

Evidence on Determinants of the Choice of Sail or Steam from the Hamburg Passenger Lists of 1866

Gary Roseman

Berry College - Mount Berry, Georgia

Beginning in the 1960s, studies of the economics of immigration moved from the explanation of waves of migration with macroeconomic data to more micro-oriented studies, some of which incorporated demographic characteristics. Erickson (1986), Wintle (1992), and Cohn (1995) all develop this trend further with their use of actual passenger lists to test hypotheses involving the motivations for migration, and Cohn (1984, 1987), Grubb (1987), Shlomowitz and MacDonald (1991) focus particularly on mortality rates. Cohn's (1995) contribution to the literature is his research into the causes of migration and how characteristics of emigrants, such as age, occupation, and number of dependents, affect the migration decision.¹

This study follows the method of using passenger lists for a comparison of characteristics of emigrants departing on sail- and steam-powered ships from the port of Hamburg in 1866. This year, 1866, was toward the end of the period in which both sailing and steamships made transatlantic passenger voyages. The examination of age and gender characteristics of the passengers on each type of ship is of interest because the mortality rates were higher on sailing ships, and particularly higher for certain age groups and for women, but the price of the voyage was approximately twice as high on steamships. The trade-off was then between increased safety and decreased lost earnings time on one side and a higher price paid for the voyage on the other. The evidence in this paper suggests that women and children bore the costs of the sailing

¹I. Glazier (1988). The introduction to *Germans to America: Lists of Passengers Arriving at US Ports* has a review of the trends in migration literature and in German emigration.

ship voyage, which were the longer idle time and increased health risks, instead of bearing more costs in the pecuniary form of a higher fare.

The Issue

The literature on migration indicates that long ocean voyages caused high mortality rates for passengers, with some groups of passengers more susceptible than others. Grubb (1987) compared death rates of German immigrants to those of established residents in Philadelphia in the eighteenth century and found higher rates for the immigrants for a year following their disembarkation. For age-specific rates, Cohn (1987) used data from the years 1836-53 to observe that passengers under 14 years and over 45 years of age had mortality rates on sailing ships that were at least twice as high as those of established residents in main port cities. Infants died in large numbers on sailing voyages to Australia, with as many as a quarter of those on board dying in the years 1838-53, nearly half that rate from the 1850s to the 1880s, and further falls in the death rate with the steamship voyages to Australia in the mid-1880s (Shlomowitz and MacDonald, 1991, p. 86). Cohn (1984, pp. 297-99) also found higher death rates for female passengers on voyages from 1836 to 1853 but, as inland death rates at that time that were lower in the 25-34 age range and high for five and under, he wrote the explanation for the inequality in the death rates by gender might be in the difference in age distribution of male and female passengers. By 1873, when the last New York-bound emigrant sailing ship left Hamburg, steam-powered voyages had cut the time at sea to 14 days from 44 days on sailing ships, and steamship passengers' mortality rates were much lower than those on sailing ships (Moltmann, 1989), paralleling the result for the Australia-bound ships.

Given the numerous sources of information,² the knowledge of these

² P. Taylor (1971), pp. 66-86. Information sources for migrants included guidebooks, pamphlets, shipping advertisements, and information provided by foreign governments and governments of several American states. Arguably, the most reliable sources would have been personal letters. Societies to promote the welfare of emigrants from various European countries existed in the major U.S. port cities (pp. 125-26).

G. Struve's (1866) emigrant guidebook lists the German Societies in Baltimore, Boston, New Orleans, New York, Philadelphia, and St. Louis (pp. 609-630).

relatively high mortality rates on sailing ships entered into the decision-making process for the potential emigrants. However, it is not clear that the more vulnerable categories of passengers, such as women and children, would choose the safer mode of transportation. While the steamship reduced transit time and exposure to disease, the fare differential was substantial. In 1866 the full fare for steerage on a sailing ship from Hamburg to New York was 30 to 40 Talers, while that on a steamship was 60 Talers.³ A transatlantic fare and the difference in the fares both represent a large portion of wages at that time in Germany, as Kuczynski (1962, p. 228) reports annual pay for German railroad workers in 1866 ranging from 123 to 200 Talers.

Because of the differences in the nature of the costs on the two types of voyages and in how they are borne by gender and age group, questions arise concerning the age and gender distribution of passengers on sailing and steamships. The variables will differ according to the relative valuations of the differentials in fare on the one side and decreased voyage time and disease exposure on the other. If the increased price of the steam trip outweighed the benefits for the young and for women, then these groups as proportions of total passenger numbers will be greater on sailing ships.

The trade-off between increased fare and reduced time, with the physical costs of the increased sailing time borne more acutely by women and children, who were not participating in the labour market as frequently as males aged 18 and older and therefore were not bearing the same costs of forgone wages, generates some questions that have answers in quantifiable comparisons. Specifically, if the opportunity cost of time expressed as the fare difference outweighs the value of the reduction in mortality rates for the more vulnerable groups of passengers, then

- i) the proportion of

³ B.Gelberg (1973), p. 44 lists the sailing ship fares for ships of the Hamburg-Amerikanische Packetfahrt Aktiengesellschaft, citing as a source G.Struve (1866). G.Struve (1866), pp. 585-586, 558, 565 has this fare as well as a second class sailing ship fare of 60 Talers and first class for 100 Talers. Steamship fares were 60 Talers for steerage and 110 Talers and 150 Talers for second and first class, respectively. Children 10 and under usually went for half the adult fare in steerage.

- a) women and
 - b) children on sailing ships will be higher than on steamships, even though they were particularly susceptible to the increased mortality rates on these voyages
 - ii) working aged males, defined as 18 and older, will make a greater proportion of passengers on steamships
- Related to these two predictions are observations on the sail-steam choice for adults travelling with dependents.

Data

The data source for this study is microfilm of the Direct Passenger Lists for the year 1866 from the Historical Emigration Museum in Hamburg. These lists contain the name of each emigrant, the groupings by family, and the age, gender, occupation, and place of residence on ships leaving Hamburg for a direct voyage to their destination. At the end of each ship's entry is a summary of the number of emigrants with subtotals by gender and age subgroups of 14 and older, younger than 14, and 1 and younger.⁴ The lists contain the name of each ship with its captain and date of departure, and for 88 of the 96 ships on the Direct Lists for 1866 there is an indication of the type of power – sail or steam – of the ship. The Museum has the lists of passenger ships for emigrants sailing from this port from 1850 to 1934. Hamburg and Bremen were the two major German ports for emigrant ships in the nineteenth century. The emigration archives in Bremen suffered damage during World War II, while the Hamburg archives remained intact. To prevent the loss of the information on these lists, the Utah Genealogical Society microfilmed the records in 1964.

The data consist of 37 sailing ships and 39 steamships carrying 33,475 passengers, which is the entire set of ships with specified power (sail or steam) that departed from Hamburg for New York on the Direct Lists in

⁴ The age of 14 was the most commonly used separator, though some ships had the ages divided at 10 years. No discernible pattern of sail, steam, size, captain, or month of departure existed for determining which ships used 10 and which used 14.

the archives of the Hamburg Historical Emigration Museum. This data set covers 76 of the 88 ships on the Direct Lists in 1866 which had the mode of power specified.

Limiting the data from 1866 avoids the distortions caused by the Civil War and, because 79 of the 96 ships on the 1866 Direct Lists were going to New York, holds constant conditions in the United States that would greatly influence emigration flows, as well as other random shocks over time. The focus on ships bound for New York also avoids the effects of varying distances and the subsidies paid to emigrants to Australia and Latin America.⁵

Alternatives to the Hamburg lists exist. One is the National Immigration Archives in Philadelphia. Because of the mild penalties for falsification of lists and the volume of work facing the overworked U.S. immigration officers, historians sometimes doubt the quality of these lists, which often contain rows of ditto marks after an entry under the lists' heading for occupation.⁶

Results

Table 1 summarizes the results of the entire data set of ships leaving Hamburg directly for the United States in the year 1866. The table shows that female and infant passengers, defined as children one year and

	Males	Females	Total	Infants
Sailing Ships	6,277	5,127	11,404	579
	55.04%	44.96%		5.08%
	<i>6724.19</i>	<i>4679.81</i>		
Steamships	13,461	8,610	22,071	834
	60.99%	39.01%		3.78%
	<i>13103.81</i>	<i>9057.19</i>		
Total	19,738	13,737	33,475	1,413

⁵ Taylor (1971), pp. 82-83 reviews these subsidies.

⁶ See C. Erickson (1986) and R.L. Cohn (1995), pp. 384-87 for discussions of the quality of these lists.

younger, made a greater proportion of the sailing ships' passengers, as parts a and b of prediction i, above, stated. The numbers in italics are the expected frequencies of each observation, based on the margin totals and are used to calculate the chi-square test statistic.⁷ In this case, $\chi^2 = 109.92$ with 3 degrees of freedom, which allows rejection of the null hypothesis that the sail or steam choice was independent of gender at the $\alpha = .001$ level. Even though death rates were significantly lower on steamships, the extra cost of the voyage meant that women bore these costs rather than the pecuniary costs.

Table 2 below contains information on the ages and genders of the passengers gathered from a random sample of the data to test the validity of prediction ii and offer more insights into the choice of sail or steam, given an emigrant's demographics. The sample size of 1,124 individuals represents 3.36 percent of the 33,475 passengers included in this study. Various methods for collecting data from microfilmed ship records have involved taking data from every *n*th ship or spinning the handle of the

TABLE 2

	Sail	Steam
Total Number of Passengers	407	717
Total Number of Males	226	424
Total Number of Females	181	293
(as percentage of total passengers)	44.47%	40.86%
Number of Males 18 and older	160	321
(as percentage of total passengers)	39.31%	44.77%
Males, ages 25 to 34	71	111
(as percentage of total passengers)	17.44%	15.48%
(as percentage of males 18 and older)	44.38%	34.58%
Number of Females 18 and older	120	214
(as percentage of total passengers)	29.48%	29.85%
Females, ages 25 to 34	53	61
(as percentage of total passengers)	13.02%	8.51%
(as percentage of females 18 and older)	44.17%	28.50%
Children 5 and under	57	62
(as percentage of total passengers)	14.00%	8.65%

⁷ The χ^2 statistic is $\sum \sum (O_{ij} - E_{ij})^2 / E_{ij}$, where O_{ij} is the observed value for the *i*th row and *j*th column and E_{ij} is the corresponding expected value.

microfilm reader a given number of times.⁶ This sample was taken by spinning the microfilm roll five times and taking the information from the page which appeared, ensuring a random sample from the entire roll. If the spinning ended on a ship bound for a foreign destination or on a ship with uncertain power, then that page was discarded and the roll spun again.

Some categories in the table reflect Cohn's (1984) findings of higher death rates for females on voyages in the years 1836-1853 and the possible explanation of this result in different age structures of male and female passengers, given the differences in inland death rates for children under five years old and adults in the 25-34 age range from the mean rate (p. 299). The assumption is that the extra four weeks in the time of voyage on sailing ships was harder on females in general and children under five.

The percentage of working aged males, assumed to be 18 and older because of the infrequency of a listed occupation for males younger than 18 and the frequency of their travel with a parent on these lists, is greater for the steamships.⁷ However, the difference in the proportions of sailing ship and steamship passengers who are in the 25-34 age group of males is not statistically significant. While this age group held the lowest death rate, according to Cohn (1984), and could therefore expect to withstand the physical stress of the longer voyage, this group would likely have a relatively high opportunity cost of forgone earnings. However, the 25-34 age group, in prime child-bearing years, has a greater frequency of travel with dependents. In this sample, a greater percentage of males 18 and older on sailing ships travelled with dependents (36.88 percent) than was the case on steamships (19.94 percent). For females in the age range, Cohn's conjecture about the age structure on mortality rates holds in this

⁶ See C.Erickson (1986) and R.L.Cohn (1984), p. 293 for a review of sampling techniques from microfilmed ship records. A test of the null hypothesis that the respective gender proportions in the sample used in Table 2, which is a subset of that used in Table 1, are equal to those in Table 1 cannot be rejected at any significance level.

⁷ The null hypothesis that the proportions of males 18 and older on sailing ships and steamships are equal is rejected at the $\alpha = .05$ level in favour of the hypothesis that the proportion of males 18 and older on steamships is greater. The test for the null hypothesis that the proportions of passengers who are females on each type of ship are equal generates a p-value of 0.12.

sample. Women in the less-susceptible 25-34 age range are a smaller share of passengers on steamships.

An interesting insight arises when dividing the sample of women passengers into those travelling with a husband and those without, though possibly with dependents. Of the 214 females 18 and older on steamships, 140 (65.42 percent) were travelling without a husband. On sailing ships, the number of women passengers without husbands was 56 of 120 (46.67 percent). Put another way, 71.43 percent of women traveling without a husband went by steam. For the 114 women in the 25-34 age range who were without a husband, slightly more than half (53.51 percent) went by steam. These results may suggest that women who travelled without husbands were joining men who had become established in America and had sent funds or prepaid tickets to their families. While prepaid tickets were common in the nineteenth century,¹⁰ the Hamburg passenger lists offer no indication of the identity of the fare-payer.

Cohn (1984) also found higher death rates for ships arriving in November through February, possibly because of conditions in the North Atlantic at this time of year (p. 299). A question arises about the willingness of females and the guardians of infant passengers, who had higher mortality rates among migrants, to endure the increased hardships of the passage in this season. An examination of the data for ships leaving Hamburg for New York in the months of October through January, and therefore arriving in November through February, shows that 7,482 passengers, for 22.35 percent of the total for 1866, left during that period, or less than a quarter for the quarter year. Of this total, 5,017 left on steamships and 2,465 on sailing ships. Of these numbers, 1,886 and 1,171 were female passengers, respectively, representing 21.90 percent and 22.84 percent of the female passengers by type of ship for the year. For infants, however, the totals in these months were 220 for steam and 155 for sail, which means that 26.38 percent and 26.77 percent of the total

¹⁰ P.Taylor (1971), pp. 101-102. In the 1890s, 30-40 percent of passengers on Hamburg and Bremen shipping lines had prepaid tickets and an investigation at Ellis Island in 1908 reported that 35.5 percent of Germans had prepaid tickets.

infants on these ships in 1866 left during the hazardous months. These differences in these proportions from the proportion of all the 1866 passengers who left in the more unhealthy months are both statistically significant at the .01 level.¹¹ Before ascribing this result to neglect, it should be remembered the passengers may have been able to afford the extra costs involved after the harvest.

Conclusion

Mode of travel was not a random choice and steam, the safer alternative, was not a choice for the passengers who were, according to previous studies, more susceptible to the difficult conditions on sailing ships. The premium paid for steamship was justifiable for those with higher opportunity cost of time. Indeed, an examination of the occupations of passengers on each type of ship in the random sample indicates that labourers were more likely to sail (77 of 160 males over 18 on sailing ships were labourers) than go by steamship (73 of the 321 males over 18).¹²

The evidence from 1866 suggests that, in that year, the decreased physical costs of steamship travel did not outweigh the increased fare for women and children, even though Shlomowitz and MacDonald present evidence of decreased mortality rates on steamships for a particularly afflicted group and Moltmann (1989) finds decreased general mortality rates on steamships. However, the result for women without husbands suggests that steamship travel may have been more common for spouses of previous emigrants who had established themselves in America. The costs of travel to America were a portion of the emigrants' costs. Others were the costs of forgone relationships, both business and personal, and the adjustment costs upon arrival in the destination country.

¹¹ The null hypothesis that the proportions of passengers on sailing and steamships who are five and younger are equal is rejected at the $\alpha = .005$ level in favour of the hypothesis that the proportion on sailing ships is greater.

¹² Labourers as a group formed the largest category of occupations among all immigrants to the United States in the 1870s, when this category was 40.93 percent of the occupations of immigrants in that ten-year period, according to the Bureau of the Census (1975), p. 111.

These costs varied with the personal characteristics of the emigrant, as the literature has analyzed in the past. The increased probability of death was one of the travel costs of migration and was a function of the sail or steam choice. This cost varied with gender and age, yet the deciding factor appears not to be the severity of this non-pecuniary cost on particular groups, such as women and children.

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