I Z A Institute of Labor Economics

Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

Emigrant Voyages from the UK to North America and Australasia, 1853-1913

Timothy Hatton

I Z A Institute of Labor Economics

Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 16281

Emigrant Voyages from the UK to North America and Australasia, 1853-1913

Timothy Hatton
University of Essex and IZA

JULY 2023

ABSTRACT

Emigrant Voyages from the UK to North America and Australasia, 1853-1913

Studies of the determinants of emigration from Europe from 1850 to 1913 include the gains to migrants but often neglect the costs. One component of those costs is earnings forgone on the voyage. In this paper I present new data on the voyage times for emigrants from the UK traveling to the United States and to Australia. Between 1853-7 and 1909-13 the voyage time from Liverpool to New York fell from 38 days to just 8 days (or 79%). Over the same years, the emigrant voyage to Sydney fell by more in absolute terms, from 105 days to 46, but by less in relative terms (56%). Differences in profiles of travel times are explained with a focus on the relative efficiency of sail and steam and (for Australia) the use of the Suez Canal. Data series for fare prices and forgone wage costs are combined to create new series on the 'total' cost of emigrant voyages. Econometric analysis of UK emigration to the US, Canada and Australia supports the view that time costs mattered.

Corresponding author:
Timothy J. Hatton
Department of Economics
University of Essex
Colchester CO4 3SQ
United Kingdom

E-mail: hatton@essex.ac.uk

Introduction

In his famous book, *The Tyranny of Distance,* Geoffrey Blainey wrote of Australia in the second half of the nineteenth century that: "the long era in which distance was a tyrant seemed to be fading away" (Blainey 1966, p. 173). Blainey and others have described how improved shipping technology and navigation brought Australia closer to Europe by reducing the length and variability of the time it took to get to the other side of the world. This was important for trade in goods and a range of studies have shown that declining shipping costs stimulated international trade in the first age of globalisation. While the second half of the nineteenth century also witnessed a boom in international migration, much less attention has been paid to trends in migration costs. For migration, an important element of cost is the time it took to reach the destination. In this paper I provide new estimates for 1853 to 1913 both of the cost of a ticket to Australia and, most importantly, of the foregone earnings cost of time on the voyage. As potential migrants faced choice of destinations it is important to place this in a comparative context. To do so I compare the estimates of ticket costs and time costs to Australia with those for the obvious alternative for UK emigrants—a voyage across the Atlantic to the United States or Canada.

My estimates show that the average duration of emigrant voyages from the UK to New South Wales fell from 105 days in 1853-57 to 46 days in 1909-13 while, over the same years, average voyage times from Liverpool to New York fell from 38 days to just 8 days. In absolute terms the voyage to the antipodes fell by twice as much as the trip across the Atlantic, 59 days versus 30 days, but in *relative* terms it fell by less, 56 percent compared with 79 percent. I examine the reasons why the proportionate gains were smaller on the route to Australia. One reason is that the adverse winds and currents for westward passages on the North Atlantic route meant that the gains from the shift from sail to steam were greater than they were for sailing to Australia via the Cape of Good Hope, where the winds were mostly favourable. On the route to Australia there were continued improvements in voyage times under sail, most importantly due to better navigation. The transition from sail to steam for steerage passengers on emigrant ships did not come until the early 1880s, nearly two decades later than on the Atlantic route. There were several reasons for the delay, but when it did come, the gains in voyage times from the transition to steam were somewhat smaller than they had been on the north Atlantic route. Perhaps more surprisingly, even as late as 1909-13, more than half of emigrant voyages still came via the Cape rather than through the Suez Canal, partly because the reduction in distance of using the Suez route was modest (as compared, for example, with voyages to the Far East) and partly because Suez tolls added to the cost.

In contrast to the trends in freight rates, the downward trend in ticket prices is modest at best. For the voyage to New South Wales the cost of a ticket fell from £17 in 1853-7 to £13 in 1909-13. For the voyage to the United States over the same years the cost of a ticket actually increased slightly. So falling ticket prices alone do not seem to have been a major cause of the boom in emigration. If foregone earnings on the voyage are added to form a measure of the 'total' voyage cost, then there is a strong downward trend, which is steeper when total cost is expressed as equivalent weeks' work (at average UK earnings). For the growth in long-distance trade the fall in freight rates was preeminent but for emigration the decline in voyage times was more important. The fact remains, however, that for migration to Australia, the ticket price alone was higher by a factor of three than for an Atlantic passage and the total cost, on average, by slightly more.

Although the number of emigrants heading for the United States was four times the number travelling to Australia and New Zealand combined, perhaps the question should not be why so few went to Australia but, rather, why so many did so. In the nineteenth century antipodean governments were well aware of competition with North America for UK emigrants and so they offered a variety of assisted passage schemes. As a result, from 1853 to 1913, nearly half of all emigrants to Australian and New Zealand travelled on assisted passages. It is possible, however, that for emigrants, the ticket price and the cost of foregone earnings may have mattered little compared with the allure of distant destinations. But econometric analysis of unassisted emigrant flows from the UK to the USA, Canada and Australia/New Zealand from 1855 to 1913 indicates that the total cost of emigration, including the cost of travel time, did in fact have a negative effect on the number of emigrants.

The rest of the paper proceeds as follows. The next section outlines some of the literature on migration highlighting the paucity of evidence on migration costs and with a focus on emigration from the UK. The following section presents new estimates of voyage durations for steerage passengers from the UK to New South Wales and these are compared with recent estimates of voyage times from Liverpool to New York. The following section examines the question of why, from the 1850s, the duration of emigrant voyages to the antipodes did not fall even more steeply and why the transition from sail to steam occurred nearly two decades later than on the Atlantic route. I then examine trends in the voyage costs when the time costs, in the form of foregone earnings, are included. Finally, I offer some econometric evidence in support of the view that the costs, and especially the time costs, did indeed influence the volume of emigration from 1855 to 1913.

Shipping costs and Emigration from the UK

It has become commonplace to think that the globalisation era that gathered pace from the middle of the nineteenth century owes much to the decline in the cost of shipping from one part of the world to another. Estimates of freight rates for shipping goods by sea show declines on the order of 50 percent between 1870 and 1913 (Harley 1988; Shah Mohammed and Williamson 2004; Jacks and Stuermer 2021) and the evidence suggests that declining trade costs contributed to the boom in international trade (Jacks et al. 2010). One study suggests that the transition from sail to steam in ocean shipping could account for as much as half of the increase in trade during the second half of the nineteenth century (Pascali 2017). Although the boom in international migration from mid-century is often cited as an integral part of the first era of globalisation much less attention has been paid to the likely contribution of the costs of migration. However, several studies have provided estimates of ticket costs on the emigrant route from Europe to North America (Killick 2014; Keeling 2008; Dupont et al. 2017). These cover different parts of the period from 1850 to 1913 and do not span the transition from sail to steam. Nevertheless, when linked together the resulting index shows little evidence of the steep downward trend in ticket costs that is evident in ocean freight rates.

Perhaps for this reason the studies that seek to estimate the determinants of emigration have often focused on the incentives for international migration, while neglecting the costs. For example, in their econometric studies of emigration from Europe to the New World, Hatton (1995) and Hatton and Williamson (1998) include measures representing the wage gains, as well as fluctuations in economic activity at home and abroad but no direct measure of the costs. However, a few studies have paid more attention to the costs. In their study of quarterly data for 1899–1913, Deltas et al. (2008) found that emigration on routes to the US and Canada was 22 percent lower at times when shipping cartels in effect (and thus ticket prices were higher) but they do not measure ticket prices directly. Sanchez-Alonso (2000) found that between 1882 and 1905 the depreciation of the Peseta, which increased the travel costs for Spanish emigrants, reduced their numbers by up to 30 percent. And Hatton (2021) found that emigration to the USA, Canada and Australia/New Zealand was associated negatively with an index of ticket prices.

None of the existing quantitative studies of the determinants of migration have included the cost of foregone earnings. In comparison with trade in goods, time spent on the voyage was much more important for migrants. In what many see as the foundation paper on the economic analysis of migration Larry Sjaasdad (1962) wrote: "The non-money considerations involved in migration are surely significant, probably far more so than the money costs. The first non-money costs to consider are opportunity costs--the earnings foregone while traveling, searching for, and learning a new job."

Yet despite this imperative and despite the fact that in the nineteenth century emigration to the New World often involved a passage of weeks or months rather than hours or days, scant attention has been paid to this important component of the cost. While neglected in much empirical work, the cost of time was often recognised by contemporaries. Indeed, an emigrant handbook when comparing voyages across the Atlantic by sail and by steam noted that: "The rates of passage are generally lower on sailing than on steam vessels, but the difference is not great enough to compensate for the loss of time and the hardships of a long voyage." (American Social Science Association 1871, p. 5).[1]

Figure 1: Gross Emigration from the UK to the US, Canada and Australia & NZ, 1853-1913
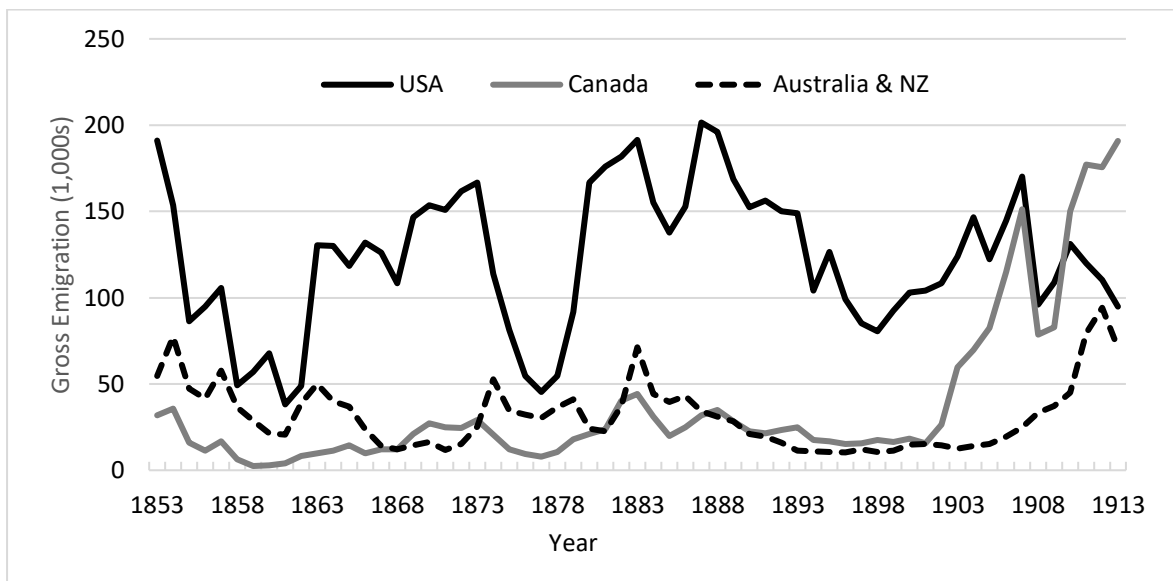
Source: Carrier and Jeffrey (1953), Table D/F/G (1).

It is useful to compare emigration from a common source to destinations where the costs and voyage lengths are very different. Figure 1 shows the annual gross passenger movement to the United States, Canada and Australia and New Zealand combined. Emigration to the US was by far the largest stream, making up 64 percent of the total, with Canada accounting for 20 percent and Australia/New Zealand just 16 percent. After a sharp decline in the early 1850s, the number travelling to the USA gradually increased with steep downturns in the late 1870s and late 1890s. In contrast, the numbers heading to Canada increased sharply from the turn of the century as did those to Australia from 1905. As previous studies have shown, the wide year-to-year fluctuations are explained largely by the ups and downs of the business cycle in destination countries. Much less clear is how they were influenced by the costs of migration, and in particular, by foregone wage costs.

---

[1] It is also an enduring theme in accounts of Australian economic history. For example, Jackson (1977, p. 41 observed that "a major barrier to migration to Australia was the length and cost of the ocean voyage from Europe." Seltzer (2016, p. 181) notes that "part of this cost disadvantage was due to the tyranny of distance."

Long term trends in voyage times

One reason that the time costs of emigration from Europe have been neglected is that we lack comprehensive information on average voyage durations. While there are numerous commentaries on how changes in shipping technology, navigation and business practices affected the speed of ships, much of this describes how innovations affected speeds at the technological frontier rather than presenting average speeds or durations. And much of the existing literature focuses on merchant shipping and trade costs rather than on emigrant ships. Here I present new series for average voyage times for emigrant ships travelling from the UK across the Atlantic and to Australia. A likely reason why such series have not previously been available is that existing sources for arrival dates at the destination often lack information on the date of departure, while sources for departure dates from ports of origin usually lack dates of arrival. In order to calculate voyage durations, it is therefore necessary to match arrival and departure dates for the same voyage from different sources.

Time on the Atlantic crossing is represented by the duration of voyages from Liverpool to New York. For the years from 1853 to 1913 the data on departure dates of emigrant ships from Liverpool presented in the annual reports of the UK Emigration Commissioners was matched with arrival dates of these ships in New York from *Arriving Passenger and Crew Lists (including Castle Garden and Ellis Island), 1820-1957* in Ancestry.co.uk. For 1890 to 1913 a sample of ship arrivals was taken from the same source for each year and these were matched with departures of the same ships from *UK and Ireland, Outward Passenger Lists, 1890-1960*, also from Ancestry.co.uk. For the years 1870 to 1889 there is no convenient source for departures from Liverpool and so a series was constructed for ships carrying Mormon emigrants from Liverpool to New York from the website *Saints by Sea*. This series includes 2399 voyages for 1853 to 1869, 169 for 1870 to 1889, and 2620 for 1890 to 1913. Full details of the sources and construction of this series is provided in Hatton (2023).

As Figure 2 shows, average voyage duration fell from around 38 days in the 1853-57 to 8 days in 1909-13—a fall of 79 percent. Four fifths of this decline had taken place by 1869 by which time average duration of passage had fallen to 16 days, largely as a result of the transition from sail to steam (see further below). This is illustrated by the sharp drop in the median between 1863, when the median voyage was by sail, and 1864 when the median voyage was by steam. The voyages by sail were generally direct but steamships often stopped at Queenstown, Ireland (now Cobh, the port of Cork), which usually added one day or less. As sailing ships were more at the mercy of winds and ocean currents their voyage durations varied far more than voyages by steam. The standard deviation of voyage times (all under sail) averaged 7.6 days in 1853-7; by 1909-13 it had fallen to just 1.4 days.

Figure 2: Mean and median crossing times from Liverpool to New York 1853-1913
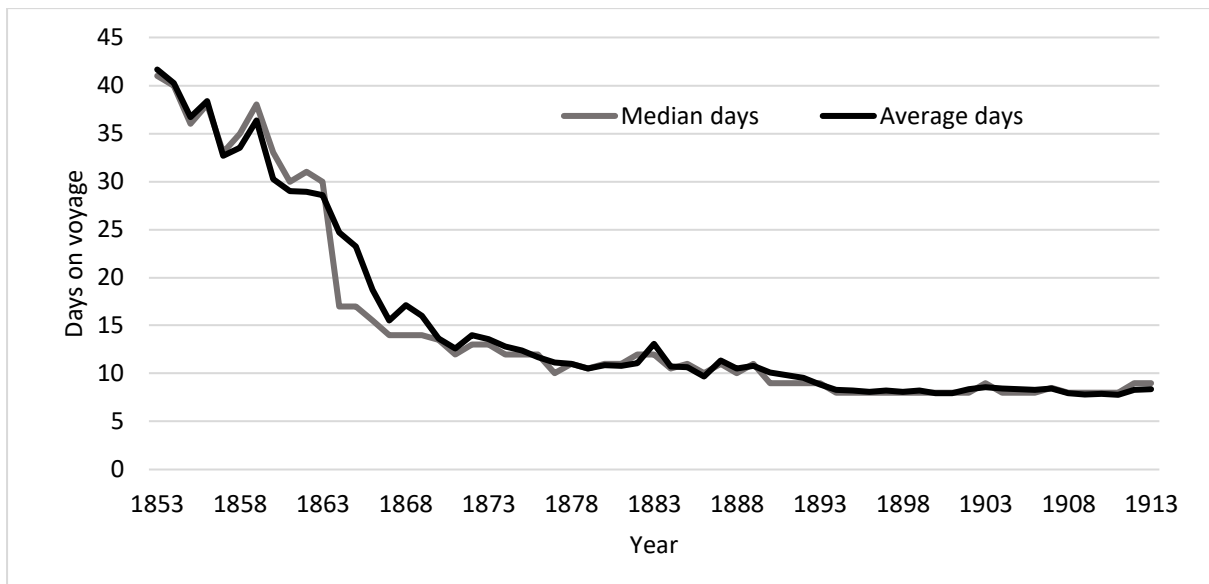

Source: Hatton (2023).

An index of average voyage times for emigrant ships to the antipodes was constructed from the difference between the dates of departure from the UK ports and dates of arrival at Sydney, New South Wales. From 1837 to 1888 the series is for ships carrying assisted immigrants. This is taken from the summary of *Assisted Immigrants (digital) Shipping Lists* at the New South Wales State Archives. Departure dates were obtained mainly from the original ships lists at the same site. For the years 1890 to 1913 a sample of ship arrivals was taken from the New South Wales *Unassisted Immigrant Passenger Lists 1826-1922*, accessed in Ancestry.com, and their arrival dates were matched with departures of the same ships from *UK and Ireland, Outward Passenger Lists, 1890-1960*, also from Ancestry. The series consists of a total of 1141 voyages; 667 voyages from 1837 to 1888 and 474 from 1890 to 1913. The annual series is reported in Appendix 1 together with full details of the sources and construction.

There are fewer voyages per year on average than in the series for Liverpool to New York and their itineraries are rather more diverse. These voyages originated from a number of UK ports, although most departed the south coast of England, notably London or Plymouth. They usually stopped *en route*, most often at Cape Town, and they typically came to Sydney via other Australian destinations such as Albany, Fremantle, Adelaide and Melbourne. As illustrated in Figure 1 the average duration of voyages in 1837 to 1841 was 124 days, or exactly four months. It then declined by about 30 percent to an average of 86 days in 1879-83. This was followed by a sharp drop from 1882 to 1885 in both the mean and the median voyage time with the transition of sail to steam. From the early 1890s there was almost no downward trend up to 1909-13 by which time the average voyage had fallen to 46 days.

Not surprisingly, the standard deviation also fell steeply, from 22.7 days in 1837-41 to 13.4 days in 1879-83 and 5.8 days in 1909-13.

Figure 3: Mean and median voyage durations from UK ports to Sydney 1837 to 1913
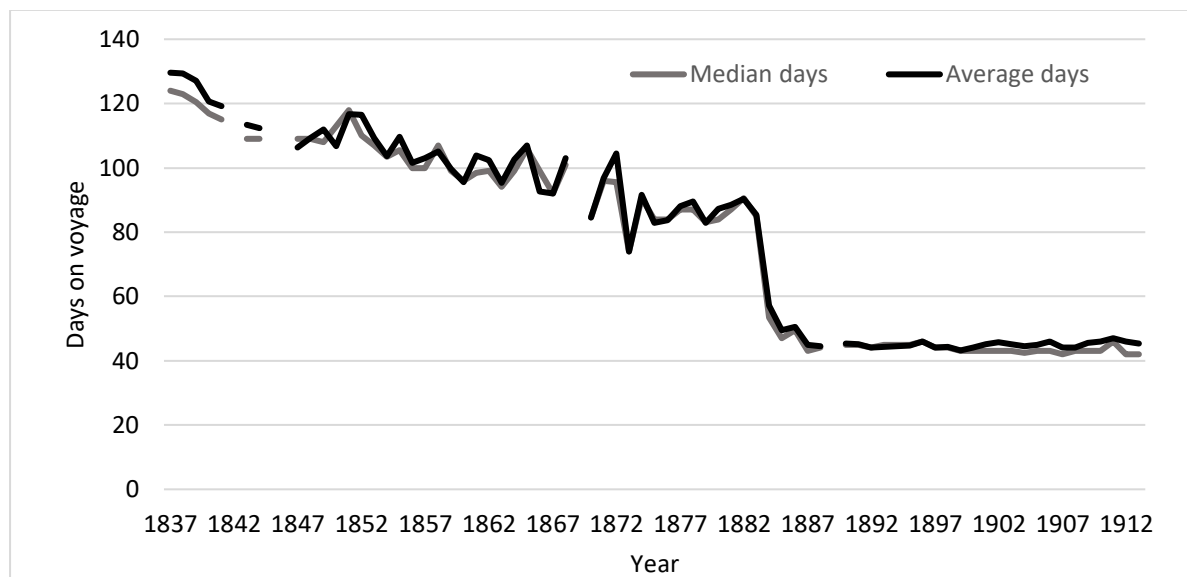
Sources: See Appendix 1.

Comparing voyage durations to Australia with those across the Atlantic, three features stand out. First and most obvious, voyages to the antipodes took far longer than those across the Atlantic. Second, from 1853-57 to 1909-13, time on the voyage to Sydney fell by more in absolute terms, 59 days versus 30 days to New York, but by less in relative terms, 56 percent versus 79 percent. Third, when the shift from sail to steam on emigrant voyages to Australia did come about in the early 1880s, it was almost two decades after the corresponding transition on the Atlantic route. This lag seems all the more surprising as the Suez Canal, which favoured steam over sail and also provided a more direct route to Australia, opened in 1869. So why weren't the gains in voyage times to Australia even larger, and why was the transition from sail to steam apparently so tardy?

Explaining trends in voyage times

There were significant improvements in sailing ship technology that increased ship speeds and reduced voyage durations up to the first half of the nineteenth century. These include coppering of hulls as well as a host of other improvements in the configuration of sails and rigging, the design of hulls and decks, and methods of construction such as the use of iron joints. (Solar and Hens 2016; Kelly and Ó Gráda 2019). On the North Atlantic route these gains were largely exhausted by the 1850s and

sail was soon eclipsed by steam.[2] But, as illustrated in Figure 3, voyage times to Australia under sail continued to fall up to 1880 and this was due in part to further improvements in ship design for long distance voyages. These included the diffusion of iron hulls, and above all, the advent from the early 1850s of the clipper ship.[3] But the most important advances were in improved navigation of the vast southern oceans where the passenger traffic was thinner than in the North Atlantic.

There were three main improvements in navigation to the antipodes. One was the improvement in charts that detailed coastlines, islands, reefs and navigational dangers (Kelly et al. 2021). Another was the increased knowledge of sailing routes. In particular, Maury (1851; 1855) provided guidance to sea captains based on a large collection of ship's logs which included data on prevailing winds ocean currents and their seasonal variations. Even more significant, the Mercator projection of the globe onto two dimensions gave a misleading impression of the most direct route. Maury showed that the great circle route which involved sailing further west and south was more direct and could cut sailing time from 125 to 92 days (Graham, 1956, p. 82). On the outward route not only was the distance shorter but, by sailing due south towards the coast of South America, and continuing south before turning east, ships could pick up the winds of the roaring forties where speeds of up to 15 knots were possible.[4] A third factor was the improvement in ascertaining a ship's position as the marine chronometer replaced dead reckoning and/or the lunar distance method as the means of ascertaining latitude (Miotto and Pascali 2022).

On both routes the transition from sail to steam accounted for a dramatic decline in voyage times. From Liverpool to New York this transition took place over a decade from the late 1850s. On voyages to Sydney it took place almost two decades later and over shorter span in the early 1880s. Table 1 shows the average voyage times by sail and by steam from the data underlying Figures 2 and 3 for the

---

[2] My series for Liverpool to New York begins only in 1853 and so I do not observe preceding improvements under sail. However, Albion (1938, pp. 197; 317) calculated average port-to-port times from Liverpool to New York for American sailing packets, which were the fastest ships of the day. These were 37.9 days in 1818-32, 34.3 days in 1833-47, and 34.6 days in 1848-57. These ships were typically hard-driven on a more direct, northerly, route than emigrant ships. After 1830, they continued to increase in size but not in speed.

[3] Improvements in hull design followed from changes in the measurement of ships' tonnage (which determined port fees), originally introduced 1836 but made effective by the Merchant Shipping Act of 1854. Iron hulls were not widely diffused for sailing vessels on long distance routes until the 1870s (Graham, 1956, pp. 76-80). On the clippers, see Clark (1911) and Lubbock (1948). These were initially stimulated by the gold rushes in California from 1848 and Victoria from 1851. Lubbock (1948 p. 52) reports that, in 1853-4, 26 of the fastest ships made it to anchorage in Australia (mainly Melbourne) in an average of 84 days. Clipper ships continued carrying emigrants on the Australian run for another 30 years. One example is the Aberdeen Line ship *Samuel Plimsoll*, a three masted iron-hulled clipper of 1450 gross tons, typically making the outward voyage in 70-80 days (Lubbock, 1948, pp. 240-44).

[4] This route, which became known as the Clipper route, was also popularised by Liverpool-based John Towson in the 1850s (Blainey 1966, p. 179). While the Clippers carrying goods could take full advantage of this intelligence, most emigrant ships took a compromise route which still involved a stop at Cape Town to disembark passengers and re-provision.

transition decade on each of the two routes. On the North American route, steamships reduced the voyage time by an average of 23.6 days, or 61 percent. Not surprisingly the gain on the route to Australia was greater in absolute terms at 39.4 days but as a percentage it was much less at 45 percent.[5] This, despite the improvements in speed and efficiency of steamships between the 1860s and the 1880s, partly reflects the preceding improvements in voyage durations to Australia under sail.[6] In the age of sail, crossing the Atlantic in the face of the westerlies and against the gulf stream was slow. Eastbound ships took a southerly route, to take advantage of the north easterly trade winds in the southern part of the North Atlantic Oscillation. The return voyage, following a more northerly route where the winds and ocean currents were more favourable, took little more than half as long (Hubbard and Winter 1988, p. 1, Clark 1911, p. 38). While the voyage to Australia presented many challenges, the winds were more favourable on the outward voyage and, as noted above, improvements in navigation enabled captains to take more advantage of them.[7]

Table 1: Average voyage durations during transitions from sail to steam.

	Liverpool to New York 1860-9		UK to NSW 1879-88	
Voyage time (days)	Sail	Steam	Sail	Steam
Mean	38.4	14.8	88.4	49.0
Standard deviation	7.9	2.7	10.8	5.1
Number	524	1071	55	41

Source: Author calculations—see text and Appendix 1.

Given the large savings in voyage times it is worth asking why the gains were not realised earlier, especially on the Australian route. One reason is that, because of the low efficiency of the early steam engines, steamships needed to carry a large amount of coal, halving the available space, and so they took few steerage passengers.[8] It was not until improvements in steam technology, specifically compound engines and screw propulsion, overcame lower carrying capacity and higher costs of motive power that mass migration shifted to steam on the North American route (Cohn 2005). On the Australian route the lack of coaling stations other than at the Cape meant that even the later and more

---

[5] The shortening of the voyage during the transition from sail to steam can also be assessed using data for the voyage durations of ships disembarking at least 100 emigrants at Queensland ports--mainly Brisbane. Full details are provided in Appendix 1. For voyages departing the UK in the years 1878 to 1887 the average number of days on the voyage was 98.5 by sail and 53.8 by steam, a difference 44.7 days or 45 percent.

[6] It is worth noting that the variation in voyage length as represented by the standard deviation also fell by relatively more on the North American route. In part this reflects the vicissitudes of sail on the North Atlantic route despite the greater diversity, even under steam, in routes and ports of call on voyages to Sydney.

[7] Some ships returned by rounding Cape Horn or passing through the Magellan Strait, which was faster even though it was a longer distance than going via the Cape of Good Hope.

[8] Steam ships were making voyages across the Atlantic and down into the southern hemisphere well before the respective transitions for steerage passengers in the 1860s and 1880s respectively. On the Atlantic route, steam packets carrying mail and cabin passengers on a regular schedule became common from the late 1840s and were crossing in 16-18 days (Hubbard and Winter, pp. 1, 388).

efficient ships needed to allocate considerable space to coal. And the longer the voyage larger the share of coal in total cost.[9] So although steamships via the Cape were faster, up to the late 1870s, with few exceptions, they carried mail and cabin passengers rather than emigrants travelling steerage.

Two other factors increased the profitability of carrying steerage emigrants by steam in the early 1880s. One was overcoming the obstacle of finding a bulk cargo for the return voyage outside of the wool season (November-December).[10] An important element in surmounting this mismatch was the rise in the exports of frozen meat and chilled dairy and fruit which lent itself to shipping by steam (which also provided the power for refrigeration).[11] As these goods were high in value and low in volume there was every incentive for shippers to choose the fastest possible method of transport and hence they were well suited to mail ships (Harcourt 1995, p. 4). A second precipitating factor was the award by the New South Wales government in 1883 of a mail contract (renewed in 1888) shared between the Peninsular and Oriental (P&O) line and the Orient line, the added security of which stimulated the latter to commission new steam ships catering also for the emigrant mass market (Maber 1967, p. 102; Broeze 1989, p. 9-10; Williams 2000, p. 2). A similar development occurred in Queensland where the government awarded a mail contract to the British Steam Navigation Company, which commenced operations in 1881 (Broeze 1989, p. 10; Maber, 1967, p. 170). This was quickly extended to include the transport of assisted immigrants, a programme that was expanded in 1882 (Woolcock 1986, p. 19).

Even so, with the opening of the Suez Canal in 1869 one might have expected the transition to come earlier, causing an abrupt shift from sail to steam.[12] As compared with sailing via the Cape, the Suez Canal drastically reduced the distance between coaling stations for steamships from around 5000 to 2000 miles, releasing more space for passengers and cargo (Graham 1956, p. 81; Fletcher 1958, p. 559). It also provided more potential ports of call for the comfort and convenience of passengers as

---

[9] Even with the more advanced engine technology, cost of coal alone for an outward voyage of 50 days using 30 tons of coal a day at £1.25 per ton would amount to £1,875, or the equivalent of around 125 adult fares. The breakthrough was marked by the voyage of the *SS Aberdeen* in 1882, equipped with a triple expansion engine, from London via Tenerife and the Cape to Adelaide, Melbourne and Sydney (Graham 1956, p. 87; Maber 1967, p. 181; Broeze 1989, p. 11). On the gradual diffusion of steam over longer distances, see Harley (1971) and Kaukiainen (1992).

[10] As a result, sailing ships went on to destinations such as Shanghai, Manila and Batavia or to pick up return cargoes, or engaged in trade within the region, before returning to Australia in a year-long seasonal rotation. (Broeze 1978; 1989).

[11] As Broeze (1989, p. 10) notes the "rapid rise of the frozen meat and dairy exports from [Australia and New Zealand], which provided attractive back-loading opportunities, . . precipitated a new wave of investment in steamers and a transition to steam on all routes incorporating the major ANZ ports." This trade was initiated with voyage of the *SS Strathleven*, equipped with refrigeration machinery, which carried 60 tons of meat and butter from Sydney and Melbourne to London in 1880, but it was pursued most vigorously by the Orient Line.

[12] The very few sailing ships that did pass though the Suez Canal (just 4.5 percent in its first five years) needed to be towed and then to sail the difficult passage through the Red Sea (Fletcher, 1958, p. 558).

well as better opportunities for return cargoes from Asian ports.[13] Yet, even after steam supplanted sail on passages to Australia, the striking fact is that more than half of the emigrant ships still travelled via the Cape (although some with perishable cargoes returned via Suez). As late as 1909-13, among the 76 outward voyages underlying Figure 3, only 48 percent went through the Suez Canal. The Suez Canal dramatically cut sailing times to India and (to a lesser extent) China, providing a substantial boost to international trade (Fletcher 1958; Harley 1971), but the reduction in voyage times to Australian ports was more modest. In 1909-13 the emigrant voyages that arrived in Sydney via the Cape took just 8 days longer on average than those coming through Suez. Nevertheless, this is still a significant difference in voyage times and it raises the question of why so many emigrant ships continued to ply the Cape route.

One important reason is that passage through Suez incurred heavy tolls.[14] A rough calculation, the details of which are provided in Appendix 2, suggests that, compared with a voyage via the Cape, the extra costs of using the canal (one way) amounted to something like £668 in 1884, reducing to £218 in 1913. Not surprisingly, the shipping lines that were at the forefront of the transition from sail to steam in the 1880s were those with lucrative mail contracts and they also used the Suez Canal. These were the P & O Line, whose voyages extended to Bombay, Shanghai and Yokohama in the far east, and the Orient Line. Indeed, the award of a share in the New South Wales government's mail contract caused the Orient line to abandon the Cape route in 1883 in favour of Suez (Maber, 1967, p. 102). But almost all of the other regular services taking emigrants to the south coast of Australia still travelled via the Cape. Even among emigrant ships travelling to Queensland, which could be reached by sailing around the north of Australia through the Torres Strait, many still sailed via the Cape. In 1909-13, of ships disembarking at least 100 emigrants in Queensland, 21 percent came via the Cape, taking an average of 59.2 days as compared with 50.3 days for ships that sailed through the Suez Canal.[15]

Voyage costs

How did the cost of a voyage to the antipodes compare with that across the Atlantic? In contrast with freight costs there are few indices of ticket prices and none that cover the transition from sail to steam.

---

[13] While calling at more ports would have added to voyage times, as Williams and Armstrong (2010) point out, steamships were able to enter and depart from ports more easily than sailing vessels which often had to wait upon on a 'fair wind'.

[14] Noting that most passengers and cargo still reached Australia via the Cape, Blainey (1966, p. 218) commented that "a generation after the [Suez] canal opened, big mail steamers paid about 10 percent of the total cost of their Australian voyage for the privilege of passing though the canal."

[15] Companies that continued to use the Cape route include the Aberdeen Line and the Federal Houlder Line. As they carried emigrants for destinations such as Adelaide, Melbourne and Sydney, the number for Queensland tended to be smaller. If the criterion of the minimum number disembarking in Queensland is reduced from 100 to 50, the percentage of voyages via the Cape in 1909-13 increases from 21 to 32.

For the route from Liverpool to New York an index for the steerage fares that covers the six decades from 1853 to 1913 is provided by Hatton (2023). This is based on combining the series provided by Killick (2014) for sail, and Dupont et al. (2017) and Keeling (2008) for steam to calculate a weighted average of fares by sail and steam. Full details are provided in the appendix to Hatton (2023). I construct a series for ticket prices for the routes from the UK to New South Wales based on the contract price per adult emigrant paid to shipping lines for assisted emigrants up to the mid-1890s followed by an index of ticket prices from Pope and Withers (1993). Full details are provided in Appendix 2. The cost in terms of time (foregone earnings) is valued by applying average weekly earnings from Feinstein (1990) to the average number of weeks on the voyage (Appendix 2).

Figure 4: Ticket costs and foregone earnings costs, Liverpool to New York, 1853-1913
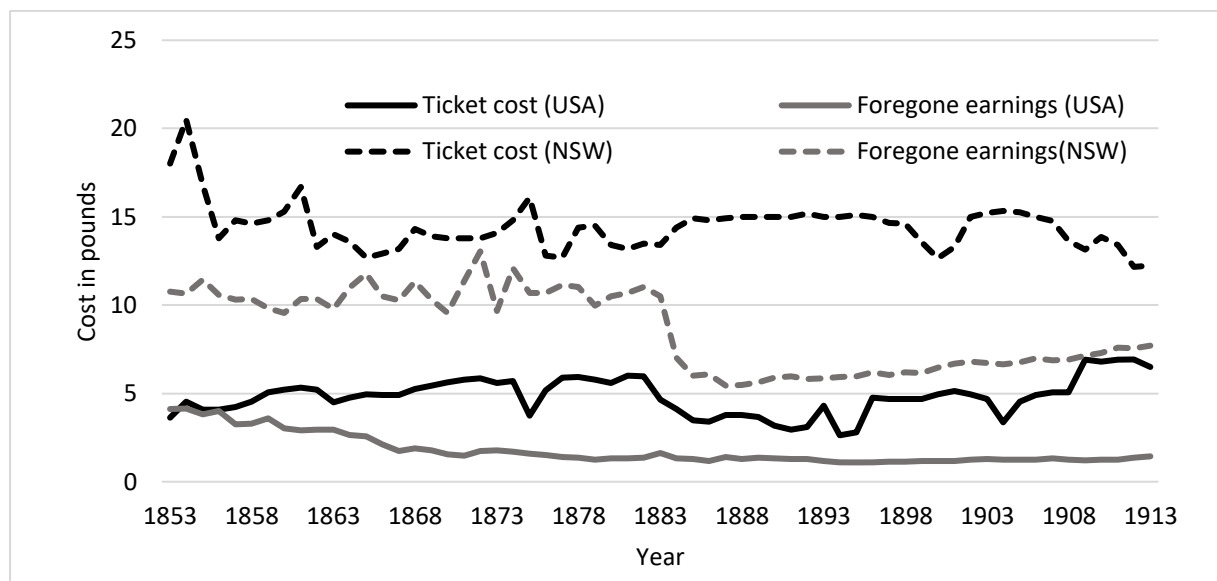
Sources: Liverpool to New York from Hatton (2023); UK to NSW from Appendices 1 and 2 (underlying voyage length values are interpolated for 1868 and 1889).

As Figure 4 shows, the ticket cost of a passage from Liverpool to New York increased from around £4 in the early 1850s to £6 in the early 1880s, declining to around £3 in the early 1990s before increasing to £7 in the early 1910s. From the mid-1890s passage prices were determined by the Atlantic shipping cartel, with occasional lapses (Keeling 2012, pp.63-70) and the index also includes the US head tax on the arrivals of foreign nationals, which doubled three times from 50c in 1882 to $4 in 1907. The foregone earnings cost, which was approximately equal to the price of a ticket in the early 1850s, declined steeply with the transition from sail to steam and by the 1910s it was less than one fifth of the ticket price. As Figure 4 also shows, the costs of the voyage to Australia evolved rather differently. After a peak in the early 1850s, the passage price levelled out at £14 to £15 before declining in the decade to 1913. While contract prices probably varied by less than prices on the open market, the average price over the six decades was three times that of the Atlantic passage (£14.42 vs £4.74). The

foregone earnings cost of travel to Australia was about two thirds of the ticket price in the 1860s and 1870s and, after falling in the early 1880s with the transition from sail to steam, was still more than half of the ticket cost in the 1910s. Thus, relative to the price of a ticket, the saving in earnings foregone over the six decades was much less on the route to Australia.

Figure 5: Cost of ticket plus foregone earnings in money and time equivalent

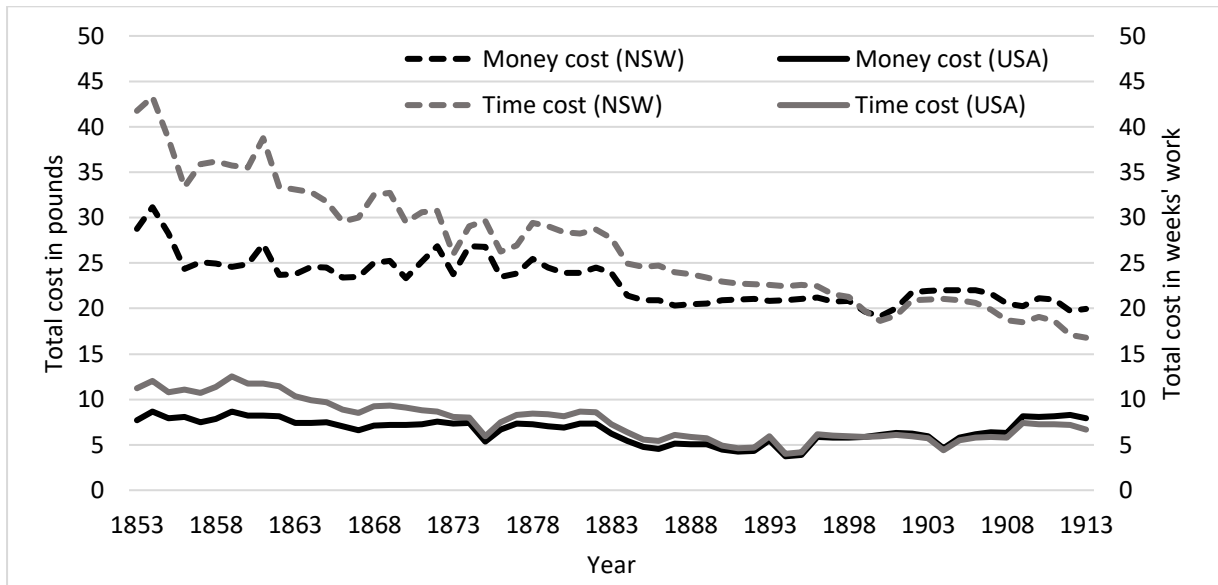*Sources*: Liverpool to New York from Hatton (2023); UK to NSW from Appendices 1 and 2 (underlying voyage length values for 1868 and 1889 are interpolated).

Figure 5 shows the effect of combining these two components of the cost. For travel to the US the cost in money terms (the darker line, left scale) exhibits a mild downward trend as the nominal value falls from around £8 in the mid-1850s to an average of £6 in the two decades from the mid-1880s before returning to around £8 at the end of the period. For voyages to Australia (the darker hatched line, left scale), after a sharp fall in the early 1850s total cost in money terms falls from £25 to around £20 in 1914. In contrast with the Atlantic voyage, both the ticket price and the foregone wage cost contribute to the downward trend. Following Killick (2014) the total cost may alternatively be expressed in terms of weeks worked. For the US (lighter line, right scale) this exhibits a somewhat steeper decline from 11 weeks in the early 1850s to around seven weeks in 1913. In terms of weeks worked the cost falls more steeply, from 36 weeks in the late 1850s to 17 weeks in 1913 or by about half. While in absolute terms the decline in cost for travel to Australia (lighter dashed line) is larger, in relative terms the decline is not much, if at all, greater than for the Atlantic crossing.

Given that a passage to Australia cost three times as much as crossing the Atlantic, notwithstanding other costs, why did emigrants of modest means choose to go to the antipodes? One important reason is the subsidised passages that were offered by Australian (and New Zealand) governments. As a historian of New South Wales immigration policies put it: "It was realized that the difference in cost

and the length of time required for a passage from the United Kingdom to Australia as compared with one to the United States or to Canada required the colony to underwrite all or a portion of this difference if New South Wales was to compete with North America for the surplus population of the homeland" (Hayden, 1971, p. 3). At different times, the six Australian colonies and New Zealand operated a variety of schemes for assisting emigrants. The most important were selection and nomination, both of which provided substantial subsidies. [16] Selection schemes offered subsidised (and sometimes almost free) passages to emigrants with specific characteristics by occupation, age and gender.[17] From the early 1840s until its abolition in 1872 the process of selecting desirable applicants was undertaken by the Colonial Land and Emigration Commission. From the 1860s agents from the colonies assisted, and then from the 1870s took over, the selection of emigrants. In nomination (or 'remittance') schemes, residents of the colony put down a deposit and nominated for a subsidised passage an emigrant who met specified criteria. In the early years these were sometimes linked to the purchase of land by the nominator. In addition, under so-called land order schemes (used especially in Queensland (Woolcock 1886, pp. 9-21; Morgan, 2021), full fare paying immigrants were allocated land to the value of the fare, subject to a repayment schedule.

These schemes were financed, for one or a few years at a time, by votes on appropriations in the individual colonial legislatures, as political and economic conditions warranted. After Federation in 1901, assisted immigration was revived but remained under the control of the individual (now state) legislatures. From 1853 to 1913 an estimated 47 percent of all immigrants to Australia and New Zealand travelled on assisted passages. Figure 6 shows the profiles of assisted and unassisted emigration, the latter calculated by subtracting assisted from total emigration (for details see Appendix 2). Most of the Australian colonies offered one or more schemes up to the early 1880s, with sharp spikes in 1874 and 1883. While the former was driven almost entirely by free passages offered by the government of New Zealand, the latter was spread more widely across the colonies. From the late 1880s assisted immigration went into decline, ceasing almost completely in the 1890s depression before rising to another peak in 1912. Thus, while the US government was busy increasing the head tax on immigrants, governments in Australia were reviving assisted passages in order to compete for

---

[16] As Richards (1993, p. 262) notes, "The assistance given to emigrants to Australia was remarkably generous and met most of the expenses of transit to the colonies. Ordinary migrant families were commonly subsidized to the equivalent of a year's income. Nevertheless, the total costs of passage and resettlement were rarely covered in their entireties."

[17] As an example, for assisted passages to Queensland in 1875 emigrants aged between 12 and 40 paid £4 (men) or £2 (women) plus 10s 6d for 'ship kit' (bedding, utensils, etc.); 'free' passages were offered to those with certain occupations for £1 (Agent General for Queensland, 1875, p. 14).

migrants from the UK. Unassisted emigration, while somewhat less volatile, increased steadily from the 1860s, then declined in the 1890s before rising to a peak in 1912.

Figure 6: Assisted and unassisted migration to Australia and New Zealand
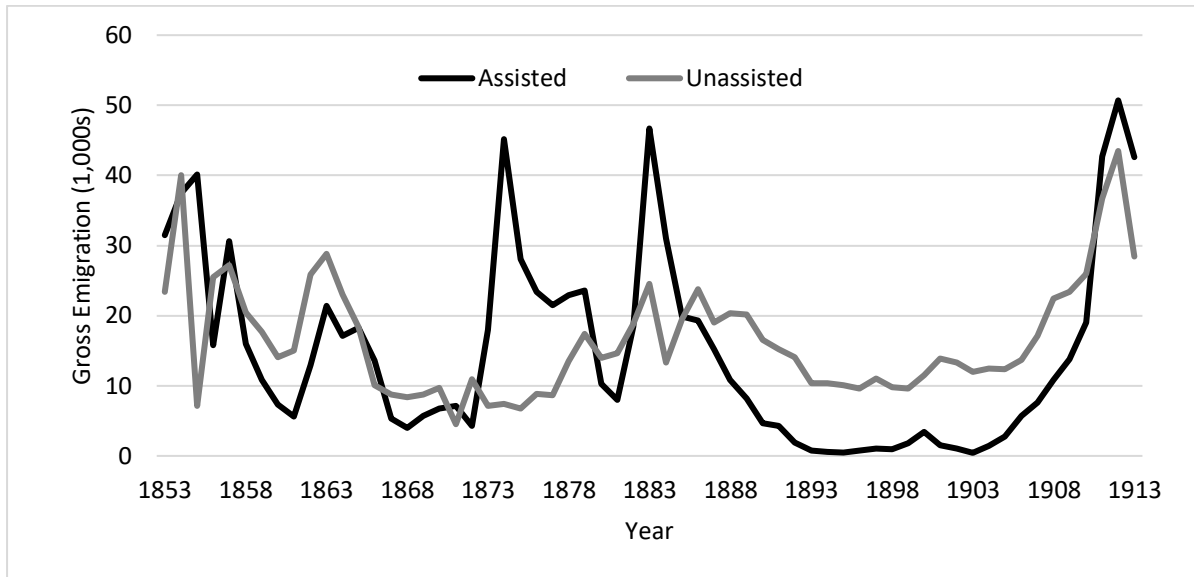
Source: See Appendix 2.

Did the time costs affect emigration?

Many studies have estimated the correlates of emigration in the so-called age of mass migration, but as noted above, few have taken full account of the costs. In order to examine the possible influence of costs on emigration to the three destinations, the following equation is estimated:

$$y_{it} = \alpha_0 + \alpha_1 x_{it} + \alpha_2 z_{it} + \alpha_3 y_{it-1} + \alpha_4 d_i + \varepsilon_{it}$$

The dependent variable is the log of the number of emigrants to each of the three destinations, the USA, Canada and Australia/New Zealand, where *i* is destination and *t* is year. These are the series illustrated in Figure 1 except that for Australia/New Zealand the dependent variable is unassisted emigration only (see Appendix 2). Assisted emigration is excluded because the cost to emigrants and the number assisted varied over time and between the different colonies. While it is possible that the availability of assisted emigration could reduce the number of unassisted emigrants, Hatton (2021) finds little evidence that there was 'crowding out' (or 'crowding in') of unassisted by assisted emigration.

x_{it} represents the costs of migration including foregone earnings, as illustrated in Figure 6, either in money terms, deflated by the UK cost of living index, or in the equivalent of weeks worked. The Liverpool to New York series are used for migration to the United States and also for Canada but excluding the US head tax from the ticket cost. As some studies have found that the migration costs

depend on the volume of migrants (as well as other variables—see McDonald and Shlomowitz, 1991; Deltas et al., 2008) these costs are taken as endogenous and so instrumental variables is used. Three instruments for voyage costs are used. The first is freight rates for coal to Atlantic ports for the US and Canada and to ports in the East for Australia/New Zealand from Harley (1989) to capture shipping efficiency. As coal was carried mainly by tramp shipping and over different routes, these are not close substitutes for ships carrying emigrants.[18] The second is a dummy variable representing the shift from sail to steam. The shift is dated from when the median voyage changed from sail to steam: 1864 for the USA and Canada, and 1884 for Australia/New Zealand. This variable is justified as an instrument on the grounds that the transition was determined largely by technical advance and political decisions rather than by the volume of passengers. The third instrument is a linear time trend aimed at capturing the decrease in voyage length.

z_{it} represents variables that often appear in push-pull models of international migration. The real wage gap comes from Williamson (1995) and is lagged one year. Fluctuations in economic activity in destination countries are represented by the rate of change of real GDP per capita from Maddison (Bolt and van Zanden 2020), including both the current value and the one-year lag. It is worth mentioning at the outset three variables that were originally included but were dropped from the analysis as they were never significant. One is the stock of UK-born at each destination aimed to capture the friends and relatives (chain migration) effect. As this was constructed from using the emigration series to interpolate between census benchmarks, it seems likely that the lagged dependent variable captures this effect, especially as recent emigrants are likely to have been the most important. In addition, neither the growth of UK real GDP (a push factor) nor a linear time trend took a significant coefficient. y_{it-1} is the lagged dependent variable which captures the equation dynamics which may arise from the formation of expectations and/or the so-called friends and relatives effect. d_i are destination country dummies (fixed effects) and ε_{it} is the stochastic error term with possible cross correlations. The data sources are detailed in full in Appendix 2.

The results of this estimation over the years from 1854 to 1913 are presented in Table 2. These are instrumental variables regressions with standard errors adjusted for cross sectional dependence and autocorrelation. The first-stage results are reported in Appendix 3. 'Total' costs measured in either money (column 1) or weeks of work (column 2) give significant negative coefficients as would be expected. The significance of test statistics for under-identification and the overall F-statistic for the

---

[18] Harley (1989, p. 315) notes that "the great trade of the North Atlantic that employed some 16% of British shipping before the war had practically no connection with the coal trade." And with regard to Australasia and the Far East, that "this shipping was somewhat connected with the coal exports to the Mediterranean as they passed on their outward voyages to the Suez Canal, but there were no important coal exports to the region itself."

first stage indicate that the instruments are sufficiently highly correlated with the cost variables. More importantly, the insignificant test statistics for over-identification indicate that the instruments are not correlated with the error term and are therefore valid in the sense that they can be legitimately excluded from the second stage regression. As the instruments include a time trend this suggests that there is no additional trend component in the second stage regression.

Table 2: Panel Estimation of Emigration from the UK to the USA, Canada and ANZ, 1855-1913

	(1)	(2)	(3)	(4)
Real total money cost (t)	-0.137**			
	(0.06)			
Total cost in weeks (t)		-0.029***		
		(0.01)		
Ticket cost in weeks (t)			-0.049***	
			(0.02)	
Weeks on voyage (t)				-0.047**
				(0.02)
Log real wage ratio (destination/origin) (t-1)	0.550*	0.527*	0.353	0.500
	(0.33)	(0.30)	(0.28)	(0.31)
Growth of real GDP per capita (destination, t)	5.107***	5.007***	4.903***	5.057***
	(1.32)	(1.44)	(1.45)	(1.44)
Growth of real GDP per capita (destination, t-1)	3.704***	3.623***	3.563***	3.683***
	(1.31)	(1.19)	(1.20)	(1.22)
Log emigration (t-1)	0.782***	0.811***	0.832***	0.818***
	(0.06)	(0.05)	(0.05)	(0.05)
R^2	0.908	0.918	0.916	0.919
Under-identification, X^2 (3)	10.05	19.45	18.75	19.04
Excluded instruments, F (3, 59)	15.12	131.09	43.15	79.51
Over-identification, X^2 (2)	0.652	0.451	1.574	0.556
Observations	177	177	177	177

Notes: Estimation using IV-GMM with Driscoll-Kray standard errors (in parentheses) with bandwidth 2 in the time dimension. The instruments are freight rates for coal for shipping from South Wales to Atlantic ports (US and Canada) and to the far East (Australia/New Zealand), a dummy variable for the switch from sail to steam in 1864 for the USA and Canada and 1884 for Australia/New Zealand and a common time trend. The first stage estimates are reported in Appendix 3, Table A3.1.

Columns (3) and (4) of Table 2 include separately the ticket cost in terms of weeks worked and the number of weeks on the voyage. These two components of the total time cost variable each take negative and significant coefficients, which are approximately equal in size. Among the other variables it is worth noting that the log wage ratio gives positive coefficients, as would be expected, although only at the margin of significance. Economic activity in destination countries gives strongly significant positive coefficients on both current and lagged terms, which is consistent with the standard push-pull model. The most significant variable of all is the lagged dependent variable, which indicates strong persistence in emigration flows, a feature of all models of this type. Further lags of the dependent variable were not significant. Overall this relatively parsimonious specification fits the data well and,

while the results are not definitive, they do suggest that the costs of migration, including the cost of time on the voyage, influenced migration flows in the six decades before 1913.

Table 3: Emigration from the UK to the USA, Canada and ANZ, 1855-1913: Alternative specifications

	(1)	(2)	(3)	(4)
	Unassisted emigration		Total emigration	
Real total money cost (t)	-0.157***		-0.169***	
	(0.06)		(0.06)	
Total cost in weeks (t)		-0.037***		-0.041***
		(0.01)		(0.01)
Log real wage ratio (destination/origin) (t-1)	0.560*	0.512*	0.714**	0.671**
	(0.34)	(0.29)	(0.33)	(0.26)
Growth of real GDP per capita (destination, t)	5.027***	4.807***	3.772***	3.495***
	(1.32)	(1.38)	(1.10)	(0.87)
Growth of real GDP per capita (destination, t-1)	3.625***	3.438***	3.639***	3.426***
	(1.35)	(1.18)	(0.97)	(0.82)
Log emigration (t-1)	0.764***	0.786***	0.758***	0.780***
	(0.06)	(0.06)	(0.05)	(0.05)
Assisted emigration policy index (t)	0.144	0.294**	0.365**	0.522***
	(0.15)	(0.15)	(0.15)	(0.15)
R^2	0.905	0.919	0.893	0.917
Under-identification, X^2 (3)	13.75	20.32	14.46	20.63
Excluded instruments, F (3, 59)	17.79	116.13	16.61	132.97
Over-identification, X^2 (2)	0.701	0.780	0.568	0.415
Observations	177	177	177	177

Notes: Estimation using IV-GMM with Driscoll-Kray standard errors (in parentheses) with bandwidth 2 in the time dimension. In columns (1) and (2) the dependent variable for Australia and New Zealand is unassisted emigration (as in Figure 7); in columns it (3) and (4) it is total emigration (as in Figure 1). The instruments are freight rates for coal for shipping from Wales to Atlantic ports (US and Canada) and to the far East (Australia/New Zealand), a dummy variable for the switch from sail to steam in 1864 for the USA and Canada and 1884 for Australia/New Zealand and a common time trend.

One concern is that this estimation takes no account of possible substitution or complementarity between assisted and unassisted emigration to Australia and New Zealand.[19] One approach would be to add a policy indicator to the regressions in Table 2 to assess the effects of assisted immigration policies on unassisted emigration. An alternative is to use total emigration from the UK as the dependent variable but to control for assisted immigration policies. To construct the policy indicator a dummy variable was derived for each colony/state taking the value 1 in years when any policy of assistance was in effect, otherwise zero. The dummies were then combined using as weights the population share of each colony/state in the total for 1881. This index varies between 1 if all

---

[19] There is also measurement error in the calculation of the series for unassisted emigration that is plotted in Figure 6. As this is calculated as the difference between total emigration recorded at the origin and assisted immigration recorded at the destination, the timing differs between these two numbers according to the average length of the voyage.

colonies/states had a policy in place and 0 in none did. It is set to zero for emigration to the USA and Canada.

Table 3 presents the results of estimating these alternative specifications. When the policy index is included for unassisted emigration in columns (1) and (2) it takes a positive coefficient, which is significant when total cost is entered in weeks of work. This suggests that, on balance, assisted emigration policies also stimulated unassisted emigration, possibly through chain migration.[20] Not surprisingly, in columns (3) and (4), where the dependent variable is total emigration, the coefficient on the policy index is larger and more significant. In all these specifications, coefficients on the total cost variables remain negative and significant. The results are also robust to other specifications as reported in Appendix 3. These include entering the cost variables in logs or lagged one period, omitting one of the instruments and dropping either the USA or Canada.

Conclusion

Time on the voyage may have mattered as an element of costs for international trade in goods but it was far more important for emigrants seeking a new life on another continent. Yet in the large quantitative literature on emigration this has been sorely neglected. In this paper I present a new series on voyage times from the UK to Australia and compare these with the very different profile of voyage times to North America. Over the six decades from 1853 to 1913 time on the passage fell dramatically to both destinations. In terms of days at sea the decline in was much greater to the more distant antipodes. But, more surprisingly, the proportionate fall in travel time to Sydney was less than that to New York. This was largely because sail was competitive for longer and the gain from switching to steam was less, notwithstanding the opening of the Suez Canal in 1869.

While freight rates fell dramatically after 1850 the cost of a steerage ticket fell much less steeply, if at all. Yet emigration boomed. If we take seriously the value of time on the voyage as measured by foregone earnings, then this forms a substantial and strongly decreasing part of the costs facing emigrants. This was especially important for emigration to Australia where the total cost, including both the ticket and time cost, was three times that for crossing the Atlantic. For this reason, nearly half of all emigrants who arrived in Australia travelled on some form of assisted passage. Travel time costs have been strangely absent from econometric studies of the determinants of emigration in the Age of Mass Migration. The evidence provided here suggests that this mattered and that it should loom larger in discussions of the migrant experience.

---

[20] However, this would not be captured by the lagged dependent variable, which in columns (1) and (2) is only unassisted emigration. If, in these regressions, the lag of unassisted emigration is replaced by the lag of total emigration, the coefficients on the policy index become negative and insignificant (see Appendix 3).

References

Agent General for Queensland (1875), *Handbook for Emigrants to Queensland, Australia,* London: Joseph Causton & Sons.

Albion, R. G. (1938), *Square-Riggers on Schedule*, Princeton NJ. Princeton University Press.

American Social Science Association (1871), *Handbook for Emigrants to the United States*, New York: Hurd and Houghton.

Blainey, G. (1966), *The Tyranny of Distance: How Distance Shaped Australia's History,* Melbourne: Sun Books.

Bolt, J. and van Zanden, J. L. (2020), "Maddison Project Database, version 2020" at: https://www.rug.nl/ggdc/historicaldevelopment/maddison/ .

Broeze, F. J. A. (1978), "British Intercontinental Shipping and Australia, 1813-1850," Journal of Transport History, 4(4), pp. 189-207.

Broeze, F (1989), "Distance Tamed: Steam Navigation to Australia and New Zealand from its

Carrier, N. H. and Jeffrey, J. R. (1953), *External Migration: A Study of the Available Statistics, 1815-1950,* General Register Office, London: HMSO.

Clark, A. H. (1911), The Clipper Ship Era: An Epitome of Famous American and British Clipper Ships, Their Owners, Builders, Commanders, and Crews, 1843-1869, United States: G. P. Putnam's Sons.

Cohn, R. L. (2005), "The Transition from Sail to Steam in Immigration to the United States," *Journal of Economic History*, 45 (2), pp. 469–95.

Deltas, G., Sicotte, R. and Tomczak, P, (2008), "Passenger Shipping Cartels and their Effect on Transatlantic Migration," *Review of Economics and Statistics*, 90 (1), pp. 119-33. [cite later paper?]

Dupont, B., Keeling, D. and Weiss, T. (2017), "First Cabin Fares from New York to the British Isles, 1826–1914," *Research in Economic History*, 33, pp. 19-63.

Feinstein, C. H. (1990), "New Estimates of Average Earnings in the United Kingdom, 1880-1913," *Economic History Review*, 43 (4), pp. 595-632.

Fletcher, M. E. (1958), "The Suez Canal and World Shipping, 1869-1914," *Journal of Economic History*, 18(4), pp. 556-573.

Graham, G. S. (1956), "The Ascendancy of the Sailing Ship 1850-85," *Economic History Review,* 9 (1), pp. 74-88.

Harcourt, F. (1995), "P&O and Orient: A Cool Partnership, 1886-1914," *The Great Circle*, 17(2), pp. 73-94.

Harley, C. K. (1971), "The Shift from Sailing Ships to Steamships, 1850-1890: A Study in Technological Change and its Diffusion," in D. N. McCloskey, ed. *Essays on a* Mature Economy: Britain after 1840, Princeton NJ: Princeton University Press.

Harley, C.K. (1988), "Ocean freight rates and productivity, 1740–1913: the primacy of mechanical invention reaffirmed," *Journal of Economic History*, 48(4), pp. 851–876.

Harley, C. K. (1989), "Coal Exports and British Shipping, 1850-1 913*," Explorations in Economic History,* 26, pp. 311-338.

Hatton, T. J. (1995) "A Model of UK Emigration, 1870-1913," *Review of Economics and Statistics*, 77(3), pp. 407-15.

Hatton, T. J. (2021), "Emigration from the United Kingdom to the United States, Canada and Australia/New Zealand, 1870–1913: Quantity and Quality," *Australian Economic History Review*, 61 (2), pp. 136-158.

Hatton, T. J. (2023), "Time on the Crossing: Emigrant Voyages Across the Atlantic, 1853 to 1913," *European Review of Economic History* (forthcoming), also IZA Discussion Paper 16274.

Hatton, T. J. and Williamson, J. G. (1994), *The Age of Mass Migration: Causes and Economic Impact*, New York: Oxford University Press.

Hayden, A. A. (1971), "New South Wales Immigration Policy, 1856-1900," *Transactions of the American Philosophical Society*, 61 (5), pp. 1-60.

Hubbard, W. and Winter, R. (1988), *North Atlantic Mail Sailings 1840-75*, Canton, Ohio: U.S. Philatelic Classics Society.

Jacks, D. S., Meissner, C. M. and Novy, D. (2010), "Trade Costs in the First Wave of Globalization," *Explorations in Economic History*, 47, pp. 127–141.

Jacks, D. S. and Stuermer, M. (2021), "Dry bulk shipping and the evolution of maritime transport costs, 1850–2020," *Australian Economic History Review*, 61 (2) pp. 204-227.

Jackson, R. V. (1977), *Australian Economic Development in the Nineteenth Century*, Canberra: Australian National University Press.

Kaukiainen, Y. (1992), "Coal and Canvas: Aspects of the Competition between Steam and Sail, c. 1870-1914," *International Journal of Maritime History*, 4 (2), pp. 175-191.

Keeling, D. (2008), "The Voyage Abstracts of the Cunard Line as a Source of Transatlantic Passenger Fares, 1883-1914," *Business Archives Sources and History*, 96, pp. 15-36.

Keeling, D. (2012), *The Business of Transatlantic Migration between Europe and the United States, 1900-1914,* Zurich: Chronos Verlag.

Killick, J. (2014), "Transatlantic Steerage Fares, British and Irish Migration, and Return Migration, 1815-60," *Economic History Review*, 67 (1), pp. 170-191.

Kelly, M. and Ó Gráda, C. (2019), "Speed under Sail, 1750–1830," *Economic History Review,* 72 (2), pp. 459–480.

Kelly, M., Ó Gráda, C. and Solar, P. M. (2021), "Safety at Sea during the Industrial Revolution," *Journal of Economic History*, 81 (1), pp. 239-275.

Lubbock, B. (1948), The Colonial Clippers, Glasgow: James Brown and Son.

Maber J. M. (1967), *North Star to Southern Cross*, Prescot: T. Stephenson & Sons.

Miotto, M. and Pascali, L. (2022), "Solving the Longitude Puzzle: A Story of Clocks, Ships and Cities," unpublished paper.

Maury, M. F. (1851), *Explanations and Sailing Directions to Accompany the Wind and Current Charts Approved by Commodore Lewis Warrington*, Washington: G. Alexander [Forgotten Books reprint].

Maury, M. F. (1855) *The physical geography of the sea,* London: Sampson, Low, Son & Co.

McDonald, J. and Shlomowitz, R. (1991), "Passenger Fares on Sailing Vessels to Australia in the Nineteenth Century," *Explorations in Economic History*, 28, pp. 192-208.

Morgan, K. (2021) "Peopling a New Colony: Henry Jordan, Land Orders, and Queensland Immigration, 1861-7," *Historical Research*, 94, pp. 1 - 33.

Pascali, L. (2017), "The Wind of Change: Maritime Technology, Trade, and Economic Development," *American Economic Review*, 107 (9), pp. 2821–2854.

Pope, D. and Withers, G. (1993), "Do Migrants Rob Jobs? Lessons of Australian History, 1861-1991," *Journal of Economic History*, 53 (4), pp. 719-742.

Richards, E. (1993), "How did poor people emigrate from the British Isles to Australia in the nineteenth century?" *Journal of British Studies*, 32 (3), pp. 250-279.

Sánchez-Alonso, B. (2000), "European Emigration in the Late Nineteenth Century: The Paradoxical Case of Spain," *Economic History Review*, 53 (2), 309–330.

Seltzer, A. (2016), "Labour Skills and Migration" in S. Ville and G. Withers (eds.), The Cambridge Economic History of Australia, Melbourne: Cambridge University Press.

Shah Mohammed, S. I. and Williamson, J. G. (2004), "Freight Rates and Productivity Gains in British Tramp Shipping 1869–1950," *Explorations in Economic History*, 41, pp. 172–203.

Sjaastad, L. A. (1962), "The Costs and Returns of Human Migration," *Journal of Political Economy*, 70, (5, part 2), pp. 80-93.

Solar, P. M. and Hens, L. (2016) "Ship Speeds during the Industrial Revolution: East India Company Ships, 1770–1828," *European Review of Economic History*, 20 (1), pp. 66–78.

Williams, D. M. (2000), "Market Pressures and Innovation: The Orient Steam Navigation Co. and the Development of Pleasure Cruising, 1888-1900," *Northern Mariner*, 10 (4), pp. 1-12.

Williams, D. M. and Armstrong, J. (2010), "Changing Voyage Patterns in the Nineteenth Century: The Impact of the Steamship," *International Journal of Maritime History*, 22 (2), pp. 151-170.

Williamson, J. G. (1995), "The Evolution of Global Labor Markets since 1830: Background Evidence and Hypotheses," *Explorations in Economic History*, 32, pp. 141-196.

Woolcock, H. R. (1986), *Rights of Passage: Emigration to Australia in the Nineteenth Century,* London: Tavistock Publications.

Appendix 1: Calculation of sailing times on emigrant voyages to Australia.

Emigrant voyages from the UK to Sydney.

Arrival dates and the names of ships for 1837 to 1888 were taken from the New South Wales State Archives digital file (summary) at: https://www.records.nsw.gov.au/archives/collections-and-research/guides-and-indexes/assisted-immigrants-digital-shipping-lists. Departure dates and the number of passengers were then taken from the original ships lists at the same site (see also the pdf list at: https://www.records.nsw.gov.au/sites/default/files/Public%20Access/PDF%20Guides/Appendix%20A%20-%20Immigrant%20ships%20arriving%20in%20New%20South%20Wales%201828-96.pdf). Some missing values for passengers and departure dates were added from the tables of emigrant ships provided in the annual reports the UK Emigration Commissioners. From 1837 to 1888 the total for which departure dates could be found is 680 out of 884 and a further 13 were dropped that departed from a non-UK port, arrived at Moreton Bay or where arrival dates were unclear, leaving a total of 667 voyages. These departures were from different UK ports, notably London and Plymouth, but including others such as Liverpool, Glasgow and Cork.[21]

The statistics of these voyages by year of departure are reported in Table A1.1. As noted in the main paper, for some years there are very few voyages and hence there is considerable year to year variation in voyage length, and there are no observations for the years 1842, 1845, 1846 and 1867. From 1847 to 1883 number of days on the voyage averaged across years, for sailing ships only, is 98.1 days which may be compared with the annual average over the same years (sail only, to all Australian destinations) from McDonald and Shlomowitz (1991, p. 196) of 100.4 days.

Table A1.2: Emigrant Voyages from the UK to New South Wales 1837-1888

Departure year	Mean days	Median days	Standard deviation	Min days	Max days	No of voyages
1837	129.6	124	17.9	109	167	16
1838	129.4	123	27	93	235	38
1839	127	120.5	21.6	95	171	26
1840	120.7	117	18.7	91	178	25
1841	119.1	115	22.1	76	242	59
1843	113.4	109	15.8	92	130	5
1844	112.4	109	13.7	103	136	5
1847	106.3	109	6.4	99	111	3
1848	109.3	109	8.3	93	125	24
1849	111.9	108	14.9	89	144	32
1850	106.8	113	15.1	62	118	12
1851	116.7	118	19.2	87	142	12
1852	116.5	110	16.1	98	158	23
1853	109.3	107	15.8	86	148	23
1854	103.6	103.5	13.1	75	130	36
1855	109.6	105.5	30.4	85	275	38

---

[21] From 1852 Plymouth was the Australian mail port and for that reason many ships called there. But as ships became larger London, and Southampton became the base ports and tenders conveyed the mail and passengers from Plymouth to ships anchored inside the breakwater.

1856	101.6	100	10.2	74	124	26
1857	103.1	100	12.8	87	150	25
1858	105.1	107	13.3	85	130	17
1859	99.7	99	9	89	115	12
1860	95.6	96	10.8	83	116	8
1861	103.8	98.5	11.7	97	127	6
1862	102.3	99	6.6	96	114	9
1863	95.3	94	10.3	79	115	15
1864	102.6	99	11.7	88	121	11
1865	107	106	16	83	123	5
1866	92.7	99	11	80	99	3
1867	92	92	7.1	87	97	2
1868						
1869	103	101	13.7	90	120	4
1870	84.5	84.5	0.7	84	85	2
1871	96.7	96	5	92	102	3
1872	104.5	95.5	16.6	93	134	6
1873	74	74	.	74	74	1
1874	91.5	90.5	4	88	97	4
1875	82.8	84	4	77	86	4
1876	83.8	84	7.8	76	91	4
1877	88.1	87	8.7	76	101	15
1878	89.5	87	9.6	77	104	11
1879	82.9	83	13	53	98	11
1880	87.3	84	14	71	106	8
1881	88.5	87	6.5	79	96	6
1882	90.3	90.5	8.2	78	104	10
1883	85.3	85	16.7	48	122	22
1884	57.2	53.5	14	44	94	10
1885	49.4	47	4.4	44	56	9
1886	50.5	49.5	3.7	46	57	6
1887	44.9	43	4	41	52	7
1888	44.5	44	1.4	43	47	8

For 1890 onwards, a sample of voyages was taken from the New South Wales database "Unassisted Immigrant Passenger Lists 1826-1922," which is accessed in Ancestry.com.au. Although these are for unassisted immigrants they also include some assisted immigrants, particularly in the early 1890s and after 1906. 500 passengers from the UK were sampled for each year of arrival, which (using a filter for age 20) produced an annual average of around 100 voyages. As the ships lists recorded on arrival do not include departure dates, it was necessary to match the arrival with a departure, using the ship name and year, from the database "UK and Ireland, Outward Passenger Lists, 1890-1960," also in Ancestry.com.au. The match rate of departures to the sample of arrivals is 57 percent. Failure to match is likely the result of the fact that the departures data is not complete and some of the voyages would not have been recorded if they did not fall under the UK Passenger Acts. It is also likely in some cases that ship names were recorded differently on departure and arrival, sometimes due to differences in transcription (e.g. *Orotava* vs *Oratava*—one that could be resolved).

As for the earlier years, ships departed from a range of different UK ports. I choose the date when most passengers for Sydney embarked; choosing the latest departure date would probably reduce voyage times by about half a day. It is important to note that many of matched voyages disembarked very few passengers at Sydney. These were often on ships that were not principally emigrant ships ('short ships') and/or that came more indirectly to Sydney. In order to gain greater comparability with the series from 1837 to 1888, the voyages that brought less than 100 immigrants to NSW were excluded. As a result, only 474 out of 1,475 voyages were retained in the data. As listed in Table A1.2, this gives an average (by year) voyage length of 45.0 days. For voyages with less than 100 passengers bound for NSW the average (by year) is 49.0 days. The overall average number of passengers departing for New South Wales, with a minimum of 100, is 230. This compares with the average number of passengers on voyages in 1847 to 1888 of 329.

All the ships in the database were identified as sail or steam using the New South Wales database for "Vessels Arrived in Sydney 1837-1925" at: https://www.records.nsw.gov.au/archives/collections-and-research/guides-and-indexes/node/1356/browse (which also provides a check on arrival dates). Where necessary, further checks were made using Lloyds Register Foundation Heritage and Education Centre at: https://hec.lrfoundation.org.uk/. For the years 1909 to 1913 voyages were identified as sailing via the Suez Canal or via the Cape of Good Hope by searching the departure passenger lists, which list the destination for each passenger. If some of the passengers were found to be bound for ports such as Marseilles, Naples, Suez, Port Said or Colombo then the voyage was identified as sailing via Suez, otherwise the Cape.

Table A1.2: Emigrant Voyages from the UK to New South Wales 1890-1913

Year	Mean days	Median days	Standard deviation	Minimum days	Maximum day	No of voyages
1890	45.3	45.0	0.9	44.0	47.0	10.0
1891	45.2	45.0	1.4	43.0	49.0	20.0
1892	44.1	44.0	1.6	40.0	46.0	18.0
1893	44.4	45.0	1.0	43.0	46.0	14.0
1894	44.5	45.0	1.5	42.0	46.0	15.0
1895	44.8	45.0	1.3	41.0	47.0	18.0
1896	45.9	46.0	1.7	42.0	48.0	9.0
1897	44.2	44.0	1.9	41.0	47.0	19.0
1898	44.4	44.0	3.1	41.0	56.0	20.0
1899	43.2	43.0	1.2	42.0	45.0	21.0
1900	44.1	43.0	2.9	42.0	54.0	15.0
1901	45.1	43.0	4.0	42.0	56.0	20.0
1902	45.7	43.0	4.6	41.0	54.0	18.0
1903	45.1	43.0	3.9	40.0	50.0	12.0
1904	44.6	42.5	4.3	42.0	53.0	8.0
1905	44.9	43.0	3.4	42.0	51.0	12.0
1906	45.9	43.0	5.2	41.0	53.0	8.0
1907	44.1	42.0	3.7	41.0	52.0	22.0
1908	44.0	43.0	2.8	42.0	52.0	20.0
1909	45.5	43.0	4.0	42.0	54.0	33.0
1910	46.0	43.0	5.7	40.0	60.0	34.0
1911	47.1	46.0	6.4	40.0	64.0	42.0
1912	45.9	42.0	7.1	39.0	68.0	31.0
1913	45.4	42.0	5.2	40.0	58.0	35.0

Emigrant voyages from the UK to Queensland

Voyage times from the UK to destinations in Queensland are based on the database "Register of passengers on immigrant ships arriving in Queensland" at: https://www.archivessearch.qld.gov.au/items/ITM18474. The initial base for departures was the list provided by the Perth Dead Persons Society at http://www.perthdps.com/shipping/mig-wa.htm. This was supplemented for 1890 to 1913 by matching arrivals by ship name with departures from "UK and Ireland, Outward Passenger Lists, 1890-1960," at https://www.ancestry.com.au/. Occasionally other sources were used such as the database "Ozships: Australian shipping 1788-1968", at http://www.blaxland.com/ozships//index.htm and reports in newspapers such as the *Brisbane Courier* and *Brisbane Herald* accessed in Trove at https://trove.nla.gov.au/. These voyages departed from a range of UK ports, most often London and Plymouth but also from Liverpool and Glasgow among others. The principal destination was Brisbane (or Moreton Bay) but ships disembarked emigrants at a range of other ports further up the coast including Maryborough, Rockhampton and Townsville. Where the arrival dates were recorded for more than one port the earliest arrival date was taken in order to avoid cases where the ship sojourned before proceeding to round Australia calling at destinations on the south coast.

From 1873 to 1913, out of a total of a total of 1,392 arrivals, 1,261 or 90.6 percent, could be matched to departure dates. But, as with ships carrying unassisted passengers to New South Wales, many of these voyages disembarked relatively few emigrants in Queensland. Ships could take considerably longer when Queensland was not the principal destination. As Woolcock (1986, p. 68-9) notes, more than half of Queensland-bound voyages up to 1900 were accounted for by 'short ships' (those carrying too few passengers to be covered by the UK Passenger Acts) and in the 1890s they accounted for 70 percent of voyages and 43.6 percent of passengers. "The majority of short steamers carried mails and therefore kept to a regular schedule, but short ships under sail, not being tied in this way, could afford a more leisurely passage" (Woolcock, 1986, p. 69). In order to be consistent with the series for New South Wales from the 1890s I restrict the index of durations to voyages disembarking at least 100 passengers in Queensland. Ships not otherwise identified as sail or steam were classified using the Lloyds Register Foundation Heritage and Education Centre at: https://hec.lrfoundation.org.uk/. And, as with voyages to New South Wales, voyages to Queensland from 1909 to 1913 were identified as sailing either via Suez or via the Cape from the destination ports of passengers on passenger lists for departures.

Over the four decades this yields nearly 500 voyages, which are tabulated by year in Table A1.3. However, there are very few between 1890 and 1908 when immigration to Queensland was low and there were very few assisted passages, which leaves gaps for 1893-8, 1901-2 and 1904-6. For the years 1873 to 1888 the mean voyage duration averaged across years is 84.4 days as compared with 74.4 days on voyages to New South Wales. For the years 1890-1913, again averaged across years, the difference is somewhat smaller: 50.2 days to Queensland and 45.0 days to New South Wales.

Table A1.3: Emigrant Voyages from the UK to Queensland 1873-1913

Year	Mean days	Median days	Standard deviation	Minimum days	Maximum days	No of voyages
1873	97.7	95.5	12.4	68.0	121.0	14.0
1874	107.8	105.0	18.3	89.0	178.0	21.0
1875	114.9	114.0	13.4	97.0	142.0	16.0
1876	103.4	101.5	13.5	89.0	129.0	16.0
1877	101.1	102.0	14.9	79.0	129.0	15.0
1878	107.1	105.0	13.2	82.0	135.0	19.0
1879	98.2	98.0	9.0	83.0	109.0	6.0
1880	99.5	103.0	7.3	90.0	110.0	11.0
1881	83.1	86.0	22.0	51.0	120.0	17.0
1882	76.4	68.5	24.9	40.0	118.0	36.0
1883	77.3	86.0	25.1	42.0	121.0	62.0
1884	56.1	52.0	14.4	47.0	121.0	29.0
1885	56.2	52.0	10.3	49.0	91.0	30.0
1886	59.3	51.0	19.7	45.0	114.0	25.0
1887	60.3	52.0	21.6	38.0	119.0	27.0
1888	53.8	51.0	14.4	44.0	107.0	17.0
1889	53.3	48.0	18.3	44.0	116.0	14.0
1890	50.9	47.0	11.2	43.0	80.0	9.0
1891	46.6	47.0	3.2	39.0	49.0	8.0
1892	49.7	50.0	0.6	49.0	50.0	3.0
1899	53.0	53.0	1.4	52.0	54.0	2.0
1900	51.2	52.0	2.3	48.0	54.0	5.0
1903	48.0	48.0	.	48.0	48.0	1.0
1907	47.4	48.0	1.3	45.0	48.0	5.0
1908	48.0	48.0	1.2	47.0	49.0	4.0
1909	53.1	49.0	7.2	48.0	72.0	13.0
1910	49.0	48.0	4.7	45.0	59.0	18.0
1911	53.0	50.0	8.6	44.0	75.0	33.0
1912	53.3	54.0	4.3	47.0	60.0	13.0
1913	52.3	52.0	2.8	50.0	59.0	9.0

References for Appendix 1

McDonald, J. and Shlomowitz, R. (1991), "Passenger Fares on Sailing Vessels to Australia in the Nineteenth Century," *Explorations in Economic History*, 28, pp. 192-208.

Woolcock, H. R. (1986), *Rights of Passage: Emigration to Australia in the Nineteenth Century*, London: Tavistock Publications.

Appendix 2: Data on Costs and Benefits

Ticket prices and foregone wage costs on emigrant voyages 1853-1913

For voyages from the UK to the US, I use the index for steerage fares from Liverpool to New York reported in Hatton (2023, appendix). This is based on three series. For voyages by sail I use the series provided by Killick (2014), based on Cope Line voyages from Liverpool to Philadelphia. This is raised slightly to allow for agents' fees to £3 10s in 1863, which is consistent with the range of £3 5s to £3 15s for single adult from Liverpool to New York reported by the UK Emigration Commissioners, 24th Report, (1864) p. 16. For steam, from 1866 to 1889, I use the average of quarterly westward steerage rates from Dupont et al. (2017), adjusted to pounds sterling, which is extended back to 1853 with additional fare quotes. For the years where they overlap, the average of sail and steam fares is calculated using as weights the shares of passenger arrivals by sail and by steam in New York. From 1890 to 1913 the series is the average of quarterly westward steerage fares from Keeling (2008, Appendix 1), to which is added the United States head tax on non-citizen arrivals. The annual values for this series are presented in the appendix to Hatton (2023).

I estimate the cost of passage from the UK to New South Wales for 1853 to 1896 using the same source as for the calculation of arrival dates: https://www.records.nsw.gov.au/archives/collections-and-research/guides-and-indexes/assisted-immigrants-digital-shipping-lists. The last page of each ship's list often includes the contract price per statute adult for transporting assisted immigrants (the outcome of tenders by shipping companies). This gives a total of 314 observations over the 44 years. The series is very close to the contract price series provided by McDonald and Shlomowitz (1991) for sailing ships from the UK to all Australian destinations. For the years that they overlap (1857 to 1885) the means are identical at £14.05.[22] So I use their series for the years before 1857. From 1897 to 1913 I use the series of Pope and Withers (1993), kindly provided by Glenn Withers. These are unassisted (basic) passage costs per adult constructed from colonial and state statistical registers, various newspapers and P & O Fleet Records. Prices for voyages by sail and steam are not separated in the index. However, McDonald and Shlomowitz (1991, p. 201) note that when, in the early 1880s, the governments of Queensland and New South Wales made contracts with shipping firms to transport assisted immigrants, the contract prices on steamships were only slightly higher than on sailing ships. The final series is listed in Table A2.1 below.

Table A2.1: Index of voyage costs per emigrant from the UK to Australia 1853 to 1913 (£)

Year	Cost	Year	Cost	Year	Cost	Year	Cost
1853	18.0	1868	14.3	1883	13.4	1898	14.6
1854	20.5	1869	13.9	1884	14.4	1899	13.6
1855	16.8	1870	13.8	1885	14.9	1900	12.7
1856	13.8	1871	13.8	1886	14.8	1901	13.3
1857	14.8	1872	13.8	1887	14.9	1902	15.0
1858	14.6	1873	14.1	1888	15.0	1903	15.2
1859	14.8	1874	14.8	1889	15.0	1904	15.3
1860	15.3	1875	16.1	1890	15.0	1905	15.3

---

[22] As a further check, the figure of £15.1 for 1895 can be compared with the average quote of third class fares to Sydney for 10 shipping lines of £15.33 (with ship kit) and £14.28 (without ship kit) (Hutchinson ed., 1996, p. 364).

1861	16.7	1876	12.8	1891	15.0	1906	15.0
1862	13.3	1877	12.7	1892	15.2	1907	14.8
1863	14.0	1878	14.4	1893	15.0	1908	13.6
1864	13.6	1879	14.5	1894	15.0	1909	13.1
1865	12.7	1880	13.4	1895	15.1	1910	13.9
1866	12.9	1881	13.2	1896	15.0	1911	13.4
1867	13.2	1882	13.5	1897	14.7	1912	12.2
						1913	12.2

Sources: See text.

Foregone earnings during passage is calculated using the series for weekly earnings for all employees from Feinstein (1990) extended back to 1853. This is multiplied by the average number of weeks during the passage for the US and Canada from Hatton (2023) and for Australia/New Zealand from Table A1.1 above to give the cost in terms of earnings foregone.

Other variables used in regression analysis

Outward passenger movements to the United States, Canada and Australia/New Zealand (ANZ) are taken from Carrier and Jeffrey (1953), Table D/F/G (1). In order to calculate the flow of unassisted emigrants to ANZ it is necessary to deduct the number of assisted emigrants. For 1853 to 1900 these are the total for five Australian colonies from Haines and Shlomowitz (1992). The series for Queensland is based on the count from passenger lists at: https://www.data.qld.gov.au/dataset/assisted-immigration-1848-to-1912. These data were filtered by hand to exclude captains, masters, surgeons and to eliminate exact and non-exact duplicates arising from differences in the spelling of names. For 1901 to 1913 assisted migrants to the six Australian states are taken from Pope (1976, vol. 1), p. 157. The series for assisted migration to New Zealand was kindly provided by personal communication from Les Oxley.

Among the explanatory variables, indices of real unskilled wage rates were taken from Williamson (1995). As the data for Canada begins only in 1870 the years back to 1853 were extrapolated using the series for the US. The UK series is a weighted average of the series for Great Britain and Ireland. Real GDP per capita is taken from the updated Maddison series at: https://www.rug.nl/ggdc/historicaldevelopment/maddison/releases/maddison-project-database-2020. For Canada the annual series begins only in 1870 with benchmarks for 1850 and 1960; the intervening years were interpolated using the series for the US.

Freight rates per ton of coal, taken from Harley (1989), are used as an instrument for migration costs. As he notes (1989, p. 315) "it is one of the few freight rate indices available that begins prior to and extends through the technological revolution in shipping that saw wooden sailing ships replaced by steel steamers." For the US and Canada, the series is for rates from Welsh ports to Atlantic Ports and for Australia/New Zealand the series is for rates from Welsh ports to Colombo. When used as an instrument this series is deflated by the UK cost of living index.

The index of emigrant assistance policies was created by first specifying a dummy variable for each colony/state equal to 1 for years when any such policies were in place. For the Australian colonies up to 1900 these were derived from the summary in Haines (1995) pp 13-34, and for 1901 to 1913 from Pope (1976, Vol. 1) pp. 208-244. The policy variable for New Zealand is derived from Brooke (2011),

p. 165. These variables are summed with the weight for each colony/state as its share of the aggregate population in 1881. Thus the series ranges from zero when no colony has a policy in effect to one when all colonies have an active policy.

Difference in shipping costs: Suez versus the Cape

The calculations that follow are illustrative and use round figures to avoid spurious accuracy. Following Hutchinson (1914), I assume a steamship of 6,000 tons gross, 3,000 tons net register, sailing at 10 knots and consuming 30 tons of coal per day. As mentioned in the text, based on the data on voyages to Sydney in 1909-13, the difference in voyage time via the Cape and through Suez is taken to be 8 days.

In 1884 tolls on the Suez Canal were 10 francs per registered ton and 10 francs per passenger. By 1913 the tonnage toll had been gradually reduced to 6.25 francs but passenger tolls remained at 10 francs (Johnson, 1912, p. 98). A ship carrying 400 passengers would therefore pay F34,000 or £1,360 in 1884 and F22,750 or £910 in 1913.

Coal consumption would be slightly more for the longer voyage around the Cape. For 8 more days using 30 tons of coal per day at a price of £1.25 per ton (see Johnson, 1912, p.159; Hutchinson 1914, p. 579-80), the additional cost would be £300.

As is often noted, ships sailing around the Cape needed to carry more coal for the longest leg between coaling stations than ships passing though Suez. The longest leg via Suez is assumed to be Colombo to Freemantle = 4000nm which would require 500 tons of coal.[23] Via the Cape, Durban to Freemantle is 4500nm but here I use Durban to Adelaide which is 5700nm and which would require 712.5 tons, giving a difference of 212.5 tons. On the basis of 7.5 tons net register per passenger (3000 tons, 400 passengers) this would mean that 28 fewer passengers could be carried on voyages around the Cape, implying a cost in foregone revenue of £14*28 = £392. An alternative would be the cost of forgone cargo which at £1.65 per ton (Hutchinson 1914, p. 582), would mean foregone cargo to the value of £350.

Thus on this calculation the total cost difference (Suez minus the Cape) would be: £1360 - £300 - £392 = £668 in 1884 and £910 - £300 - £392 = £218 in 1913. As Wilson (1938, p. 94) noted "The saving of 1,000 miles between London and Melbourne is more than outweighed by the burden of canal dues." He also observed that in 1908 twice as many ships between Europe and Australia and New Zealand sailed north though the canal than sailed south. In part this may have been due to the extra cost of passengers, predominantly travelling south.

References for Appendix 2

Brooke, G. T. F. (2011), "Three Essays on Economic History", PhD thesis, University of Auckland.

Dupont, B., Keeling, D. and Weiss, T. (2017), "First Cabin Fares from New York to the British Isles, 1826–1914," *Research in Economic History*, 33, pp. 19-63.

---

[23] According to Hutchinson (1914, p. 580) the longest leg from Liverpool to Batavia via Suez was Colombo to Batavia, which would require 465 tons of coal.

Feinstein, C. H. (1990), "New Estimates of Average Earnings in the United Kingdom, 1880-1913," *Economic History Review*, 43 (4), pp. 595-632.

Haines, R. F. (1995) "Nineteenth Century Government Assisted Immigrants from the United Kingdom to Australia," Flinders University Occasional Papers in Economic History 3.

Haines, R. and Shlomowitz, R. (1992), "Immigration from the United Kingdom to Colonial Australia: A Statistical Analysis," *Journal of Australian Studies*, 16 (34), pp. 43–52.

Hatton, T. J. (2023), "Time on the Crossing: Emigrant Voyages Across the Atlantic, 1853 to 1913," *European Review of Economic History* (forthcoming), also IZA Discussion Paper 16274.

Harley, C. K. (1989), "Coal Exports and British Shipping, 1850-I 913*," Explorations in Economic History,* 26, pp. 311-338.

Hutchinson, F. (ed.) (1896), *New South Wales: The Mother Colony of the Australias*, Sydney: Charles Potter.

Hutchinson, L. (1914), "Voyage Costs via Panama and Other Routes," *American Economic Review*, 4 (3), pp. 575-587.

Johnson, E. R (1912), *Panama Canal Traffic and Tolls*, US War Department, Isthmian Canal Commission, Washington: GPO.

Keeling, D. (2008), "The Voyage Abstracts of the Cunard Line as a Source of Transatlantic Passenger Fares, 1883-1914," *Business Archives Sources and History*, 96, pp. 15-36.

Killick, J. (2014), "Transatlantic Steerage Fares, British and Irish Migration, and Return Migration, 1815-60," *Economic History Review*, 67(1), pp. 170-191.

McDonald, J. and Shlomowitz, R. (1991), "Passenger Fares on Sailing Vessels to Australia in the Nineteenth Century," *Explorations in Economic History*, 28, pp. 192-208.

Meeker, R. (1905), "History of Shipping Subsidies," *Publications of the American Economic Association,* 3rd Series, 6 (3), pp. 1-229.

Pope, D. (1976), "The Peopling of Australia: United Kingdom Immigration from Federation to the Great Depression," PhD Thesis, Australian National University.

Pope, D. and Withers, G. (1993), "Do Migrants Rob Jobs? Lessons of Australian History, 1861-1991," Journal of Economic History, 53 (4), pp. 719-742.

UK Emigration Commissioners (1864), *24th General Report of the Emigration Commissioners*, London: HMSO.

Williamson, J. G. (1995), "The Evolution of Global Labor Markets since 1830: Background Evidence and Hypotheses," *Explorations in Economic History*, 32, pp. 141-196.

Wilson, A. T. (1939), *The Suez Canal: Its Past Present and Future,* London: Oxford University Press.

Woolcock, H. R. (1986), *Rights of Passage: Emigration to Australia in the Nineteenth Century,* London: Tavistock.

Appendix 3: Supplementary Regressions

Table A3.1: First stage results for IV regressions in Table 2

	(1)	(2)	(3)	(4)
Steam dummy	-0.683	-1.697	1.588	-3.284
	(0.23)	(0.67)	(0.40)	(0.50)
Real coal freight rate (t)	0.083	0.310	0.197	0.113
	(0.04)	(0.06)	(0.05)	(0.03)
Time trend	-0.002	-0.069	-0.045	-0.023
	(0.01)	(0.02)	(0.01)	(0.01)
Log real wage ratio (destination/origin) (t-1)	1.459	6.978	5.013	1.966
	(0.85)	(1.82)	(1.44)	(0.91)
Growth of real GDP per capita (destination, t)	0.911	5.956	3.173	2.788
	(3.19)	(4.90)	(3.98)	(2.88)
Growth of real GDP per capita (destination, t-1)	0.011	1.369	0.252	1.126
	(3.05)	(6.06)	(4.77)	(2.38)
Log emigration (t-1)	-0.264	-0.109	-0.416	0.307
	(0.13)	(0.26)	(0.22)	(0.17)
Under-identification, X^2 (3)	10.05	19.45	18.75	19.04
Excluded instruments, F (3, 59)	15.12	131.09	43.15	79.51
Observations	177	177	177	177

Notes: Estimation using IV-GMM with Driscoll-Kray standard errors (in parentheses) with bandwidth 2 in the time dimension. The instruments are freight rates for coal for shipping from Wales to Atlantic ports (US and Canada) and to the far East (Australia/New Zealand), a dummy variable for the switch from sail to steam in 1864 for the USA and Canada and 1884 for Australia/New Zealand and a common time trend.

In the IV estimates in Table A3.2 below, in columns (1) and (2) the cost variables are entered in logs rather than levels. I columns (3) and (4) the cost variables are in levels but are lagged by one year. In all cases the cost variables remain negative and significant.

Table A3.2: Emigration from the UK to the USA, Canada and ANZ, 1855-1913—Alternative Definition of Costs

	(1)	(2)	(3)	(4)
	Costs in logs		Costs lagged one year	
Log real total money cost (t)	-1.370**			
	(0.62)			
Log total cost in weeks (t)		-0.419**		
		(0.17)		
Real total money cost (t-1)			-0.140**	
			(0.06)	
Total cost in weeks (t-1)				-0.029***
				(0.01)
Log real wage ratio (destination/origin) (t-1)	0.424	0.329	0.585*	0.555*
	(0.33)	(0.26)	(0.34)	(0.31)
Growth of real GDP per capita (destination, t)	5.369***	4.825***	5.580***	5.117***
	(1.48)	(1.40)	(1.43)	(1.50)
Growth of real GDP per capita (destination, t-1)	4.103***	3.601***	3.674***	3.517***
	(1.44)	(1.22)	(1.12)	(1.12)
Log emigration (t-1)	0.749***	0.791***	0.792***	0.814***
	(0.07)	(0.06)	(0.06)	(0.05)
R^2	0.889	0.916	0.911	0.918
Under-identification, X^2 (3)	8.47	17.84	12.58	19.53
Excluded instruments, F (3, 59)	10.62	88.27	12.35	114.21
Over-identification, X^2 (2)	0.284	0.298	0.206	0.329
Observations	177	177	177	177

Notes: Estimation using IV-GMM with Driscoll-Kray standard errors (in parentheses) with bandwidth 2 in the time dimension. The instruments are freight rates for coal for shipping from Wales to Atlantic ports (US and Canada) and to the far East (Australia/New Zealand), a dummy variable for the switch from sail to steam in 1864 for the USA and Canada and 1884 for Australia/New Zealand and a common time trend.

As noted in the text, when the index of assisted emigration policies is introduced in Table 3, columns (1) and (2), the coefficients are positive, and significant in column (2). This suggests that more generous policies reduced unassisted immigration to Australia and New Zealand. However, assisted emigrants may have been encouraged to apply for assisted passages by recent emigrants whether or not the recent emigrants had been assisted. Columns (1) and (2) of Table A3.3 show that when the lagged emigration variable is total emigration (assisted plus unassisted) but the dependent variable is still only unassisted, the policy index becomes insignificant in both regressions.

In columns (3) and (4) of Table A3.3 below, lagged emigration for Australia and New Zealand is unassisted only as in columns (1) and (2) of Table 3 in the main text, but the time trend is dropped from the instrument set leaving only coal freights and the dummy for the transition from sail to steam as instruments. The coefficients on the cost variables remain negative and significant, indicating that the result does not depend on the inclusion of the time trend as an instrument.

Table A3.3: Emigration from the UK to the USA, Canada and ANZ, 1855-1913—Alternative Specifications

	(1)	(2)	(3)	(4)
	Lagged total emigration		Trend instrument dropped	
Real total money cost (t-1)	-0.220***		-0.155***	
	(0.05)		(0.05)	
Total cost in weeks (t-1)		-0.051***		-0.035***
		(0.01)		(0.01)
Log real wage ratio (destination/origin) (t-1)	0.635	0.554*	0.552	0.492
	(0.40)	(0.32)	(0.34)	(0.31)
Growth of real GDP per capita (destination, t)	3.793***	3.425***	5.025***	4.808***
	(1.31)	(1.16)	(1.32)	(1.38)
Growth of real GDP per capita (destination, t-1)	3.478**	3.208***	3.625***	3.445***
	(1.42)	(1.20)	(1.35)	(1.18)
Log emigration (t-1)	0.688***	0.720***	0.766***	0.790***
	(0.07)	(0.07)	(0.06)	(0.06)
Assisted emigration policy index (t)	-0.204	-0.014	0.142	0.284*
	(0.24)	(0.22)	(0.15)	(0.15)
R^2	0.873	0.899	0.906	0.919
Under-identification, X^2 (3)	14.46	20.63	11.43	13.87
Excluded instruments, F (3, 59)	16.61	132.97	26.80	90.08
Over-identification, X^2 (2)	1.597	2.056	0.254	0.740
Observations	177	177	177	177

Notes: Estimation using IV-GMM with Driscoll-Kray standard errors (in parentheses) with bandwidth 2 in the time dimension. The instruments are freight rates for coal for shipping from Wales to Atlantic ports (US and Canada) and to the far East (Australia/New Zealand), a dummy variable for the switch from sail to steam in 1864 for the USA and Canada and 1884 for Australia/New Zealand and a common time trend.

The results of Tables 2 and 3 in the main text, and in particular the coefficients on emigration costs, could depend disproportionately on the inclusion of one of the countries. As the focus here is on Australia and New Zealand, and because the cost variables for the USA and Canada are very similar, each of these destinations is dropped in turn in Table A3.4 below. This reduces the number of observations from 177 to 118. In columns (1) and (2) where Canada is dropped from the regressions the real wage ratio and lagged GDP growth lose significance although they remain fairly strong in columns (3) and (4) where the USA is dropped. But in each case the coefficient on the both cost variables remain negative and significant.

Table A3.4: Emigration from the UK to the USA, Canada and ANZ, 1855-1913—Dropping Destinations

	(1)	(2)	(3)	(4)
	Canada dropped		USA dropped	
Real total money cost (t-1)	-0.141**		-0.203***	
	(0.06)		(0.06)	
Total cost in weeks (t-1)		-0.026**		-0.050***
		(0.01)		(0.01)
Log real wage ratio (destination/origin) (t-1)	0.140	0.033	0.886**	0.918***
	(0.43)	(0.37)	(0.38)	(0.36)
Growth of real GDP per capita (destination, t)	2.758**	3.068**	4.202***	4.062**
	(1.21)	(1.39)	(1.50)	(1.61)
Growth of real GDP per capita (destination, t-1)	1.892	2.004*	2.839*	2.869**
	(1.31)	(1.19)	(1.64)	(1.41)
Log emigration (t-1)	0.556***	0.625***	0.741***	0.748***
	(0.10)	(0.09)	(0.06)	(0.06)
Assisted emigration policy index (t)	0.367***	0.424***	0.133	0.334**
	(0.13)	(0.14)	(0.16)	(0.14)
R^2	0.927	0.936	0.758	0.808
Under-identification, X^2 (3)	9.58	15.41	16.22	19.34
Excluded instruments, F (3, 59)	10.64	64.40	18.97	88.43
Over-identification, X^2 (2)	0.741	2.002	0.981	1.317
Observations	118	118	118	118

Notes: Estimation using IV-GMM with Driscoll-Kray standard errors (in parentheses) with bandwidth 2 in the time dimension. The instruments are freight rates for coal for shipping from Wales to Atlantic ports (US and Canada) and to the far East (Australia/New Zealand), a dummy variable for the switch from sail to steam in 1864 for the USA and Canada and 1884 for Australia/New Zealand and a common time trend.