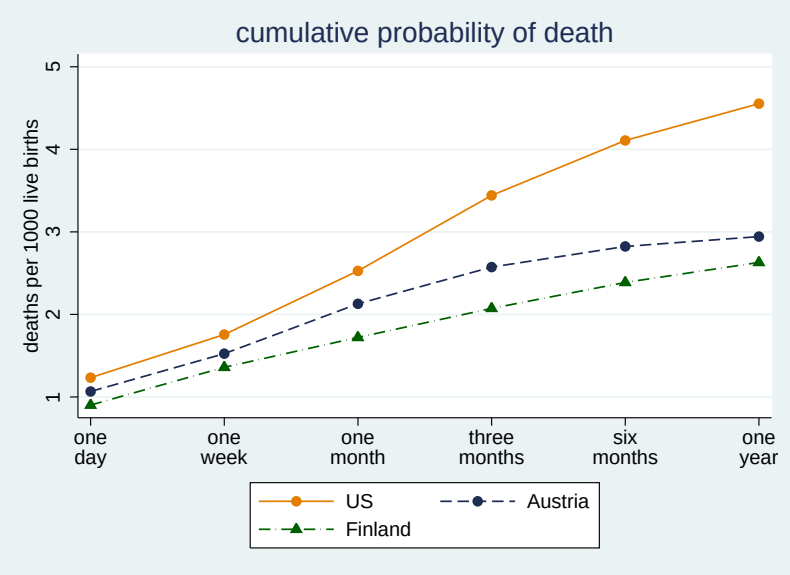
Figure 1: **US IMR disadvantage: Full sample and restricted samples**



Notes: This figure shows the number of excess US deaths per 1000 births compared to Austria and Finland overall (the first set of bars), in the sample restricted to births >=22 weeks of gestation (second set of bars), and in the sample restricted to singleton births >=22 weeks of gestation and >=500 grams (third set of bars). For the UK and Belgium the first set of bars come directly from the World Development Indicators database; the second set of bars cannot be calculated for these countries because gestational age data are not available in the tabulations we obtained for these countries.

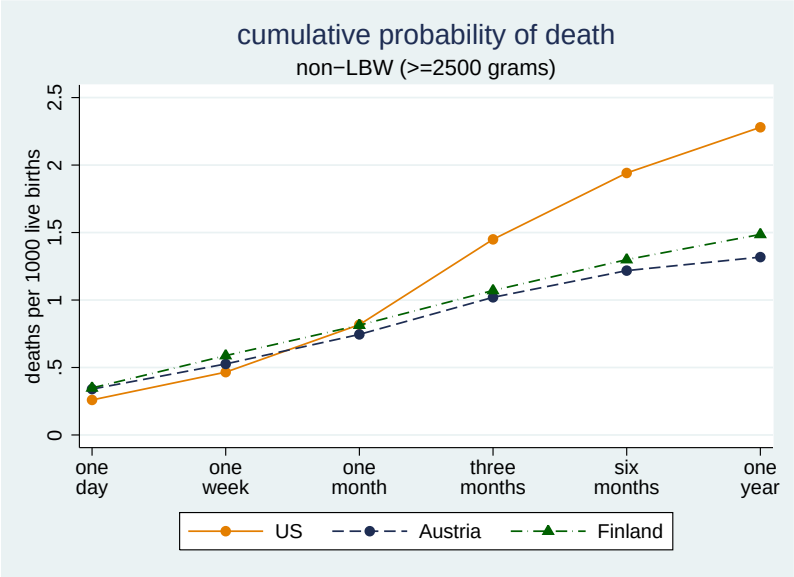
Figure 2: **Cumulative probability of death, by country**



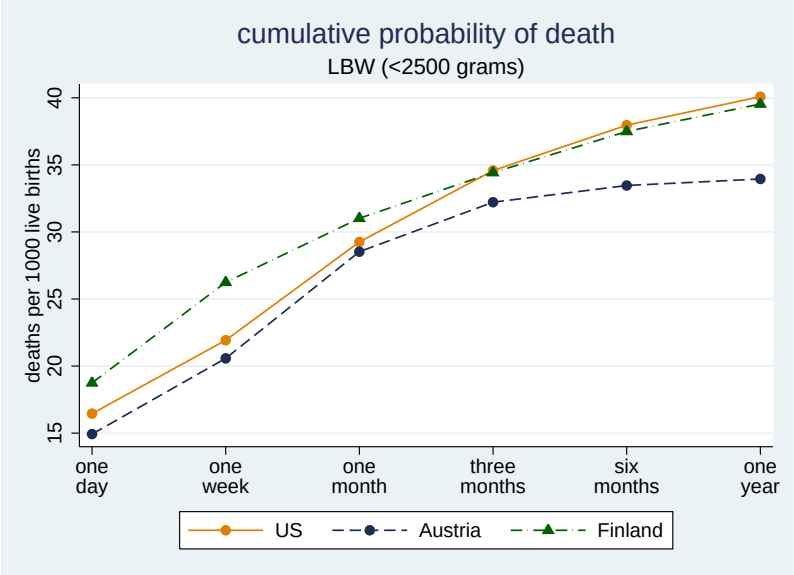
Notes: This figure shows the cumulative probability of death, by country and timing of death, unconditional on conditions at birth. Data for all countries cover 2000-2005; as described in the text, the sample is limited to singleton births at ≥22 weeks of gestation and ≥500 grams with both birth weight and gestational age observed.

Figure 3: **Cumulative probability of death, by country, by birth weight**

(a) Normal birth weight only (>=2500 grams)

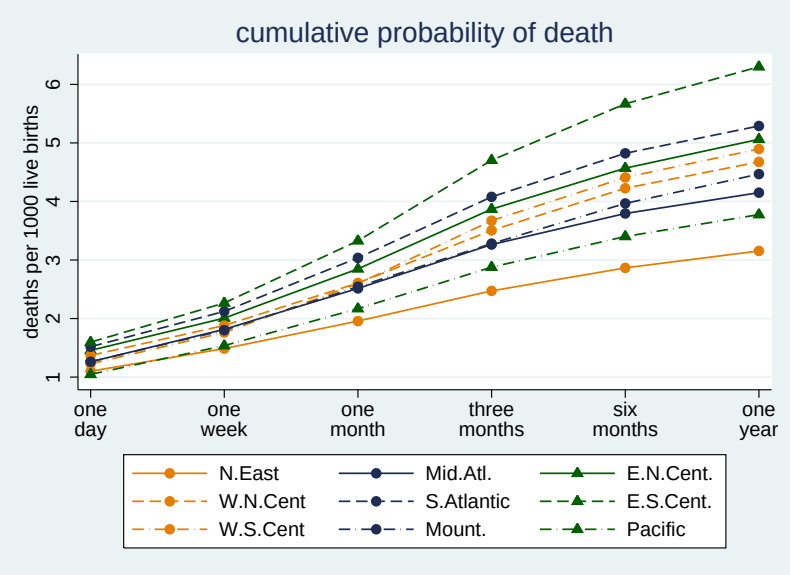


(b) Low birth weight only (<2500 grams)



Notes: These figures show the cumulative probability of death, by country, timing of death and birth weight. In Panel A, the sample includes normal birth weight babies (≥2500 grams). In Panel B, the sample includes low birth weight babies (<2500 grams). Data for all countries cover 2000-2005; as described in the text, the sample is limited to singleton births at ≥22 weeks of gestation and ≥500 grams with both birth weight and gestational age observed. In total, 94.1% of births are in the normal birth weight category shown in Panel A, and 5.9% are in the low birth weight category in Panel B.

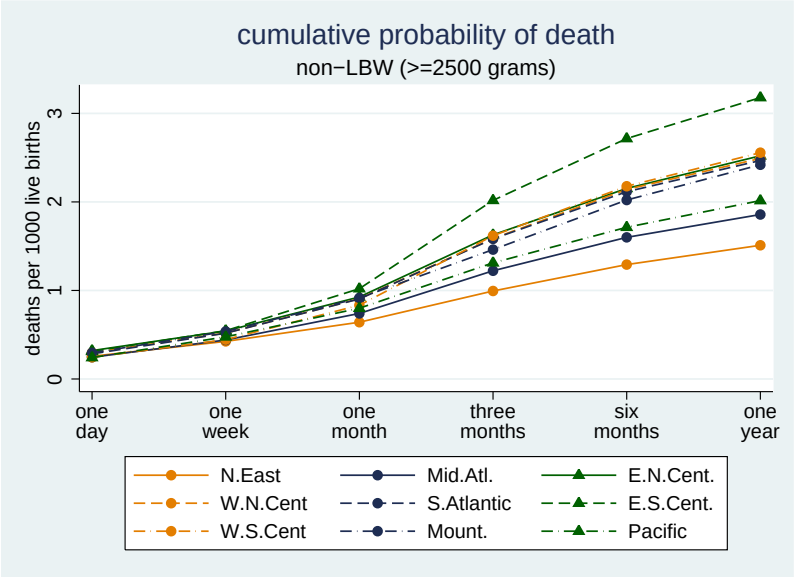
Figure 4: **Cumulative probability of death, within US**



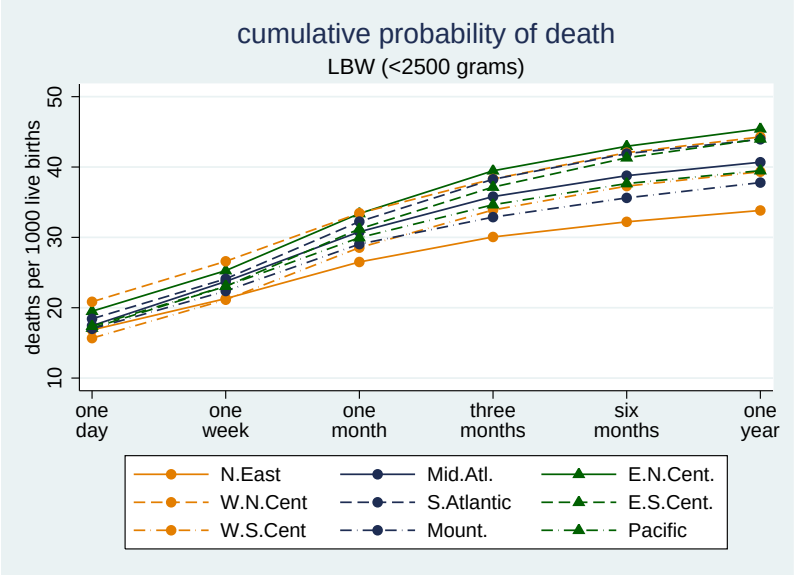
Notes: This figure shows the cumulative probability of death, by US Census division and timing of death, unconditional on conditions at birth. Data cover 2000 through 2003; as described in the text, the sample is limited to singleton births at $\geq$22 weeks of gestation and $\geq$500 grams with both birth weight and gestational age observed.

Figure 5: **Cumulative probability of death, within US, by birth weight**

(a) Normal birth weight only (>=2500 grams)



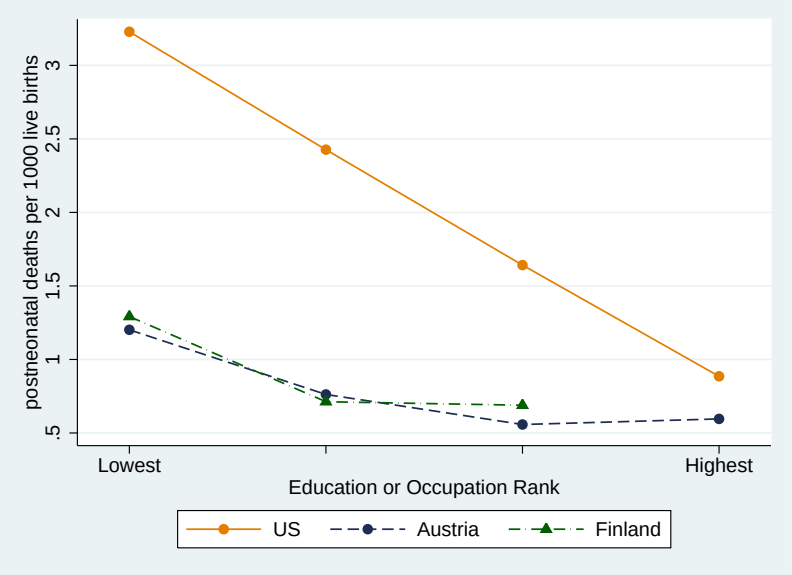
(b) Low birth weight only (<2500 grams)



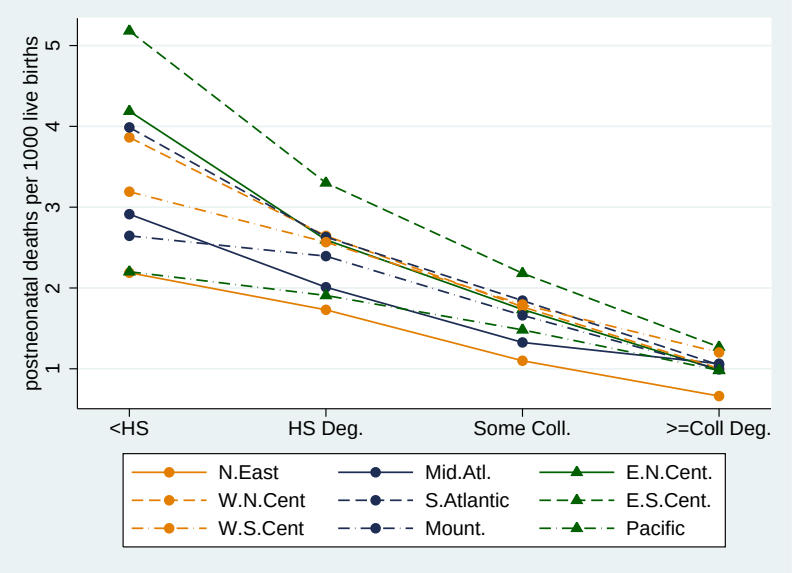
Notes: These figures show the cumulative probability of death, by US Census Division, timing of death, and birth weight. In Panel A, the sample includes normal birth weight babies (≥2500 grams). In Panel B, the sample includes low birth weight babies (<2500 grams). Data cover 2000 to 2003; as described in the text, the sample is limited to singleton births at ≥22 weeks of gestation and ≥500 grams with both birth weight and gestational age observed.

Figure 6: **Gradient in postneonatal death rates by socioeconomic status and location**

(a) Cross country



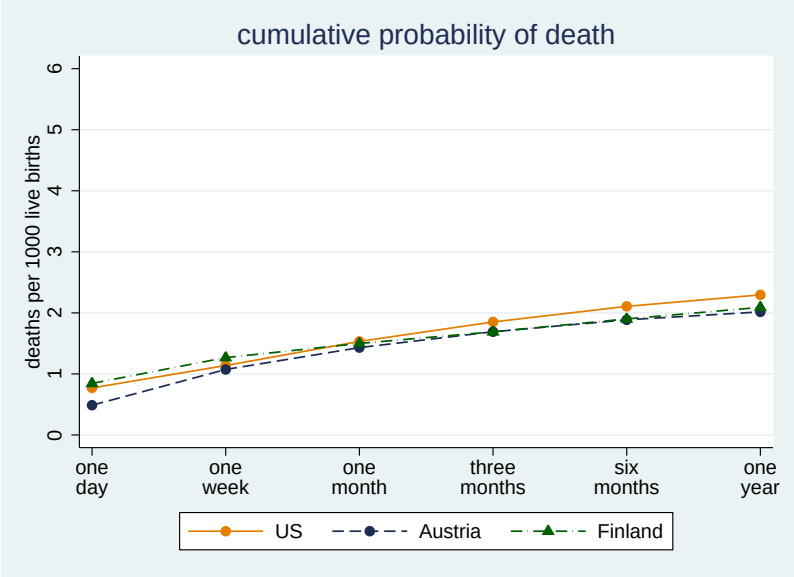
(b) Within US



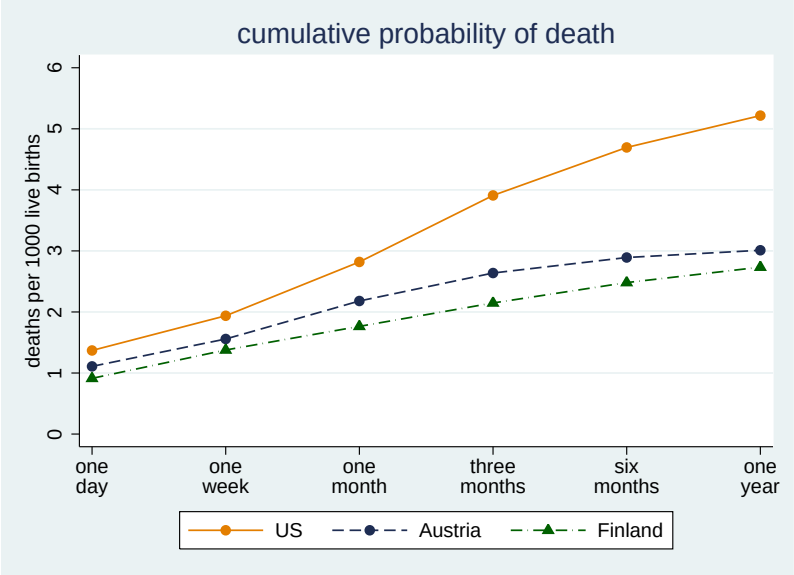
Notes: These figures show the gradient in postneonatal death rates by socioeconomic status and location. In Panel A, the sample for all countries cover 2000 through 2005. In Panel B, the sample within the US cover 2000 through 2003. The sample is limited to singleton births at $\geq$22 weeks of gestation and $\geq$500 grams with no missing covariates. Because the death rates are postneonatal the sample also excludes infants who died before 1 month of age.

Figure 7: **Cumulative probability of death, by country, by socioeconomic group**

(a) Advantaged group



(b) Disadvantaged group



Notes: These figures show the cumulative probability of death, by country, timing of death, and group. "Advantaged" is as defined in the text (mothers who are high education/occupation, married and and white (US) or non-immigrant (Austria)). Data for all countries cover 2000-2005; as described in the text, the sample is limited to singleton births at ≥22 weeks of gestation and ≥500 grams with no missing covariates.

Table 1: **Cross-country summary statistics**

	(1) United States	(2) Austria	(3) Finland	(4) UK*	(5) Belgium*
death within 1 year, per 1000 births, full sample	6.78	3.98	3.21	5.33	4.40
# of births	24,484,028	466,227	339,312		
			Panel A: Main sample		
death within 1 year, per 1000 births, restricted sample	4.65	2.94	2.64	3.43	3.67
gestational age (weeks)	38.8	38.6	39.4		
birth weight (grams)	3,332	3,345	3,550	3,368	3,310
# of births	23,411,153	451,920	327,732	3,942,209	667,697
			Panel B: Demographic sample		
death within 1 year, per 1000 births, restricted sample	4.55	2.94	2.63		
gestational age (weeks)	38.8	38.6	39.4		
birth weight (grams)	3,333	3,345	3,553		
male infant (%)	51.2%	51.2%	51.3%		
mother's age (years)	27.40	28.75	29.51		
mother is black [US] or immigrant [AU] (%)	14.9%	23.9%	–		
mother is married (%)	65.3%	65.3%	59.9%		
mother has at least college degree (%)	25.7%	11.9%			
mother is "upper white collar" worker (%)			22.0%		
# of births	23,113,240	451,920	292,786		

Notes: Race is reported only in the US data. Data cover 2000 through 2005. The first row contains the full (unadjusted) sample. Panel A is limited to singleton births at $\geq$22 weeks of gestation and $\geq$500 grams with birth weight and gestational age observed. Panel B limits to observations with no missing demographic covariates. *: For the UK and Belgium the unadjusted death rates come directly from the World Development Indicators database; gestational age and demographic data are not available in the tabulations we obtained for these countries.

Table 2: **Cross-Census division summary statistics**

	(1) North East	(2) Mid-Atlantic	(3) East North Central	(4) West North Central	(5) South Atlantic	(6) East South Central	(7) West South Central	(8) Mountain	(9) Pacific
death within 1 year, per 1000 births, full sample	5.27	6.36	7.60	6.66	7.96	8.85	6.60	6.09	5.37
# of births	689,261	2,052,697	2,472,299	1,074,249	2,917,487	953,341	2,107,572	1,204,992	2,747,287
death within 1 year, per 1000 births, restricted sample	3.16	4.15	5.06	4.68	5.29	6.30	4.90	4.47	3.78
gestational age (weeks)	39.0	38.9	38.9	38.9	38.8	38.6	38.7	38.8	39.0
birth weight (grams)	3,402	3,349	3,355	3,386	3,309	3,277	3,303	3,304	3,389
# of births	657,149	1,968,975	2,380,996	1,034,506	2,814,862	919,404	2,033,140	1,167,269	2,532,336
death within 1 year, per 1000 births, restricted sample	3.08	3.95	4.98	4.61	5.15	6.26	4.83	4.35	3.68
gestational age (weeks)	39.0	39.0	38.9	38.9	38.8	38.6	38.7	38.8	39.0
birth weight (grams)	3,403	3,351	3,356	3,387	3,310	3,277	3,304	3,305	3,389
male infant (%)	51.3%	51.2%	51.2%	51.2%	51.1%	51.2%	51.1%	51.2%	51.2%
mother's age (years)	33.78	32.29	32.27	32.39	32.27	31.18	31.49	32.06	32.32
mother is black [US] or immigrant [AU] (%)	8.8%	18.1%	15.1%	8.0%	26.3%	24.9%	15.1%	3.1%	5.5%
mother is married (%)	71.2%	66.1%	65.4%	69.5%	63.4%	63.2%	65.4%	68.2%	68.1%
mother has at least college degree (%)	38.8%	30.4%	26.5%	29.6%	25.9%	20.3%	18.9%	21.7%	23.3%
# of births	651,851	1,799,490	2,354,809	1,025,991	2,787,062	917,058	2,007,779	1,145,742	2,405,124

Notes: Race is reported only in the US data. Data cover 2000 through 2003. The first row contains the full (unadjusted) sample. Panel A is limited to singleton births at $\geq$22 weeks of gestation and $\geq$500 grams with birth weight and gestational age observed. Panel B limits to observations with no missing demographic covariates.

Table 3: **Cross country differences in mortality**

Panel A: US vs. Finland

	(1)		(2)		(3)		(4)		(5)	
sample, controls:	comparable sample, no controls		comparable sample, birthweight controls		comparable sample, birthweight controls		comparable sample, birthweight controls		comparable sample, birthweight controls	
mortality (in 1000s):	first year		first year		< 1 week		1 week to 1 month		1 to 12 months	
United States	2.008	***	0.533	***	-0.276	***	0.164	***	0.647	***
	(0.091)		(0.088)		(0.063)		(0.033)		(0.054)	
cumulative effect, US					-0.276		-0.112		0.535	
# of observations	23,738,885		23,738,885		23,738,885		23,695,461		23,677,125	
Finland mortality level					1.352		0.351		0.938	
cumulative mortality, Finland					1.352		1.703		2.641	

Panel B: US vs. Austria

	(1)		(2)		(3)		(4)		(5)	
sample, controls:	comparable sample, no controls		comparable sample, birthweight controls		comparable sample, birthweight controls		comparable sample, birthweight controls		comparable sample, birthweight controls	
mortality (in 1000s):	first year		first year		< 1 week		1 week to 1 month		1 to 12 months	
United States	1.704	***	1.140	***	-0.019		0.068	*	1.083	***
	(0.082)		(0.077)		(0.056)		(0.036)		(0.043)	
cumulative effect, US					-0.019		0.049		1.132	
# of observations	23,863,073		23,863,073		23,863,073		23,819,403		23,800,909	
Austria mortality level					1.525		0.605		0.816	
cumulative mortality, Austria					1.525		2.130		2.943	

Panel C: US vs. UK

	(1)		(2)		(3)		(4)		(5)	
sample, controls:	comparable sample, no controls		comparable sample, birthweight controls		comparable sample, birthweight controls		comparable sample, birthweight controls		comparable sample, birthweight controls	
mortality (in 1000s):	first year		first year		< 1 week		1 week to 1 month		1 to 12 months	
United States	1.214	***	0.781	***	0.043	**	0.091	***	0.648	***
	(0.033)		(0.031)		(0.021)		(0.014)		(0.020)	
cumulative effect, US					0.043		0.134		0.782	
# of observations	27,353,362		27,353,362		27,353,362		27,304,313		27,283,696	
UK mortality level					1.539		0.609		1.289	
cumulative mortality, UK					1.539		2.148		3.437	

Panel D: US vs. Belgium

	(1)		(2)		(3)		(4)		(5)	
sample, controls:	comparable sample, no controls		comparable sample, birthweight controls		comparable sample, birthweight controls		comparable sample, birthweight controls		comparable sample, birthweight controls	
mortality (in 1000s):	first year		first year		< 1 week		1 week to 1 month		1 to 12 months	
United States	0.983	***	0.252	***	-0.264	***	0.042		0.458	***
	(0.075)		(0.072)		(0.048)		(0.030)		(0.047)	
cumulative effect, US					-0.264		-0.222		0.236	
# of observations	24,078,850		24,078,850		24,078,850		24,034,786		24,016,169	
Belgian mortality level					1.622		0.594		1.453	
cumulative mortality, Belgium					1.622		2.216		3.669	

Notes: This table shows differences across countries in mortality, using Finland (Panel A), Austria (Panel B), the UK (Panel C) or Belgium (Panel D) as the omitted country. Columns (1) and (2) analyze overall one-year mortality. Column (1) limits to the comparable sample but includes no controls. Column (2) adjusts for 500-gram birth weight category cells. Columns (3) through (5) include birth weight controls and look at deaths in various periods of life. The regression results in these columns are conditional on reaching the minimum age: deaths up to 1 week; deaths from 1 week to 1 month, conditional on surviving to 1 week, etc. Coefficients are in units of 1000 deaths: a coefficient of 1 indicates an increase of 1 death in 1000 births. For Columns (3) through (5), each panel also shows the cumulative effect by country (the sum of the coefficients up to that point). Robust standard errors in parentheses. ***significant at 1% level, **significant at 5% level, * significant at 10% level. Data for all countries cover 2000-2005; as described in the text, the sample is limited to singleton births at $\geq$22 weeks of gestation and $\geq$500 grams with birth weight and gestational age observed.

Table 4: **Postneonatal cause of death, by country**

	cause of death:	(1) congenital abnormalities and low birthweight	(2) respiratory	(3) SIDS and other sudden deaths	(4) accident	(5) assault	(6) other
	US	0.380	0.068	0.699	0.208	0.064	0.613
	Finland	0.325	0.021	0.226	0.044	0.003	0.287
	Austria	0.377	0.007	0.185	0.030	0.013	0.175
US-Finland							
	raw difference	*0.055*	*0.047*	*0.473*	*0.164*	*0.061*	*0.326*
	as share of Finland	*17%*	*224%*	*209%*	*373%*	*2033%*	*114%*
US-Austria							
	raw difference	*0.003*	*0.061*	*0.514*	*0.178*	*0.051*	*0.438*
	as share of Austria	*1%*	*871%*	*278%*	*593%*	*392%*	*250%*

Notes: This table shows the difference in postneonatal mortality from each cause of death across countries. All means are computed on the sample of infants alive at 1 month. Means are in units of 1000 deaths. Data for all countries cover 2000-2005; as described in the text, the sample is limited to singleton births at $\geq$22 weeks of gestation and $\geq$500 grams with birth weight and gestational age observed.

Table 5: **Cross-Census division differences in mortality**

	(1)		(2)		(3)		(4)		(5)	
sample, controls:	comparable sample, no controls		comparable sample, birthweight controls		comparable sample, birthweight controls		comparable sample, birthweight controls		comparable sample, birthweight controls	
mortality (in 1000s):	first year		first year		< 1 week		1 week to 1 month		1 to 12 months	
Mid-Atlantic	0.996	***	0.547	***	0.072		0.163	***	0.320	***
	(0.097)		(0.093)		(0.058)		(0.040)		(0.065)	
East North Central	1.907	***	1.521	***	0.296	***	0.311	***	0.931	***
	(0.095)		(0.091)		(0.056)		(0.039)		(0.063)	
West North Central	1.521	***	1.496	***	0.374	***	0.256	***	0.874	***
	(0.108)		(0.103)		(0.064)		(0.044)		(0.072)	
South Atlantic	2.135	***	1.201	***	0.105	*	0.272	***	0.831	***
	(0.093)		(0.089)		(0.055)		(0.038)		(0.062)	
East South Central	3.146	***	1.926	***	0.092		0.360	***	1.475	***
	(0.110)		(0.105)		(0.065)		(0.045)		(0.073)	
West South Central	1.741	***	1.160	***	-.0237		0.256	***	0.920	***
	(0.097)		(0.093)		(0.057)		(0.040)		(0.064)	
Mountain	1.313	***	1.240	***	0.315	***	0.294	***	0.653	***
	(0.105)		(0.101)		(0.062)		(0.043)		(0.070)	
Pacific	0.621	***	0.870	***	0.198	***	0.215	***	0.467	***
	(0.094)		(0.090)		(0.056)		(0.039)		(0.063)	
# of observations	15,508,637		15,508,637		15,508,637		15,480,699		15,468,224	
share of total explained			*45.3%*							
				share of deaths, North East	*45.9%*		*15.3%*		*38.8%*	
				share of birthweight-adjusted explained	*17.3%*		*15.7%*		*67.1%*	

Notes: This table shows differences across US Census divisions in mortality; the omitted division is the North East. Columns (1) and (2) analyze overall one-year mortality. Column (1) limits to the comparable sample but includes no controls. Column (2) adjusts for 500-gram birth weight category cells. Columns (3) through (5) include birth weight controls and look at deaths in various periods of life. The regression results in these columns are conditional on reaching the minimum age: deaths up to 1 week; deaths from 1 week to 1 month, conditional on surviving to 1 week, etc. Coefficients are in units of 1000 deaths: a coefficient of 1 indicates an increase of 1 death in 1000 births. Shares reported in the final row are calculated based on each Census division pair and averaged. Robust standard errors in parentheses. ***significant at 1% level, **significant at 5% level, * significant at 10% level. Data for all countries cover 2000-2003; as described in the text, the sample is limited to singleton births at $\geq$22 weeks of gestation and $\geq$500 grams with birth weight and gestational age observed.

Table 6: **Cross country differences in postneonatal and neonatal mortality, by group**

Panel A: Postneonatal mortality				
	(1)		(2)	
	US versus Austria		US versus Finland	
United States	1.357	***	0.920	***
	(0.046)		(0.064)	
advantaged	-0.093		-0.296	**
	(0.144)		(0.129)	
United States × advantaged	-1.146	***	-0.941	***
	(0.145)		(0.130)	
# of observations	23,505,784		23,347,108	
high SES, US vs. Europe	0.126		0.853	
Panel B: Neonatal mortality				
	(1)		(2)	
	US versus Austria		US versus Finland	
United States	0.024		-0.149	*
	(0.068)		(0.083)	
advantaged	-0.259		-0.080	
	(0.218)		(0.192)	
United States × advantaged	0.063		-0.116	
	(0.219)		(0.193)	
# of observations	23,565,160		23,406,026	
high SES, US vs. Europe	0.675		0.128	

Notes: This table shows differences across countries in mortality by advantaged versus disadvantaged group. The regressions adjust for 500-gram birth weight category cells. The regression results are conditional on surviving to 1 month of age. "Advantaged" is as defined in the text (mothers who are high education/occupation, married and white (in the US) or non-immigrant (in Austria)). Coefficients are in units of 1000 deaths: a coefficient of 1 indicates an increase of 1 death in 1000 births. Robust standard errors in parentheses. ***significant at 1% level, **significant at 5% level, * significant at 10% level. Data for all countries cover 2000-2005; as described in the text, the sample is limited to singleton births at $\geq$22 weeks of gestation and $\geq$500 grams with no missing covariates. The last row in each panel reports the p-value from a test for equality between the advantaged group in the US relative to the advantaged group in the comparison country.

Table 7: **Cross Census division differences in postneonatal and neonatal mortality, by group**

	(1)		(2)	
	postneonatal		neonatal	
mortality (in 1000s):	1 to 12 months		< 1 month	
Mid-Atlantic	0.336	***	0.218	***
	(0.072)		(0.084)	
Mid-Atlantic × advantaged	-0.341	***	-0.245	*
	(0.094)		(0.147)	
East North Central	1.068	***	0.635	***
	(0.072)		(0.082)	
East North Central × advantaged	-0.836	***	-0.154	
	(0.095)		(0.143)	
West North Central	1.021	***	0.642	***
	(0.085)		(0.092)	
West North Central × advantaged	-0.706	***	-0.038	
	(0.112)		(0.162)	
South Atlantic	0.912	***	0.335	***
	(0.070)		(0.080)	
South Atlantic × advantaged	-0.759	***	-0.0102	
	(0.093)		(0.141)	
East South Central	1.589	***	0.497	***
	(0.091)		(0.092)	
East South Central × advantaged	-1.229	***	-0.067	
	(0.130)		(0.180)	
West South Central	0.920	***	0.239	***
	(0.073)		(0.082)	
West South Central × advantaged	-0.613	***	0.008	
	(0.102)		(0.152)	
Mountain	0.673	***	0.592	***
	(0.079)		(0.089)	
Mountain × advantaged	-0.604	***	-0.163	
	(0.109)		(0.165)	
Pacific	0.440	***	0.393	***
	(0.069)		(0.081)	
Pacific × advantaged	-0.303	***	-0.127	
	(0.093)		(0.144)	
advantaged	-0.645	***	-0.064	
	(0.078)		(0.123)	
# of observations	15,056,924		15,094,906	
average difference, advantaged	*0.17*		*0.25*	
average difference, not advantaged	*0.55*		*0.26*	

Notes: This table shows differences across Census divisions in mortality by advantaged versus disadvantaged group. The regressions adjust for 500-gram birth weight category cells. The regression results are conditional on surviving to 1 month of age. "Advantaged" is as defined in the text (mothers who are high education/occupation, married and white). Coefficients are in units of 1000 deaths: a coefficient of 1 indicates an increase of 1 death in 1000 births. Robust standard errors in parentheses. ***significant at 1% level, **significant at 5% level, * significant at 10% level. Data cover 2000-2003; as described in the text, the sample is limited to singleton births at $\geq$22 weeks of gestation and $\geq$500 grams with no missing covariates.

Table 8: **Postneonatal disadvantage within income groups**

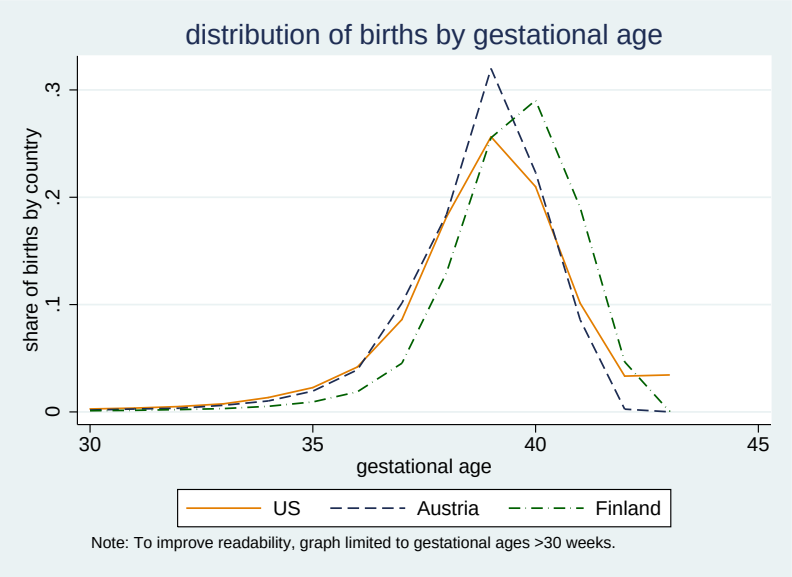
	US vs. Finland			Within US across divisions		
	(1)	(2)	(3)	(4)	(5)	
	excess US mortality, 1 - 12 months	median income, US [2005 US$] (after taxes)	median income, Finland [2005 US$] (after taxes)	average difference across divisions, 1-12 months	median income, richest division	median income, poorest division
income group 1	1.751 ***	$19,205	$20,583	0.987	$27,873	$23,421
	(0.214)			[1,040,820]		
	[1,055,295]					
income group 2	1.190 ***	$28,809	$27,892	0.631	$39,555	$37,284
	(0.397)			[1,040,783]		
	[1,054,913]					
income group 3	1.002 ***	$33,987	$34,367	0.580	$46,243	$45,101
	(0.289)			[1,043,016]		
	[1,058,082]					
income group 4	0.935 ***	$39,175	$38,788	0.366	$53,330	$52,622
	(0.239)			[1,038,100]		
	[1,090,286]					
income group 5	0.837 **	$43,993	$43,149	0.520	$60,748	$60,217
	(0.380)			[1,040,192]		
	[1,018,329]					
income group 6	0.886 ***	$49,230	$49,944	0.335	$68,886	$67,770
	(0.256)			[1,040,649]		
	[1,055,909]					
income group 7	0.540	$55,321	$57,139	0.276	$77,689	$76,507
	(0.568)			[1,040,475]		
	[1,058,485]					
income group 8	-0.348	$62,491	$59,225	0.184	$88,098	$86,244
	(0.543)			[1,040,587]		
	[1,054,957]					
income group 9	-2.109	$73,036	$71,529	0.185	$103,865	$101,755
	(1.779)			[1,047,361]		
	[1,055,930]					
income group 10	N/A	$96,706	N/A	0.256	$153,357	$125,257
	[1,056,316]			[1,033,599]		

Notes: This table shows the postneonatal disadvantage by income group. Income data is defined for the households based on their location and demographic data. US income data comes from the IPUMS. Finnish income data comes from their Household Budget Survey. For the cross-country comparison income is after tax for both countries; for the comparison within the US it is before-tax. Income deciles are defined based on the entire sample. All figures are in units of 1000 deaths: a coefficient of 1 indicates an increase of 1 death in 1000 births. Robust standard errors in parentheses. Number of observations on which the estimates are based are in square brackets. ***significant at 1% level, **significant at 5% level, * significant at 10% level. Data for all countries cover 2000-2005; as described in the text, the sample is limited to singleton births at $\geq$22 weeks of gestation and $\geq$500 grams with no missing covariates.

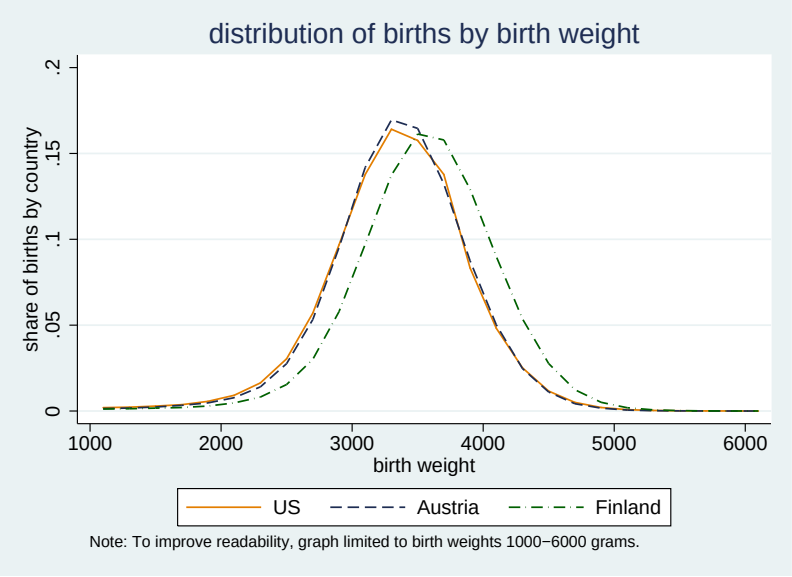
Appendix A: Additional tables and figures

Figure A.1: **Distribution of births by gestational age and birth weight, by country**

(a) Gestational age



(b) Birth weight



Notes: These figures show the distribution of gestational age and birth weight for each country. For ease of presentation, Panel A is limited to births >30 weeks and Panel B is limited to birth weights between 1000 and 6000 grams. Data for all countries covers 2000-2005; as described in the text, the sample is limited to singleton births at ≥22 weeks of gestation and ≥500 grams with both birth weight and gestational age observed.

Table A.1: **Cross country differences in mortality: Robustness**

	Panel A: US vs. Finland					
	(1)		(2)		(3)	
sample restriction	< 1 week		1 week to 1 month		1 to 12 months	
baseline	-0.276	***	0.164	***	0.647	***
	(0.063)		(0.033)		(0.054)	
exclude births < 1000gr	-0.269	***	0.124	***	0.601	***
	(0.055)		(0.030)		(0.053)	
demographic controls	-0.320	***	0.142	***	0.516	***
	(0.063)		(0.033)		(0.054)	
exclude APGAR < 9	0.027		0.123	***	0.672	***
	(0.036)		(0.038)		(0.084)	
exclude US Blacks	-0.218	***	0.145	***	0.496	***
	(0.063)		(0.033)		(0.054)	
exclude first births	-0.422	***	0.111	**	0.676	***
	(0.083)		(0.044)		(0.074)	
include multiple births	-0.351	***	0.157	***	0.697	***
	(0.067)		(0.035)		(0.054)	
	Panel B: US vs. Austria					
	(1)		(2)		(3)	
sample restriction	< 1 week		1 week to 1 month		1 to 12 months	
baseline	-0.019		0.068	*	1.083	***
	(0.056)		(0.036)		(0.043)	
exclude births < 1000gr	0.034		0.140	***	1.050	***
	(0.045)		(0.029)		(0.040)	
demographic controls	-0.067		0.059		1.026	***
	(0.056)		(0.037)		(0.044)	
exclude APGAR < 9	-0.103	***	0.082	***	0.964	***
	(0.027)		(0.025)		(0.038)	
exclude US blacks	0.078		0.049		0.904	***
	(0.056)		(0.036)		(0.043)	
exclude first births	-0.053		0.061		1.127	***
	(0.074)		(0.048)		(0.062)	
include multiple births	-0.029		0.035		1.113	***
	(0.060)		(0.039)		(0.044)	

Notes: This table shows differences across countries in mortality, using either Finland (Panel A) or Austria (Panel B) as the omitted country, as in Table 3. Each cell shows the key estimate of interest from a different regression equation: the baseline as in Table 3 (row 1 in each panel); excluding births less than 1000 grams (row 2 in each panel); including demographic controls (a quadratic in mother's age in years; an indicator variable for whether the mother is currently married; an indicator variable for whether the child is male; and an indicator variable for high education/occupation as defined in the text; row 3 in each panel); excluding infants with APGAR scores less than 9 (row 4 in each panel); excluding US Blacks (row 5 in each panel); excluding first births (row 6 in each panel); and including multiple births (row 7 in each panel). The regressions adjust for 500-gram birth weight category cells. The regression results are conditional on reaching the minimum age: deaths up to 1 week; deaths from 1 week to 1 month, conditional on surviving to 1 week, etc. Coefficients are in units of 1000 deaths: a coefficient of 1 indicates an increase of 1 death in 1000 births. Robust standard errors in parentheses. ***significant at 1% level, **significant at 5% level, * significant at 10% level. Data for all countries covers 2000-2005; as described in the text, the sample is limited to singleton births at $\geq$22 weeks of gestation and $\geq$500 grams with birth weight and gestational age observed in all rows, and no missing covariates in rows 3 through 7 of each panel.

Table A.2: **Cross country differences in mortality, by group (education only)**

	(1) US versus Austria		(2) US versus Finland	
United States	1.383	***	0.924	***
	(0.047)		(0.062)	
high SES	-0.119		-0.272	**
	(0.114)		(0.120)	
United States × high SES	-1.108	***	-0.952	***
	(0.115)		(0.121)	
# of observations	23,505,784		23,382,000	
high SES, US vs. Europe	0.009		0.782	

Notes: This table shows differences across countries in mortality by advantaged versus disadvantaged group, as in Table 6, except that "advantaged" here is defined only as high education/occupation. The regressions adjust for 500-gram birth weight category cells. The regression results are conditional on surviving to 1 month of age. Coefficients are in units of 1000 deaths: a coefficient of 1 indicates an increase of 1 death in 1000 births. Robust standard errors in parentheses. ***significant at 1% level, **significant at 5% level, * significant at 10% level. Data for all countries covers 2000-2005; as described in the text, the sample is limited to singleton births at $\geq$22 weeks of gestation and $\geq$500 grams with no missing covariates. The last row in each panel reports the p-value from a test for equality between the advantaged group in the US relative to the advantaged group in the comparison country.

Table A.3: **Cross country differences in mortality, by group (education+married only)**

	(1) US versus Austria		(2) US versus Finland	
United States	1.375	***	0.915	***
	(0.046)		(0.061)	
high SES and married	-0.064		-0.320	**
	(0.132)		(0.127)	
United States × (high SES and married)	-1.180	***	-0.922	***
	(0.133)		(0.128)	
# of observations	23,505,784		23,382,000	
high SES and married, US vs. Europe	0.119		0.947	

Notes: This table shows differences across countries in mortality by advantaged versus disadvantaged group, as in Table 6, except that "advantaged" here is defined only as high education/occupation and married. The regressions adjust for 500-gram birth weight category cells. The regression results are conditional on surviving to 1 month of age. Coefficients are in units of 1000 deaths: a coefficient of 1 indicates an increase of 1 death in 1000 births. Robust standard errors in parentheses. ***significant at 1% level, **significant at 5% level, * significant at 10% level. Data for all countries covers 2000-2005; as described in the text, the sample is limited to singleton births at $\geq$22 weeks of gestation and $\geq$500 grams with no missing covariates. The last row in each panel reports the p-value from a test for equality between the advantaged group in the US relative to the advantaged group in the comparison country.