

# Skilled Immigrants and American Industrialization: Lessons from the Shipyards\*

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## Abstract

While there is ongoing debate over the effects of immigration, relatively little attention has been paid to the possibility that immigrants may bring with them scarce but vital skills that facilitate the emergence of new firms or industries. In this paper, I provide evidence that skilled immigrant workers played just such a role during the expansion of the metal shipbuilding industry in the U.S. in the late 19th century. I take a novel analysis approach that focuses on “industry towns” such as Newport News, VA, which allows me to use the population census to analyze the origin of the labor force in the shipbuilding industry along dimensions that are typically difficult to observe. My results show that skilled immigrant workers, mainly from Britain, formed an important part of the labor force in new metal shipbuilding firms. I also provide evidence that, over time, native workers were trained in occupations initially filled mainly by foreigners. These results indicate that access to skilled immigrants can be important for industry growth with dynamic effects on the employment of native-born workers.

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# 1 Introduction

There is currently a robust debate over the size and nature of immigration flows that should be allowed into the United States. Much of the attention in this debate has been focused on competition between immigrants and native workers in the labor market. Other work investigates the role of immigrants as innovators. One possibility that has received less attention, but may also be important, is that immigrants may bring with them scarce skills that facilitate the emergence of new firms and industries, providing employment for both immigrant and native-born workers.

This paper provides new evidence on the importance of skilled immigrant workers in early American industrialization, focusing specifically on the metal shipbuilding industry. While the U.S. was an important producer of wood ships in the mid-19th century, the growth of metal shipbuilding after 1850 shifted the industry to Britain, which enjoyed the advantage of cheaper iron input prices.<sup>1</sup> This early lead allowed Britain to build up a pool of skilled metal shipbuilders that made British shipyards the most productive in the world. In contrast, U.S. shipyards attempting to move into metal shipbuilding faced a shortage of workers with the unique and vital skills required to produce large metal-hulled ships. Despite these challenges, by the beginning of the 20th century a new metal shipbuilding industry had emerged in the United States. This industry eventually became an important employer as well as a vital national resource during two World Wars.

This study aims to understand the role that skilled immigrants played in the emergence of metal shipbuilding as an important industry in the United States. I focus primarily on the experience of one of the successful new metal shipyards that opened during this period, Newport News Shipbuilding and Dry Dock Company (NNS), which began in the late 1880s in Virginia, near the mouth of the Chesapeake Bay. Focusing on NNS allows me to take a novel analysis approach in which I use the Census of Population as a window into studying the workforce of an individual

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<sup>1</sup> See Pollard & Robertson (1979), Hutchins (1948), and Hanlon (2018).

firm. This is possible because Newport News was essentially a company town in 1900, so analyzing the population census can shed light on the firm's workforce. Because the population census provides background information on individuals that is not typically included in firm records or the Census of Manufactures – such as their place of birth, year of immigration, occupational details, and age – this approach offers a novel view into the development of the firm's workforce. The use of the population census to analyze the composition of the labor force of an individual firm or industry is one of contribution of this study.

My main analysis uses information on roughly 3,500 NNS workers identified in the 1900 Census of Population. For comparison, I have also gathered information from two other important shipbuilding centers during this period, Bath, Maine and the area of Groton and Noank in Connecticut. Bath was a location with a mix of wood and metal shipbuilding, while shipyards in Groton-Noank were essentially specialized in wood ship production. A comparison between these locations and Newport News helps highlight the importance of skilled immigrants in metal shipbuilding specifically. As an additional point of comparison, I also collected information on hundreds of other immigrant residents of the town of Newport News.

The data reveal a number of interesting patterns. I find evidence that Newport News relied on immigrants to fill skilled technical positions specific to metal shipbuilding, such as boilermakers and riveters. These immigrant workers were particularly important early in the firm's life, when evidence suggests that they made up most of the firm's skilled workforce. These skilled immigrant workers were much more likely to come from leading European shipbuilding areas, particularly England and Scotland, than other immigrants. Also, relative to other immigrants in Newport News the shipbuilders were more likely to have come to the U.S. in their late 20s or early 30s, when they would have already had some work experience. These results indicate that skilled migrant workers from European shipbuilding centers played an important role in the early life of the firm.

Relative to British shipyards, I provide evidence that NNS substituted away from skilled

workers towards unskilled workers and capital, consistent with a shortage of skilled workers. I also provide evidence that, as the company grew, native-born workers were being trained to fill skilled positions. As a result, over time the firm became less reliant on skilled immigrant workers. This suggests that the availability of skilled workers early in the firm's life facilitated growth that later translated into additional employment for native workers.

Because this paper focuses on a case study, one concern is that the findings may not extend to other contexts. To help address this concern, I also analyze a second important American shipyard founded in the late 19th century, Bath Iron Works (BIW) of Bath, Maine. BIW provides a useful comparison to NNS because it emerged under very different conditions. In particular, BIW was located in the heart of the traditional U.S. (wood) shipbuilding areas. It also began as a producer of metal machinery, so it had access to a pool of skilled metalworkers. However, despite these differences I show that BIW faced many of the same challenges as NNS and overcame them in similar ways. In particular, despite the many skilled wood shipbuilders and iron workers in Maine, I show that BIW relied on foreign workers from Britain for crucial metal shipbuilding skills.

This study is related to an extensive literature on immigration.<sup>2</sup> Despite the volume of research on this topic, relatively little attention has been paid to the possibility that immigrants may bring scarce specialized skills that facilitate the expansion of new domestic firms or industries. Among this large literature, this paper is particularly related to historical work focused on immigration to the U.S. during the Age of Mass Migration from roughly 1850-1920 (Hatton & Williamson, 1998; Abramitzky *et al.*, 2012, 2014; Lafortune *et al.*, 2015; Abramitzky *et al.*, 2016; Ager & Hansen, 2017). This study differs from most of the historical work on immigration in that I am interested in the role that skilled immigrants play in the emergence of new firms and industries as well as the transfer of skills to native-born workers. While drawing on similar data sources, this study differs from most previous work on historical immigration in

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<sup>2</sup> For reviews of this literature see Kerr & Kerr (2011) and Borjas (2014). Reviews of recent historical work on immigration are provided by Margo (2014) and Abramitzky & Boustan (2017).

terms of methods. While I follow much of the existing literature in drawing on information from the Census of Population, I use these data in a different way. In particular, this study shows how, by focusing on “industry towns,” Census of Population data can be used to understand the role of immigrants in the labor force of individual firms and specific industries. This approach provides a view of the labor market interactions of immigrants and native workers which may be obscured in broader studies.

Much of the work looking at the role of immigrants in American industrialization in the late 19th and early 20th century has focused on mass migration and the importance of low-skilled immigrants in providing the manufacturing workforce (Hatton & Williamson, 1998; Hirschman & Mogford, 2009). Another set of literature focuses on the impact of very high-skilled immigrants on innovation patterns (Moser *et al.*, 2014). While these factors were no doubt important, this study highlights another channel – the transfer of scarce and vital skills needed in the production process that allowed the growth of new firms and industries – through which immigrants contributed to U.S. industrialization during this period. While these skilled immigrant workers may not have been large in number, the evidence in this paper suggests that they may have played an important role in facilitating industrialization, at least in some sectors of the economy.

This paper builds on a number of existing historical studies of the shipbuilding industry. In particular, I draw heavily on work by economic historians such as Pollard & Robertson (1979) and Harley (1973). This paper is also related to a set of studies looking at the impact of learning in the shipbuilding industry using evidence on the production of Liberty Ships during WWII (Searle, 1945; Rapping, 1965; Thornton & Thompson, 2001; Thompson, 2001, 2005, 2007). There is also a close connection to Hanlon (2018), which uses data covering essentially all major ships produced in North America from 1850-1910 and provides evidence that exposure to competition from more advanced British producers made it difficult for North American shipyards to transition from wood to metal shipbuilding. That paper provides evidence that the shipbuilding industry was characterized by local learning effects and, drawing on qualitative historical sources,

argues that the key channel through these effects operated was the development of pools of skilled local workers. This paper provides more direct quantitative evidence on the importance of worker skills and the scarcity of skilled workers in the U.S.

The remainder of the paper is organized as follows. Section 2 provides general background information while the data are described in Section 3. The main analysis is presented in Section 4. In Section 5, I provide a brief analysis of a second shipyard, Bath Iron Works. Section 6 provides a discussion of the main results and their implications.

## **2 Background**

### **2.1 The shipbuilding industry**

In the middle of the 19th century the vast majority of ships were constructed of wood. Locations with easy access to lumber, such as the Northeastern U.S., Atlantic Canada, and Scandinavia, held dominant positions in the international shipbuilding industry. The rise of metal shipbuilding starting in the middle of the 19th century resulted in a shift in the industry away from locations with cheap lumber towards locations – mainly in Britain – with low local iron prices (Hanlon, 2018). The growth of metal shipbuilding was driven by reductions in the price and improvements in the quality of iron and later steel inputs as well as the increasing use of steam power.<sup>3</sup> As a result of the shift to metal shipbuilding, Britain became the world’s leading shipbuilder, producing over 80% of world tonnage by the 1890s (Pollard & Robertson, 1979). Many North American shipyards remained focused on wood shipbuilding and went into decline (Harley, 1973; Hanlon, 2018). Only a few North American yards were able to make the shift to metal shipbuilding, a necessary step for long-term survival. This study seeks to understand the challenges that American shipyards faced in making this transition, how some shipyards managed to overcome them, and the role that skilled immigrant workers played in this process.

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<sup>3</sup> The shift to steam power, which accelerated in the 1870s, advantaged metal ships because these were better able to withstand the hull stress and vibration associated with engines. Steam power also allowed the construction of larger ships, which, above a certain size, necessitated the use of iron and steel.

Starting in the 1890s, Britain's advantage in lower iron and steel input costs relative to North America began to disappear. The discovery of new iron reserves, particularly in the Masabi Range in Minnesota, led to the expansion of iron and steel production in the U.S. (Irwin, 2003). At the same time, the efficiency of U.S. iron and steel production was improving rapidly.<sup>4</sup> As a result, the United States emerged as an important producer and exporter of iron and steel products. By roughly 1900 U.S. shipbuilders had access to iron and steel at prices that were comparable to British yards (Hanlon, 2018). Despite this narrowing of initial advantages, Britain managed to maintain its lead in the metal shipbuilding industry, even though U.S. shipyards enjoyed government support and protection through a variety of channels.<sup>5</sup> Drawing on historical sources and the work of economic historians, Hanlon (2018) argues that one likely explanation for this was the persistent advantages created by the pools of skilled workers in Britain generated as a result of longer experience in metal shipbuilding.

Existing histories of the shipbuilding industry highlight the central role played by skilled labor in the industry (Pollard & Robertson, 1979; Culliton, 1948). The building of large iron or steel-hulled ships required a wide variety of skilled workers, ranging from boilermakers, platers and riveters to ship carpenters, chippers & caulkers, and mechanics. While many of these skills were also used in other industries, or in wood shipbuilding, other vital skills were specific to metal shipbuilding. Most of these skilled were gained through on-the-job experience, often as part of a formal apprenticeship. In Britain, where training systems were firmly established, apprenticeships typically lasted 5-7 years. Only a few elite positions, such as naval architects, marine engineers and draftsmen required more formal education (Pollard & Robertson, 1979).

Several features of the shipbuilding industry increased the importance of skilled labor. For example, during the period covered by this study, most ships were unique bespoke orders.

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<sup>4</sup> See Temin (1964) and Allen (1977, 1981, 1979).

<sup>5</sup> In particular, the U.S. imposed a complete ban on the use of foreign ships for shipping products directly between two U.S. ports. This created a completely protected, though somewhat small, market for U.S. built ships. Also, the U.S. government supported domestic coastal shipyards through the awarding of contracts to build Navy ships. As discussed in Hanlon (2018), both of these channels were important for the survival of U.S. shipyards in the face of British competition.

Occasionally yards would produce two or three of the same design, but typically shipyards worked on a wide range of different ship designs, often at the same time. This variation made standardization difficult and increased the importance of workers with skills that gave them the flexibility to work on very different types of ships.<sup>6</sup>

Also, shipbuilders faced volatile demand and a highly competitive market.<sup>7</sup> Shipbuilding was a highly fragmented industry, with many small and medium-sized shipyards competing for orders. As a result, Hutchins (1948) described shipbuilding in the late 19th and early 20th Century as, “a market which, except for the influence of national laws and policies, is naturally one of the most highly competitive of all markets...” This competition, together with highly volatile demand, meant that large investments in durable capital were dangerous for shipbuilders and came with the risk of bankruptcy during downturns. As a result, “The principal task of the shipbuilders was to minimize total overhead expenses while maintaining the ability to build large and complex ships at prices that were competitive on the world market” (Pollard & Robertson, 1979, p. 28). Having access to skilled workers helped shipyards manage this volatility, by avoiding heavy fixed capital expenditures. Newer metal shipyards in places like the U.S. and Germany, lacking access to large pools of skilled workers, were forced to substitute by making heavier capital expenditures, which put them at risk of bankruptcy during the inevitable cyclical downturns in the industry (Pollard & Robertson, 1979, p. 28-29, 42).

As a result of these features, leading shipyards were heavily reliant on access to a skilled workforce. In British metal shipyards in the late 19th and early 20th century skilled workers made up 70-80% of the workforce (Pollard & Robertson, 1979, p. 153). As a result of the importance of skilled workers, together with the fact that skills were mainly gained through apprenticeships and on-the-job experience, locations with a longer history of metal shipbuilding maintained a distinct

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<sup>6</sup> These conditions were very different from those experienced during both WWI and WWII, where the production of repeated standardized designs allowed shipyards to expand by using lower skilled workers trained to do just one type of task.

<sup>7</sup> Pollard & Robertson (1979, p. 26) write that, “The amount of tonnage produced fluctuated tremendously over short periods” a feature that they attribute to the volatile nature of international trade and the fact that new tonnage was only a small fraction of the existing stock.



advantage in the availability of worker skills. This led to regional concentrations of ship production in areas where low iron prices had allowed the metal shipbuilding industry to gain an early start, particularly in the areas around Glasgow in Scotland, Newcastle-upon-Tyne and Sunderland in Northern England and Belfast in Ireland. As Pollard & Robertson write (1979, p. 129), “While foreign builders were able to choose better sites and design more efficient yards and shops, they were unable to overcome completely the greater efficiency of British labor, an efficiency that in part derived from Britain’s longer tradition as a producer of iron and steel steamships.”

## **2.2 Origins of Newport News Shipbuilding**

Any discussion of the origins of NNS has to start with the company’s founder, Collis P. Huntington. Huntington, born in Connecticut in 1821, made his fortune selling supplies to the California gold miners in the 1850s. By the 1860s he had become involved in railroad construction. Together with Leland Stanford, Mark Hopkins and Charles Crocker, he was one of the “Big Four” promoters of the transcontinental rail- road. By the 1880s, Huntington was a very wealthy man, with ownership stakes in several railroads, including the Central Pacific and Southern Pacific, shipping companies, land companies, and a variety of other businesses. In the late 1860s Huntington had become involved in resuscitating the Chesapeake and Ohio Railroad in Virginia after the Civil War. Huntington became the president of the C&O in 1869 and in 1870 he began extending the railroad from Richmond to the Ohio river valley in West Virginia, which gave access to West Virginia’s coal country. Next, the railroad turned east for a connection to the sea.

Huntington considered several possible locations for the port connection. These options included established cities such as Norfolk and Yorktown as well as rural areas along the Peninsula, a strip of land stretching southeast from Richmond to where Chesapeake Bay meets the mouth of the James River at Hampton Roads. While each location had something to recommend it, Huntington eventually settled on Newport News. This location possessed an excellent deep natural harbor. It was almost completely undeveloped, consisting mainly of

farmland and a small fishing village, which made it easy for Huntington to buy up the land in order to take advantage of the increase in value that the railroad would bring. Also, there were no competing railroad lines on the Peninsula. On the other hand, Huntington had to build the city of Newport News virtually from scratch, provide it with roads, water lines, etc.<sup>8</sup> In addition, the area did not have a history of commercial shipbuilding nor did the area have a substantial base of engineering or metalworking firms. These are important features for this study; The fact that Newport News was essentially a company town means that it is possible to relate occupations observed in the Census directly to the firm's labor force.

By the early 1880s Huntington's Old Dominion Land Company owned 17,000 acres on the Virginia Peninsula and the C&O rail connection to Newport News opened in 1882. The Chesapeake Dry Dock & Construction Company, which would eventually become Newport News Shipyard and Dry Dock Company, was chartered in 1886. The land for the shipyard was purchased from Huntington's Old Dominion Land Company and construction of the dry dock, piers, and other facilities began in 1887. The initial equipment for the yard were purchased from a defunct New York shipyard, Newburgh Iron Shipbuilding Company, and moved to Virginia. The shipyard began operation in 1888, a year that will play an important role in my analysis.

### **3 Data**

To analyze the workforce of NNS I have hand-collected data from the U.S. Population Census of 1900 manuscripts available on Ancestry.com.<sup>9</sup> Hand-collecting the data from the original manuscripts allows me to take advantage of the full set of available information while limiting the effect of transcription errors. To collect these data, I reviewed all of the original census manuscripts for the town of Newport News and digitized information on individuals where the

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<sup>8</sup> Newport News was also close to the Navy Shipyard in Norfolk, VA, which may have been useful for winning Navy contracts or learning about new metal shipbuilding technologies. Hanlon (2018) provides evidence that there were spillovers from Navy shipyards to other nearby private shipyards.

<sup>9</sup> In theory it would be nice to be able to compare these data to the 1890 population census. Unfortunately, the vast majority of that census, including the returns for Newport News, were lost in a fire.

data explicitly mention working at the shipyard (as most did) or where their occupations made it likely that they did. This review identified 3,155 individuals employed at the shipyard, nearly all of them men.

For the majority of shipyard workers, the occupation information in the census specifically references shipyard work. Even for common laborers, the enumerators in Newport News distinguished shipyard laborers from other laborers. I also include among shipyard workers those in jobs, such as draftsman or mechanic, where it is likely that most of the people holding the occupation were working at the shipyard. It is worth noting that my listing of shipyard workers is likely to miss a number of shipyard workers in occupations that were also common outside of the shipyard, such as blacksmiths, masons, cooks, etc., which I do not include in my list of shipyard workers. In addition, the many day laborers, stevedores and longshoremen listed in the Census returns for Newport News are not included in my accounting despite the fact that some of these may have worked at the shipyard, though most must have worked at the C&O's shipping terminal. Ultimately, the 3,155 shipyard workers identified in my data account for about two thirds of total employment at the yard, which Tazewell (1986) puts at 4,500 in 1899. The remainder are most likely those shipyard workers with occupations that do not clearly identify them as such. Most of these would have been relatively unskilled workers, so my data set may be biased toward over-representing skilled occupations.

There are just under 100 unique occupations associated with NNS in the data (after some basic standardization has been done). For analysis, it is useful to divide these into a smaller set of occupation groups. I use the following categorizations: *Laborers*, including assistants; *Apprentices*; *Office workers*, such as clerks, bookkeepers, and accountants; *Skilled Craftsmen*, a broad category including riveters, iron workers, carpenters, joiners, chippers & caulkers, etc.; *Managers*; and *Specialists*, high-skilled workers with skills specific to shipbuilding, such as naval architects, marine engineers, and draftsmen.<sup>10</sup>

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<sup>10</sup> The main distinction between skilled craftsmen and specialists is that the former typically acquired their skills on the job or through apprenticeships while the latter may have had some formal education.

A main advantage of the population census data is that they include background information on each worker. This includes the worker's age, location of birth, whether they were an immigrant, and their year of arrival. In addition, we typically know whether the worker was living alone or with a family, and details about family members.

For comparison purposes I also collected data on all foreign-born male workers in Newport News with occupations that signal that they were unlikely to have worked at the shipyard.<sup>11</sup> There were 393 residents who fit this description. A glance at these data reveal that by 1900 the city was incredibly diverse, with residents from 23 different countries: Irish longshoremen, Greek carpenters, Russian grocers, Chinese laundrymen, German brewers, English bartenders, a French hotel proprietor, a Turkish fruit seller, and even an Italian ice cream maker.

I also gathered similar data from two other important shipbuilding locations, Bath, Maine and Groton-Noank, Connecticut. Bath was chosen because it was an important shipbuilding town at this time and the home of Bath Iron Works, one of the other successful U.S. metal shipyards to emerge in the late 19th century. Groton-Noank was chosen because it was one of the largest wooden shipbuilding centers in the country but not part of a larger and more economically diverse city. The data from Groton-Noank will be useful for comparing the occupational structure in wood vs. metal shipbuilding. My review of manuscripts for Bath identified 1,204 workers (all males) with shipbuilding or related occupations in the seven wards of the city. In Groton and Noank I identified 501 men with occupations related to shipbuilding.

An analysis of the census data for these locations faces two limitations relative to what is possible for Newport News. First, in both locations the census enumerators did not separately identify unskilled shipyard laborers from other local unskilled workers. In addition, in Bath, some Bath enumerators wrote "Bath Iron Works" as the occupation for a number of individuals without describing exactly what their occupation was. Second, there were multiple shipyards in

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<sup>11</sup> E.g., I exclude from this list occupations such as blacksmiths and electricians where some workers were likely to have been employed at the shipyard. I also focus only on male heads of household. The focus on males makes these data more comparable to the data on shipyard workers. The reason I focus on heads of household is to exclude some sons with fathers that worked at the shipyard.

both Bath and Groton-Noank, so my analysis does not allow me to separately identify the labor force of any particular shipyard. However, I do know that in Bath the only major metal ship producer was Bath Iron Works. A final issue faced when analyzing Bath is that the town also had a well-developed iron products industry. This makes it difficult to separately identify shipyard metalworkers from metalworkers employed in other sectors except in occupations, such as boilermakers and riveters, which were primarily associated with ship production.<sup>12</sup>

## 4 Main Analysis

Operations at NNS began in late 1888, with the dry dock ready for use in 1889. The first payroll made by the yard was in December, 1888 and by September 1889 there were 104 workers employed at the yard (Tazewell, 1986). But where had these workers come from?

As a starting point for understanding how NNS assembled a labor force, Table 1 describes the breakdown of workers across broad occupation categories in the 1900 census. We can see that by far the two largest groups are unskilled laborers, which made up about 43% of the workforce, and the skilled craftsmen, which accounted for about 49%.<sup>13</sup> The very elite worker groups – managers and specialists – are much smaller. Also, we can see that by 1900 NNS was employing a number of apprentices who were learning a variety of skilled trades.

That data in Table 1 lead to my first useful finding: relative to British shipyards, NNS was using a substantially higher share of unskilled workers. Data from Pollard & Robertson (1979, p. 153) show that in 1892 unskilled workers made up just 29% and 22% of the labor force in English and Scottish shipyards, respectively. In Scotland in 1911 the share was 18% and it was 25% in Northeast England in 1913. This is much lower than the 42.8% of unskilled workers shown in Table 1. The fact that the ratio of skilled to unskilled workers at NNS was substantially below the

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<sup>12</sup> It is worth noting that boilermaker is a bit of a misnomer by the period I study, as workers with that title were not mainly engaged just in the production of boilers. Rather, boilermakers were involved in fabricating metal sheets and tubes, jobs that made them the most prominent skilled workers in metal shipbuilding.

<sup>13</sup> In fact, this number likely understates the true unskilled share since it may not include casual laborers.

ratio in British yards indicates that it faced a relative scarcity of skilled metal shipbuilders.

Table 1: Number of workers by type

	Number	Share
Laborers	1332	0.428
Apprentices	60	0.019
Skilled craftsmen	1521	0.489
Office workers	44	0.014
Managers	44	0.014
Specialists	111	0.036

Pollard & Robertson (1979) suggest that the substitution of unskilled for skilled work in U.S. shipyards required additional capital investments. They write, “Because of the lack of skilled labor in an industry founded overnight...expensive equipment was the rule in the American shipyards in 1894-1901” while, “British yard owners were able to take advantage of their more highly skilled workforces by investing only in equipment that was absolutely necessary.” While direct measures of firm capital are not available, contemporary sources suggest that this was exactly what happened at Newport News. Calvin Orcutt, the shipyard’s President, wrote that, “we have introduced numerous labor saving appliances which have never been made use of in American yards, and I doubt that they have been employed in foreign yards...” (Tazewell, 1986, p. 54). After visiting shipyards in Europe in 1897, Huntington wrote to Orcutt that he thought that they had three men to do the work that one man did in Newport News (Evans, 1954, p. 630).

The data show stark differences in the origins of workers fitting into the different occupational categories. Among unskilled laborers, 93% were born in Virginia or one of the neighboring states (Kentucky, Maryland, North Carolina, and West Virginia), while people born in these states made up just 53% of skilled craftsmen, 38% of managers and 28% of specialists (see Appendix A.1). Among more skilled groups, foreign-born workers from Britain or other parts of Europe made up a substantial fraction of the workforce: 21% of craftsmen, 12% of specialists, and 20% of managers. British-born alone made up 15% of skilled craftsmen at NNS and 88% of British workers were in one of the skilled craft occupations, while only 7% were in low-skilled work. The

importance of foreign-born workers is even larger if we focus on more experienced workers, such as those over 30 years of age. Among this group, British workers made up 22% of skilled craftsmen and 16% of specialists. Internal migrants were also important. Workers born in the Mid-Atlantic states accounted for one-third of managers and specialists as well as 15% of skilled craftsmen. Those from New England, the region with the longest history of (wood) ship production, were particularly important in the specialist positions such as draftsman. Overall, these findings fit with the historical narrative from Evans (1954) who writes (p. 637), “At the beginning of ship construction and repair in the Newport News plant, skilled mechanics and engineers had to be brought from other sections of the country and from abroad.”

To gain more insight into the importance of skilled immigrant workers it is useful to look at their shares in the major shipbuilding occupations present in Newport News. This is done for British-born workers and all foreign-born workers in Table 2 for all occupations with more than 15 workers. These data show that the occupations that were most dependent on British immigrants were riveter and boilermaker, the two quintessential skilled occupations of metal shipbuilding. British-born and other foreign-born workers also formed a substantial share of other important metal shipbuilding occupations such as machinists, coppersmiths, ship fitters, bolters, and chippers/caulkers.<sup>14</sup> It is worth noting that this table includes workers of all ages. If we instead focus only on workers over age 30, immigrants are relatively even more important. For workers over 30, for example, British-born immigrants make up over half of the chippers & caulkers, 46% of riveters and 37% of boilermakers, as well as more than a fifth of all machinists, ship fitters and draftsmen. The occupations where most workers were native-born include low-skilled occupations like watchman and laborer and those requiring skills that were not specific to shipbuilding, such as clerks and painters.

In order to identify the occupations that are distinctly associated with metal ship production it is useful to compare the occupation shares observed in Newport News to data from Bath, Maine

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<sup>14</sup> It is notable that the highest share of foreign workers was actually among riggers, an occupation not specifically associated with metal shipbuilding rather than wood. Most of this group hailed from Scandinavia, the main European wood shipbuilding center.

and Groton-Noank, Connecticut. As discussed in Section 5, Bath was an important center of both wood and metal shipbuilding as well as having an extensive iron products industry. The area around Groton and Noank was a major wood shipbuilding center with very little iron ship production.

Table 2: Share of British-born and foreign-born workers by occupation, 1900

Occupation	Share British born	Share foreign born	Total wkrs	Occupation	Share British born	Share foreign born	Total wkrs
Riveter	0.296	0.310	71	Pipe fitter	0.106	0.128	47
Boilermaker	0.284	0.333	102	Ship joiner	0.100	0.200	90
Chipper/caulker	0.215	0.231	65	Clerk	0.080	0.080	25
Machinist	0.162	0.265	431	Iron worker	0.075	0.113	53
App. machinist	0.150	0.200	20	Draftsman	0.066	0.143	91
Stat. engineer	0.148	0.259	27	Driller	0.060	0.100	50
Rigger	0.143	0.643	28	Foreman	0.054	0.189	37
Coppersmith	0.136	0.455	22	Patternmaker	0.045	0.091	22
Bolter, ships	0.125	0.188	16	Laborer	0.009	0.018	1254
Ship carpenter	0.124	0.230	161	Painter	0	0.063	16
Ship fitter	0.117	0.146	247	Watchman	0	0	18

Data from U.S. Population Census of 1900. Includes all shipyard occupations with more than fifteen workers.

In Table 3 I look at the fifteen most important skilled occupations in Newport News and compare occupation shares there to the shares in Bath and Groton-Noank. Table 3 suggests that occupations can be divided into several types. Some occupations, such as machinists, ship joiners, and stationary engineers (engine operators) appear to have been important regardless of the type of shipbuilding, though machinists appear to have been somewhat more important in Newport News.<sup>15</sup> Some occupations seem to have been specifically important in metal shipbuilding centers. These include ship fitter, boilermaker, draftsman, riveter, driller, pipe fitter and coppersmith. Many of these occupations were small or completely absent in Groton-Noank. Referring back to Table 2, it is notable that these occupations tended to have high shares of foreign

<sup>15</sup> Chippers/caulkers also appear to be important in both types of shipbuilding, but this is probably somewhat misleading because while the term caulker appears in both metal and wood shipbuilding, it means something very different in these two settings.



workers. Moreover, of the foreign workers in these occupations, a large share came from Britain. For example, 86% of the foreign boilermakers in Newport News were British, as were all of the foreign riveters.

Table 3: Comparing important skilled occupations in different locations

Occupation	Employment in Newport News	Share in Newport News	Share in Bath, ME	Share in Groton-Noank
1 Machinist	431	22.66%	11.96%	10.78%
2 Ship Fitter	247	12.99%	2.74%	–
3 Ship Carpenter	161	8.46%	29.15%	59.88%
4 Boilermaker	102	5.36%	4.57%	0.40%
5 Draftsman	91	4.78%	2.74%	0.40%
6 Ship Joiner	90	4.73%	2.33%	3.39%
7 Riveter	71	3.73%	1.99%	–
8 Chipper/Caulker	65	3.42%	3.74%	4.99%
9 Iron Worker	41	2.79%	10.54%	2.99%
10 Driller	50	2.63%	0.25%	–
11 Pipe Fitter	47	2.47%	–	–
12 Rigger	28	1.47%	2.08%	0.60%
13 Stat. Engineer	27	1.42%	3.24%	2.00%
14 Coppersmith	22	1.16%	0.50%	–
15 Patternmaker	22	1.16%	1.33%	0.40%

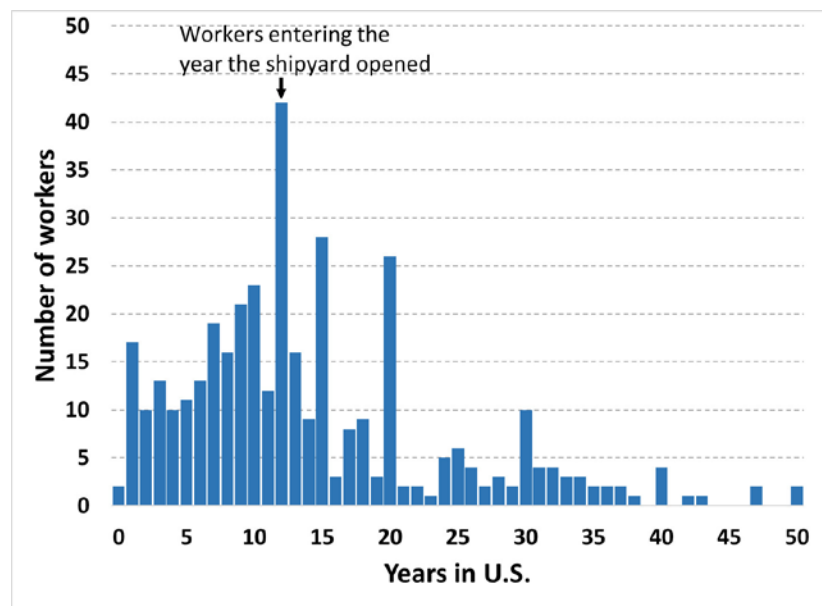
Other occupations appear to have been primarily associated with wood shipbuilding. This is mainly true of ship carpenter, an occupation that made up almost 60% of the skilled workforce in Groton-Noank but only 8.5% in Newport News. In Newport News, this occupation was less likely to be done by foreigners, and foreign ship carpenters were less likely to be British.<sup>16</sup> Finally, it is worth noting the large share of iron workers in Bath compared to the other locations. This reflects the fact that, in addition to shipbuilding, Bath was also an important center of metal goods production. The available data do not allow me to separate iron workers in Bath based on whether or not they worked in a shipyard. Note that there are also iron workers in Groton-Noank, reflecting the fact that even wood ships required iron fittings, components, and equipment.

<sup>16</sup> British-born workers made up 16% of ship carpenters in Newport News.

Thus far the results show that foreign-born, and particularly British-born workers, made up an important part of the skilled labor force in Newport News in 1900, particularly in those occupations specific to metal shipbuilding like riveter and boilermaker. While these findings are informative, I am particularly interested in understanding the impact of skilled workers earlier in the shipyard's life. We can gain additional insight into this by using information on how long immigrant workers had been in the country in 1900.

Figure 1 provides a histogram of NNS workers by the number years that they had been in the U.S. in 1900. The key feature in this graph is that there was a large spike in shipyard workers who entered the country exactly twelve years before 1900. This corresponds exactly with the opening of NNS. This pattern suggests that these foreign workers either came to the U.S. specifically to work at NNS, or that many of the foreigners with shipbuilding skills coming to the U.S. in that year opted to go to Newport News. It is worth noting that the figure also shows spikes in years such as 15, 20 and 30, consistent with recall bias, however this cannot explain the spike at year twelve.

Figure 1: Number of foreign NNS workers by years in the U.S.



The spike in year twelve in Figure 1 suggests that around 20-30 more NNS shipyard workers entered the U.S. in 1888/89, the year NNS began operation, than we would expect given the levels in other nearby years. If these workers came for the opening of the new yard then they would have represented a substantial fraction of the initial payroll, which numbered just 104 in September 1889 (Tazewell, 1986). Given that many of the other workers would have been unskilled laborers or craftsmen with skills that were useful in industries other than shipbuilding (so called amphibians), it is likely that foreign-born workers comprised most of the skilled metal shipbuilders in Newport News in the first years of operation.

Of the 43 foreign-born NNS workers in 1900 who arrived in the U.S. in 1888/89, the vast majority (35) were from Britain. Three others were from Germany, the second largest metal shipbuilding area in Europe. The occupations of these immigrant workers essentially covered the range of skills needed for metal shipbuilding: 9 machinists, 6 riveters, 2 boilermakers, 4 ship fitters, 2 ship joiners, 2 draftsmen, 2 chipper & caulkers, a coppersmith, a millwright, a rigger, etc.

It is useful to compare the patterns shown for foreign-born shipyard workers in Figure 1 to the patterns observed for foreign-born residents of Newport News working in other occupations. Figure 2 plots number of years in the U.S. for these foreign workers. Comparing this graph to Figure 1 we can see that, unlike shipyard workers, there is no concentration of foreign non-shipyard workers who arrived in the U.S. twelve years ago. This suggests that the pattern displayed by foreign workers in Figure 1 is driven by the opening of the shipyard and not simply a result of overall migration patterns.

Figure 2: Years since migration for other foreign-born workers

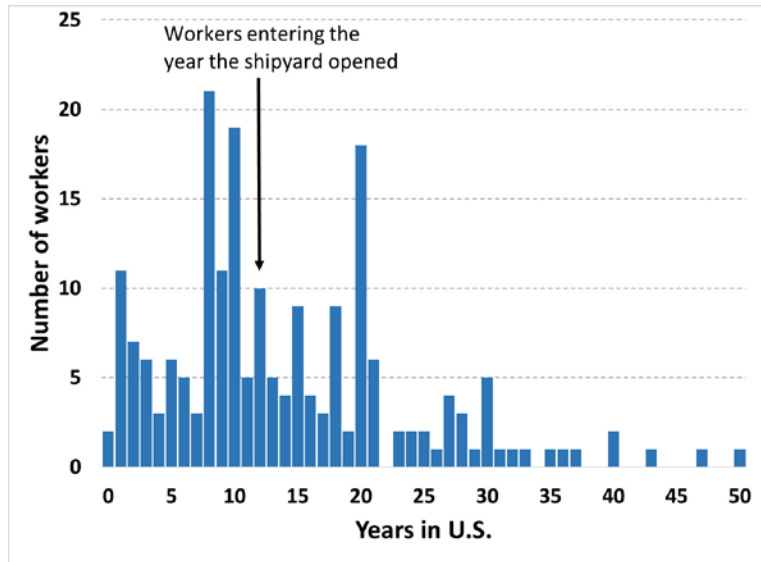


Table 4 presents result from regressions testing for differences in the number of immigrants to the U.S. in the year that NNS opened between shipyard workers and the other male foreign residents of Newport News. Specifically, using a data set containing both foreign shipyard and foreign non-shipyard workers, I aggregate workers based on their number of years in the U.S. I then run regressions looking at whether there was an increase in workers who came to the U.S. twelve years ago, the year that work began at NNS. In Columns 1-2 I look at the share of workers in each category by year of arrival, in Columns 3-4 I look at the number of workers, and in Columns 5-6 I look at the log number of workers. All regressions include fixed effects by arrival year and a fixed effect for shipyard workers. The regressions in Columns 2, 4 and 6 also interact an indicator for shipyard workers with three quadratics of arrival year, to allow the pattern of arrivals to differ between shipyard and non-shipyard workers.

All of the results in Table 4 indicate that among shipyard workers there was an unusually high share who arrived in the U.S. the year that the shipyard began operation relative to other foreigners residing in the same location. The results in Columns 3-4 suggest an excess of 25-27 arrivals. As mentioned previously, there were 104 workers on the NNS payroll at the end of

1889. This suggests that roughly one-quarter of the total shipyard workers at that point were likely to have been foreign. Since only around half of the shipyard workers were skilled, this suggests that as many as half of the skilled workers in the shipyard early on were likely to have been foreign. Moreover, even among skilled workers, only a subset of skills were specific to the metal shipbuilding industry. Foreign-born workers tended to be disproportionately concentrated among those skills. This suggests that in the early days of the shipyard the majority, and perhaps the entirety, of workers with skills specific to metal shipbuilding were recent immigrants.

Table 4: Testing the difference in immigrants in the year NNS opened

DV:	Share by arrival		Count of immigrants		Log count of immigrants	
	(1)	(2)	(3)	(4)	(5)	(6)
Ship wkrs × yr NNS opens	0.0711*** (0.00278)	0.0683*** (0.00641)	27.14*** (0.929)	25.28*** (2.074)	1.007*** (0.128)	0.851*** (0.168)
Ship wkrs.	-0.00197 (0.00278)	0.00703 (0.00521)	0.857 (0.929)	3.236 (1.969)	0.0458 (0.128)	0.319 (0.212)
Ship wkrs × arrival year		0.000850 (0.00231)		0.636 (0.768)		0.102 (0.0829)
Ship wkrs × arrival yr. sq.		-0.000160 (0.000163)		-0.0764 (0.0527)		-0.0129* (0.00651)
Ship wkrs × arrival yr. cub.		3.85e-06 (2.95e-06)		0.00165* (0.000947)		0.000297** (0.000131)
Constant	0.00700*** (0.00147)	0.00250 (0.00507)	1.571** (0.640)	0.382 (2.002)	0.670*** (0.0682)	0.533** (0.202)
Year-of-arrival effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	72	72	72	72	72	72
R-squared	0.889	0.912	0.894	0.922	0.835	0.889

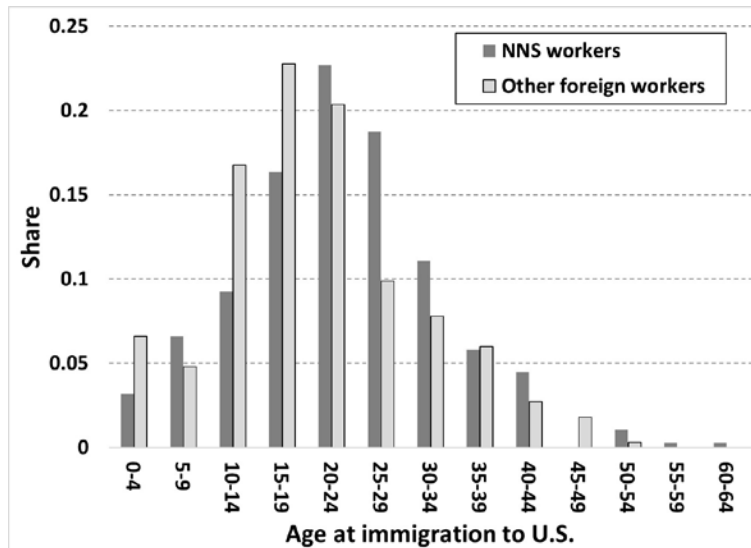
\*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Robust standard errors in parentheses. Data set includes all foreign-born NNS shipyard workers who arrived in the U.S. in the 35 years before the census and all male foreign-born head-of-household residents of Newport News who arrived in the U.S. in the 35 years before.

Even for those foreigners who came to the U.S. before the shipyard opened, the Census supplies some interesting clues about their path to Newport News. Earl Simon, for example, was a 36-year-old ship joiner in the 1900 Census. From the Census we can see that he was in Scotland at age 23, where he had a son, and then he moved to the U.S. at age 24. He had a second son at age 26 while living in Pennsylvania, before coming to Newport News. This type of trajectory appears to be typical. Another example is Alfred Bull. Born in England in 1854, Bull moved to the U.S. at age 18 and had children in Pennsylvania in 1888 and 1891 before coming to Newport News, where he worked as boilermaker. Given that Pennsylvania was the most important metal shipbuilding state in the U.S. in the 1880s and 1890s, these patterns suggest that these workers moved to the U.S. to work at the Pennsylvania shipyards, and then relocated later to work at the new NNS shipyard.

There is evidence that the immigrant shipyard workers were more experienced than other immigrant workers in Newport News. This is shown in Figure 3, which plots the age at migration for immigrant shipyard workers in Newport News and other non-shipyard immigrant workers. This graph shows that those foreigners who worked at NNS were more likely to have migrated in their late 20s or early 30s than foreign workers outside of NNS.

Immigrant shipyard workers in Newport News were also much more likely to hail from major European metal shipbuilding nations than other immigrant workers during this period. This is illustrated in Table 5, which provides a comparison between immigrant shipyard workers at Newport News, other immigrant workers living in Newport News, and immigrant workers in the wood shipbuilding center of Groton-Noank. For each group, the table shows the top fifteen countries of origin and its share of immigrant workers.

Figure 3: Age of migration for NNS and other foreign workers in Newport News



This figure plots the share of workers falling into each age bin based on when they immigrated to the U.S. The first series covers immigrant workers in Newport News with shipbuilding occupations. The second series covers all other immigrant male household heads in Newport News with non-shipyard occupations.

Table 5 shows that immigrants working in shipyard occupations in Newport News primarily came from just a few locations – England, Scotland, Ireland and Germany– the major European metal shipbuilding centers. Together, these four locations of birth make up almost three-quarters of all of the immigrant shipyard workers. As a point of comparison, Britain (England, Scotland and Wales), Ireland and Germany made, respectively, up around 14%, 13% and 23% of all migrants to the U.S. from 1870-1900 (United States Bureau of the Census, 1975). Thus relative to national immigration trends, English and Scottish workers were substantially overrepresented among the shipyard workers in Newport News.

The origins of shipyard workers contrasts with the origins of other foreign-born residents of Newport News working in non-shipyard occupations, shown in the middle columns of Table 5. While England, Ireland and Germany are also important among this group, the shares are spread much more evenly across origin countries. The differences between shipyard and non-shipyard workers are particularly stark for England and Scotland. Overall, the pattern for non-

shipyard workers is much closer to the patterns exhibited at the national level (see, e.g., United States Bureau of the Census (1975)). For example, non-shipyard workers were more likely to be from Italy and Russia, two important sources of migrants during this period and the shares for non-shipyard workers are also closer to the national average for migrants from Poland, Ireland and Canada.

Table 5: Top ten countries of origin for different groups of workers

<b>Newport News shipyard wkrs.</b>		<b>Newport News other foreign wkrs.</b>		<b>Groton-Noank shipyard wkrs.</b>	
Country of birth	Share	Country of birth	Share	Country of birth	Share
England	0.2633	England	0.1582	Canada	0.7757
Scotland	0.1932	Germany	0.1469	England	0.0572
Ireland	0.1449	Ireland	0.1243	Scotland	0.0503
Germany	0.1353	Russia	0.1102	Ireland	0.0481
Canada	0.0556	China	0.1073	Norway	0.0160
Sweden	0.0386	Scotland	0.0621	Sweden	0.0137
Wales	0.0362	Canada	0.0621	Germany	0.0092
Hungary	0.0290	Italy	0.0424	Italy	0.0069
Austria	0.0242	Austria	0.0395	Russia	0.0046
Denmark	0.0169	Poland	0.0226	Finland	0.0023

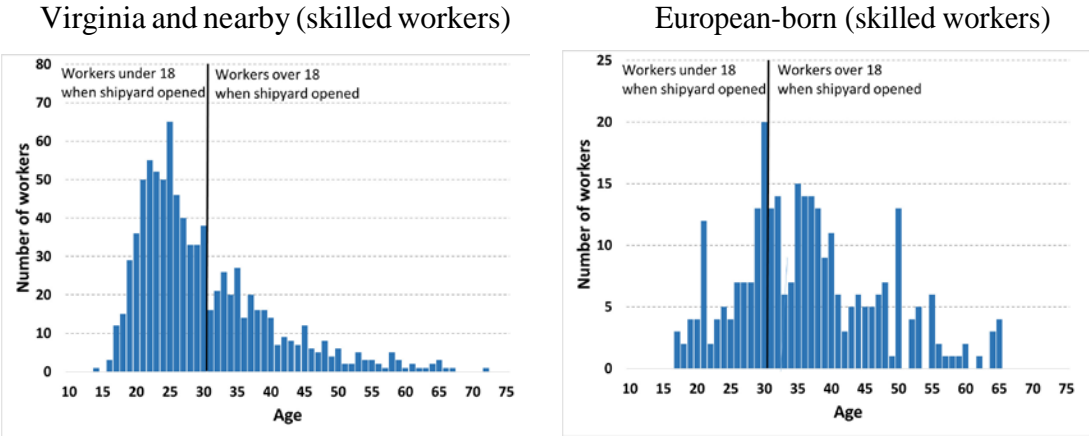
A further contrast is provided by comparing to the main immigrant groups in Groton-Noank in the far-right columns. In that area, as in many wood shipbuilding centers, the foreign population was dominated by Canadians. Many of these had immigrated fairly recently from the declining wood shipbuilding towns of Nova Scotia and New Brunswick to the wood shipbuilding centers of the U.S. These U.S. wood shipyards were partially protected from competition from British metal ship producers thanks to government regulations banning the use of foreign-built ships to ship between U.S. ports. In contrast, as part of the British Empire, Canada could not offer similar protections to its local shipbuilders, resulting in a far steeper decline in that industry in Canada than in the U.S. (Hanlon, 2018).

The census data can also be used to provide evidence that, while NNS initially drew



heavily on foreign workers, it soon began training local workers to move into higher-skilled positions. One piece of evidence suggesting this is shown in Figure 4, which describes the age distribution of local workers (from Virginia or nearby states) and foreign workers in skilled shipbuilding occupations in Newport News. For native-born workers, in the left panel, we see that in 1900 there were many more shipyard workers just below the age of 30 than just above age 30. This is exactly the age that would have been moving into the labor force at the time that the shipyard opened. This suggests that local workers who had not yet entered the labor force when the shipyard opened were substantially more likely to take up shipyard work than those who were already of working age.

Figure 4: Age distribution of local-born workers and European-born workers

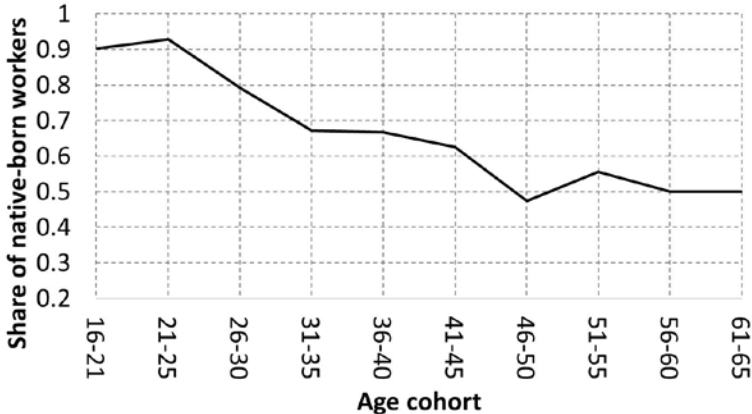


This pattern contrasts sharply with what we see for European-born workers, in the right panel of Figure 4. There are relatively few European-born workers under age 29 but many more around 29-32. These workers would have been starting out in the labor force around the time that NNS opened. This suggests that the shipyard may have attracted Europeans who were just moving into the labor force when the shipyard opened, but that the yard did not continue to attract similar workers in later years. An even more important pattern is the high level of European-born workers in the late 30s. Workers in that age category would have finished their apprenticeship period – typically 5-7 years in British yards – around the time

that NNS was opening. It is worth noting that the double-peaked age pattern shown for foreign shipyard workers in Figure 4 does not appear in the age distribution of other foreign residents of Newport News, nor does it appear for the immigrant wood shipbuilders of Groton and Noank (see Appendix A.2).

A more direct way to look at this effect is to study how the share of native-born workers in skilled occupations varied across age cohorts. Figure 5 does this for those occupations most closely associated with metal shipbuilding: boilermakers, riveters, coppersmiths, and ship fitters (including apprentices in these occupations). This figure shows that native-born workers made up almost all of the workers in their early 20s in these occupations but that for older age cohorts a substantial fraction of these occupations were filled by foreign workers. This pattern suggests that immigrant workers were initially important in these occupations but that over time they were being replaced by native-born workers.<sup>17</sup>

Figure 5: Share of native-born workers in key metal shipbuilding occupations



This figure plots the share of native-born workers in the occupations most closely associated with metal shipbuilding: boilermakers, riveters, copper- smiths, and ship fitters, including apprentices in each of these occupations.

There is also additional evidence that NNS began training local workers to fill skilled

<sup>17</sup> An alternative explanation is that native-born workers were more likely to drop out of these occupations as they grew older, but this seems unlikely.

positions soon after the yard opened. For example, we know that the first apprenticeship certificate from NNS was issued to Norwood Jones in 1894, just a few years after the shipyard opened (N.N.S.D.D.Co., 1961). By 1900, the Census lists 60 workers as apprentices in skilled occupations, with the most common being machinist, draftsman, ship fitter, boilermaker and coppersmith. Out of this group, 55 (91%) were native-born Americans, with most born in Virginia or Pennsylvania. From the Census returns it is clear that the few foreign-born apprentices were often the sons of shipyard workers.

To summarize, the census data tell us a number of useful facts about how NNS assembled a workforce despite the scarcity of skilled local workers. In particular, I find that the shipyard depended heavily on attracting skilled workers from abroad, particularly from Britain, the world's leading shipbuilding country. There is evidence that these skilled foreign workers were particularly important early in the firm's life, and particularly in those occupations most closely associated with metal shipbuilding, while over time native-born workers were trained to fill these positions. This suggests that early access to foreign workers may have eventually led to increases in both unskilled and skilled employment among native-born workers. There is also evidence that the shipyard substituted towards unskilled workers, relative to British yards, consistent with facing a scarcity of skilled workers.

## **5 A second example: Bath Iron Works**

A second important American shipyard, Bath Iron Works (BIW) of Bath, Maine, was also founded in the 1880s. This section provides a brief summary of the early experience of this yard which allows me to assess the extent to which the patterns documented for NNS were more general. However, because of the data limitations discussed in Section 3, it is not

possible to analyze the workforce of BIW at the same level of detail as was done for NNS.

BIW provides a useful comparison to NNS because it began under very different conditions but still faced many of the same challenges. BIW was founded by Thomas W. Hyde, a former Civil War General and native of Bath. In 1884 he took over a small iron foundry in the city which he combined with a marine engine and ironworks company in 1885. In the late 1880s these facilities began ship production, with the first ship launched from the new yard in 1890.

In terms of the supply of workers, the origins of BIW gave the yard several initial advantages not available to NNS. Most importantly, Bath was in the heart of the most important wood shipbuilding region of North America. This gave BIW access to a pool of workers skilled in wood shipbuilding. Also, because the firm originated as a producer of metal products it began life with a ready supply of skilled metal workers. Despite these local labor resources, there is evidence that BIW still relied on foreign workers to move into metal shipbuilding. Morison (1958) writes (p. 13) that Bath,

*...became a center of wooden shipbuilding in the early federal era, but the Hydes of Bath were the only Maine shipbuilders to see that the wooden sailing ship was doomed. They brought in shipbuilders from Great Britain who were used to working on iron and steel to build freighters, yachts and warships of the new material. But they made no clean break with the past. The skilled Maine shipwrights, caulkers, riggers and joiners found plenty of employment, too.*

There is evidence that many of the British workers employed by BIW early on were stolen from other U.S. yards. Eskew (1958) writes that, “Scotch and English workmen from the Cramp yard [in Philadelphia] made a further nucleus of skilled labor; and from these, Bath workmen, most of whom had already worked in wooden-ship yards, soon learned the tricks of the new trade.”

Using the Census of Population data, we can provide more direct evidence on the importance of foreign workers in Bath. The census data show that of the workers in Bath holding shipbuilding-related occupations, 59% were born in New England (the vast majority in Maine), 28% in Canada, 5.7% were born in Britain, 2.4% in other part of Europe, 1.4% from the mid-Atlantic states, and the remainder from other locations. Thus, British-born workers were present, but they were less common than those from Canada.

However, the British-born workers in Bath were concentrated in occupations that were important for metal shipbuilding and within these occupations they made up an important fraction of the labor force. For example, British-born workers accounted for more than a quarter of boilermakers and riveters and 12% of iron workers. They also made up 9% of workers with “Bath Iron Works” listed as their occupation and no additional details provided.

British-born workers also made up a substantial fraction of shipyard management in Bath. Snow (1987) describes the building of the first metal vessels constructed by BIW, two Navy gunboats, “under the supervision of Mr. Skolfield from England, who directed the erection of the hulls.” Of the four shipyard superintendents or assistant superintendents listed in Bath in the 1900 Census, two were born in Scotland. John McInnis, the assistant superintendent at BIW, came to the U.S. in 1890 after working his way up in Scottish yards.<sup>18</sup> After arriving in the U.S. he was a naval architect at the Columbian Iron Works in Baltimore before moving to Bath, where he became yard superintendent late in 1900.

It is useful to compare the patterns observed for British workers with immigrant workers from Canada. Canada, particularly the Maritime Provinces, was a major wood shipbuilding center. The data reveal stark differences between these two immigrant groups; more than two-thirds of those born in Canada listed ship carpenter as their occupation, a job primarily present in wood shipbuilding.

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<sup>18</sup> See Eskew (1958), p. 65.

The timing of the arrival of British-born workers also matches the beginning of iron shipbuilding in Bath. Figure 7 in the appendix shows that by far the largest share of British-born shipyard workers in Bath arrived in the U.S. between 1886 and 1890, the period in which BIW began producing metal ships. In contrast, workers from other foreign countries do not show concentrations during that period.

While the data do not allow an analysis of BIW that is as detailed as was possible for NNS, this brief discussion provides evidence that BIW also relied on foreign workers to fill important needs in order to move into metal ship construction. Unlike NNS, BIW was able to leverage local skills in wood ship production, woodworking, and sail rigging, as well as the company's own experience in metalworking.<sup>19</sup> Despite these advantages, foreign workers – mainly from Britain – appear to have been important, particularly in occupations closely associated with metal shipbuilding.

## **6 Discussion**

Taking an “industry towns” approach to using Census of Population data, this paper documents the contribution of skilled immigrant workers to the emergence of metal shipbuilding in the U.S. in the late 19th century. These immigrants, hailing primarily from Britain, the world's leading metal shipbuilding center, came with more experience than other immigrants and filled vital metal shipbuilding occupations. I also provide evidence that these immigrants were a particularly large part of the firm's skilled labor force early on, while over time native-born workers were trained to fill the types of occupations which were initially filled by skilled immigrants. These findings, which are corroborated by qualitative historical sources, suggest that access to skilled immigrant workers played an important

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<sup>19</sup> It is interesting that an important product line at BIW was the production of large luxury yachts. These combined metal hulls with rich wood-paneled interiors, allowing the shipyard to take advantage of both its ability to build metal ships as well as the local availability of skilled woodworkers.

role in the emergence of metal shipbuilding in the United States.

This paper should not be interpreted as claiming that without access to skilled immigrants metal shipbuilding would not have emerged in the U.S. However, the fact that the Newport News Shipyard substituted heavily towards unskilled labor (and capital) compared to leading British shipyards tells us that the firm faced a relative scarcity of skilled workers. Given the number of skilled immigrant workers employed by the firm, without immigration skilled shipbuilders would have been even more scarce. This suggests that the ability to attract foreign skilled workers lowered the costs faced by U.S. metal shipbuilding firms, particularly early on.

One innovation offered in this paper is the application of the “industry towns” approach, which allows me to use Census of Population data to shed new light on the role played by immigrants in the labor force of specific firms and industries. This approach may be useful for improving our understanding how immigrant workers influenced other industries that predominantly operate in industry or company towns.

## References

- Abramitzky, R, & Boustan, LP. 2017. Immigration in American Economic History. *Journal of Economic Literature*, **55**(4), 1311–45.
- Abramitzky, R, Boustan, LP, & Eriksson, K. 2014. A Nation of Immigrants: Assimilation and Economic Outcomes in the Age of Mass Migration. *Journal of Political Economy*, **122**(3), 467–506.
- Abramitzky, R, Boustan, LP, & Eriksson, K. 2016. *Cultural Assimilation During the Age of Mass Migration*. NBER Working Paper No. 22381.
- Abramitzky, R, Boustan, LP, & Eriksson, K. 2012. Europe’s Tired, Poor, Huddled Masses: Self-selection and Economic Outcomes in the Age of Mass Migration. *American Economic Review*, **102**(5), 1832–1856.
- Ager, P, & Hansen, CW. 2017. *Closing Heavens Door: Evidence from the 1920s U.S. Immigration Quota Acts*. Working paper.
- Allen, R.C. 1977. The Peculiar Productivity History of American Blast Furnaces, 1840-1913. *The Journal of Economic History*, **37**(3), 605–633.
- Allen, R.C. 1979. International Competition in Iron and Steel, 1850-1913. *The Journal of Economic History*, **39**(4), 911–937.
- Allen, R.C. 1981. Accounting for Price Changes: American Steel Rails, 1879-1910. *Journal of Political Economy*, **89**(3), 512–528.
- Borjas, G. J. 2014. *Immigration Economics*. Cambridge, MA: Harvard University Press.
- Culliton, JW. 1948. *The Shipbuilding Business in the United States of America*. The Society of Naval Architects and Marine Engineers. Chap. Economics and Shipbuilding, pages 1–13.
- Eskew, GL. 1958. *Cradle of Ships*. New York: G.P. Putnam’s Sons.
- Evans, CW. 1954. *Collis Potter Huntington*. Newport News, VA: The Mariners’ Museum.
- Hanlon, WW. 2018 (February). *The Persistent Effect of Temporary Input Cost Advantages in Shipbuilding, 1850-1911*. Mimeo.
- Harley, CK. 1973. On the Persistence of Old Techniques: The Case of North American Wooden Shipbuilding. *The Journal of Economic History*, **33**(2), pp. 372–398.
- Hatton, TJ, & Williamson, JG. 1998. *The Age of Mass Migration*. Oxford University Press.
- Hirschman, C, & Mogford, E. 2009. Immigration and the American Industrial Revolution from 1880 to 1920. *Social Science Research*, **38**(4), 897–920.
- Hutchins, JGB. 1948. *The Shipbuilding Business in the United States of America*. The Society of Naval Architects and Marine Engineers. Chap. 2: History and Development of the Shipbuilding Industry in the United States, pages 14–60.
- Irwin, DA. 2003. Explaining America’s Surge in Manufactured Exports, 1880-1913. *The Review of Economics and Statistics*, **85**(2), pp. 364–376.
- Kerr, SP, & Kerr, WH. 2011. Economic Impacts of Immigration: A Survey. *Finnish Economic Papers*, **24**(1).
- Lafortune, J, Tessada, J, & Lewis, E. 2015 (June). *People and Machines: A Look at the Evolving Relationship Between Capital and Skill in Manufacturing 1850-1940 Using Immigration Shocks*. NBER Working Paper No. 21435.



- Margo, RA. 2014. *The Economic History of Migration: The Pre-WWI USA as Lens*. Edward Elgar Publishing. Pages 42–64.
- Morison, SE. 1958. *Cradle of Ships*. New York: G.P Putnam’s Sons. Chap. Introduction, pages 13–16.
- Moser, P, Voena, A, & Waldinger, F. 2014. German-Jewish Emigres and U.S. Innovation. *American Economic Review*, **104**(10), 3222–55.
- N.N.S.D.D.Co. 1961. *Three Generation of Shipbuilding*. Newport News, VA: Newport News Shipbuilding and Dry Dock Company.
- Pollard, S., & Robertson, P. 1979. *The British Shipbuilding Industry, 1870-1914*. Cambridge, MA: Harvard University Press.
- Rapping, L. 1965. Learning and World War II Production Functions. *The Review of Economics and Statistics*, **47**(1), 81–86.
- Searle, AD. 1945. Productivity and Labor in Industry. *Monthly Labor Review*, December, 1132–47.
- Snow, RL. 1987. *Bath Iron Works: The First Hundred Years*. Maine Maritime Museum.
- Tazewell, WL. 1986. *Newport News Shipbuilding: The First Century*. Newport News, VA: Newport News Shipbuilding and Dry Dock Company.
- Temin, P. 1964. *Iron and Steel in Nineteenth-Century America*. Cambridge, MA: The MIT.
- Thompson, Peter. 2001. How Much Did the Liberty Shipbuilders Learn? New Evidence for an Old Case Study. *Journal of Political Economy*, **109**(1), pp. 103–137.
- Thompson, P. 2005. Selection and Firm Survival: Evidence from the Shipbuilding Industry, 1825-1914. *The Review of Economics and Statistics*, **87**(1), pp. 26–36.
- Thompson, P. 2007. How much did the Liberty shipbuilders forget? *Management Science*, **53**(6), 908–918.
- Thornton, R. A., & Thompson, P. 2001. Learning from Experience and Learning from Others: An Exploration of Learning and Spillovers in Wartime Shipbuilding. *The American Economic Review*, **91**(5), pp. 1350–1368.
- United States Bureau of the Census. 1975. *Historical statistics of the United States, colonial times to 1970*. US Department of Commerce, Bureau of the Census.

# **A Appendix**

## **A.1 Workers by category and birthplace**

Table 6 uses location-of-birth information to study where the NNS workers came from. The top panel looks across all workers while the bottom panel focuses on more experienced workers aged 30 and up. We can see that the vast majority of unskilled laborers came from Virginia or other nearby states (North Carolina, Maryland, West Virginia and Kentucky). Apprentices were also predominantly from nearby areas. However, many skilled workers hailed from further away.

The Mid-Atlantic states (Pennsylvania, New York and New Jersey) provided a sizable number of skilled craftsmen, managers, and high-skilled specialists. Among these, most of the skilled craftsmen came from Pennsylvania, the main center for coastal metal shipbuilding in the U.S. during this period. The shipyard's first superintendent, Henry Konitzky, came to NNS from Cramp shipyard in Philadelphia, though he would not last in the position long enough to appear in the 1900 Census returns (Tazewell, 1986). He was followed by Sommers N. Smith, who came from the Neafie & Levy shipyard, also in Philadelphia. Charles F. Bailey, the chief draftsman at the yard in 1891 was also formerly of Neafie & Levy. A number of specialists, particularly draftsmen, were born in New England. This had been the country's main shipbuilding center in the mid-19th century, when wood ships dominated, but shipbuilding in that region was in decline in the late 19th century due to the switch to iron and steel ships.

Table 6 shows that foreign workers were also important. A large number of skilled craftsmen, as well as some managers and specialists, came from Britain (which includes Ireland) and a number also came from continental Europe. The continental workers mainly hailed from Germany and Scandinavia, both important shipbuilding areas. However, the

results in the top panel of Table 6 understate the importance of foreign workers early in the shipyard's history, because they include a large number of young workers who could not have been in the labor force when the shipyard was founded.

In order to get a better idea of what the shipyard's workforce looked like earlier in its history, the bottom panel of Table 6 presents data focusing only on workers over age 28 in 1900. These workers would have been at least 18 when the shipyard opened, so they provide a sample that better reflects the yard's initial labor force. Here we see that those born in Britain and Europe made up an even more important share of skilled craftsmen and high-skilled specialists, while the Mid-Atlantic region was also important. Overall, the data in Table 6 show that NNS assembled a workforce using a combination of local workers, many of them unskilled, and more skilled craft workers drawn from the more industrial areas of the U.S. or abroad. Workers from Britain, the most important shipbuilding nation, were particularly important.

Table 6: Birthplace of workers by type

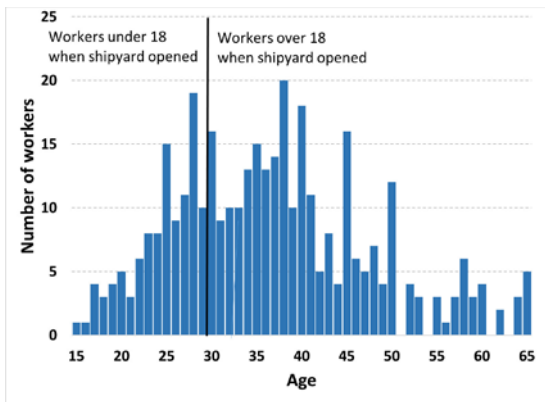
<b>A. All workers</b>						
	Laborers	Appr.	Skilled Craft.	Office	Man.	Spec.
Virginia & nearby	1244	34	812	32	17	32
Mid-Atlantic	24	16	246	4	15	38
Great Lakes	4	2	38	1	1	7
New England	1	1	34	1	1	16
Canada	2	0	24	1	0	0
Britain	19	4	233	2	4	7
Europe	19	1	97	0	5	7
Other	18	2	41	1	1	4
<b>B. Workers over 28 in the 1900 census</b>						
	Laborers	Appr.	Skilled Craft.	Office	Man.	Spec.
Virginia & nearby	430	0	320	10	11	7
Mid-Atlantic	10	0	142	4	12	5
Great Lakes	1	0	19	1	0	2
New England	1	0	27	1	0	4
Canada	1	0	15	0	0	0
Britain	13	1	177	1	4	5
Europe	12	1	74	0	3	6
Other	8	0	19	1	1	2

## A.2 Age distribution of other foreigners

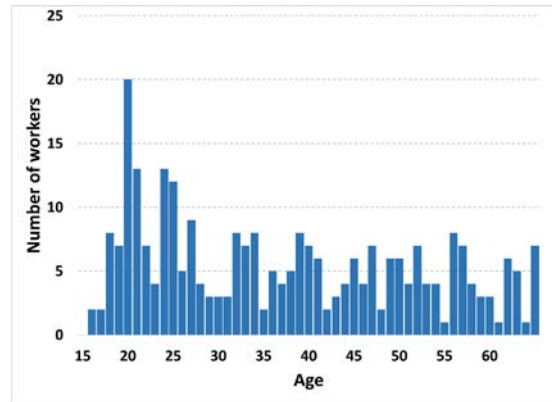
Table 6 describes the age distribution of foreign residents of Newport News that did not hold shipbuilding occupations (left panel) and foreign residents of Groton-Noank holding shipbuilding occupations. The main take-away from this graph is that neither of these two comparison groups shows the distinct double-peaked age distribution found for the shipbuilding workers in Newport News in Figure 4.

Figure 6: Comparison foreign-born age distributions

Foreign residents of Newport News not in shipbuilding occupations



Foreign residents of Groton-Noank in shipbuilding occupations



### A.3 Evidence from Bath Iron Works

Figure 7 plots the share of immigrant shipyard workers in Bath, ME by year of arrival. There is evidence of a concentration of British shipyard workers arriving in 1886-1890, the period in which BIW began ship production, while no similar pattern appears for immigrants from other locations.

Figure 7: Year of immigration of shipyard workers in Bath, ME in 1900

