

Skilled Immigrants and American Industrialization: Lessons from Newport News Shipyard *

W. Walker Hanlon
NYU Stern School of Business & NBER

July 16, 2018

Abstract

In the late nineteenth century, American firm sought to enter into modern metal shipbuilding, a sector dominated by British shipyards. In doing so, they faced a challenge: a shortage of domestic workers with the skills to fabricate large metal ships. Using census of population data and a novel “company towns” approach, this article describes how one important U.S. shipyard, Newport News Shipbuilding, overcame the shortage of skilled domestic workers in order to assemble an effective workforce. The results show that skilled immigrants, mainly from Britain, played an important role in the shipyard’s early life, while over time native workers were trained to fill skilled occupations. Thus, access to skilled immigrants allowed the firm to expand, ultimately enhancing the employment opportunities of native-born workers.

*I thank Paula Bustos, Bill Collins, Reka Juhasz, Joan Monras and seminar participants at CEMFI and Michigan State for helpful comments. Giorgio Ravalli provided excellent research assistance. This paper was funded by a Cole Grant from the Economic History Association, the Hellman Fellowship at UCLA, and a research grant from UCLA’s Ziman Center for Real Estate. Author contact: NYU Stern School of Business, 44 West 4th Street Room 7-160, New York, NY, 10012, whanlon@stern.nyu.edu.

1 Introduction

The economic impact of immigrants remains an active area of both scholarly and public debate. In recent years, much of the economic analysis of immigration has focused on the impact of low-skilled immigrants on native workers through labor market competition, or the effects that very high-skilled immigrants may have as entrepreneurs or inventors.¹ Yet there is another group of immigrants, the skilled craft workers, that typically receive less attention from economists.

The fact that skilled craft workers are often ignored in economic analysis is somewhat surprising given that historians have documented the important role that skilled immigrants played in the development of American industry. John Lewis and coauthors, for example, describe the role that skilled Welsh workers played in early tinplate manufacturing (see, e.g., Jones & Lewis (2007)). Recent work by Fones-Wolf (2004) on Belgian glass workers provides a second case. While studies of this type are insightful, they are limited by their focus on relatively small and somewhat obscure industries as well as the difficulty in quantifying the effects that they describe.

This article augments and extends previous on skilled immigrants, by documenting the role they played in the development of modern industrial shipbuilding in the U.S. in the late-19th century. The analysis focuses mainly on one shipyard, Newport News Shipbuilding (NNS), which grew from its founding in the late 1880s to become the most important American shipbuilder. Today it continues to be the nation's preeminent shipyard, and the only yard capable of producing the largest classes of Navy ships.

¹See (Hatton & Williamson, 1998; Hirschman & Mogford, 2009) on the impact of immigrants on natives through labor market competition. On the impact of very high-skilled immigrants on innovation patterns see (Moser *et al.*, 2014). For reviews of the modern economic literature on immigration see Kerr & Kerr (2011) and Borjas (2014). Reviews of recent historical work on immigration are provided by Margo (2014) and Abramitzky & Boustan (2017).

Shipbuilding is an ideal setting in which to examine the importance of immigrant workers. This is undoubtedly an industry of great importance to the United States since the colonial era. It is also a sector where access to skilled workers was important. In addition, as I discuss below, the fact that shipyards were often located in smaller towns allows me to take a novel approach to understanding how a new shipyard like NNS assembled the skilled workforce necessary to built large metal ships.

The shipbuilding industry has had a long and volatile history in the United States. Early in the country's history New England shipyards, drawing on the continents vast untapped timber resources, supplied wooden sailing ships to buyers around the world. However, after 1850, the industry began to decline. The rise of metal shipbuilding shifted the industry towards Britain, which enjoyed the advantage of initially cheaper iron inputs and more workers with engineering experience.² This early lead allowed Britain to build up a pool of skilled metal shipbuilders that made British shipyards the most productive in the world (Pollard & Robertson, 1979).

Toward the end of the 19th century, the development of the U.S. as a major iron and steel producer lowered the cost of metal inputs, opening up the possibility that U.S. shipyards could compete in metal ship production.³ However, young American shipyards still faced important challenges. Chief among these was a lack of workers with the unique and vital skills necessary to fabricate large metal ships.

How did NNS assemble, virtually from scratch and over a relatively short period of time, the skilled workforce necessary to successfully produce large metal ships? In studying this topic, the paucity of available corporate records during these early

²(Pollard & Robertson, 1979; Hutchins, 1948; Hanlon, 2018).

³The drop in iron prices was due in part to the discovery of new iron reserves, particularly in the Masabi Range in Minnesota, which led to the expansion of iron and steel production in the U.S. (Irwin, 2003). At the same time, productivity in U.S. iron and steel production was improving rapidly (Temin, 1964; Allen, 1977, 1981, 1979).

stages of the firm's life presents a challenge. While firm records give us information about the senior level of managers, they provide little information about the main body of the workforce, the men who actually built the ships.

To overcome this, this study applies a somewhat novel approach that takes advantage of the fact that Newport News was essentially a company town during the first two decades of the firm's existence. As a result, anyone residing in Newport News and holding a shipbuilding or related occupation was almost certainly working for NNS during these years. This means that the Population Census can be used as a unique window into the firm's workforce. The Census provides details about workers' backgrounds that are typically not included in corporate records. For example, the census provides each resident's occupation as well as background information such as birth place, what year immigrant workers came to the U.S., race, marital status, and household composition. These details can help us understand the origin and composition of the workforce that NNS assembled.

The analysis presented below highlights the vital role that skilled immigrants played in the early life of NNS. Immigrants from Britain, the world's leading shipbuilding nation, filled key skilled positions, particularly early in the firm's life. These skilled immigrant workers, together with skilled Americans hailing mainly from the Mid-Atlantic region, were employed together with a large pool of unskilled workers, mainly African-Americans, drawn from Virginia and neighboring states. Over time, local (white) workers were trained to take up skilled positions. Thus, my analysis highlights the importance of access to skilled foreign workers for the early development of NNS, as well as how, over time, local workers were trained to fulfill the firm's expanding need for skilled labor.

2 Industry background

The shipbuilding industry has attracted a substantial amount of interest from historians and economists. One topic of study has been the factors behind the rise of British shipbuilding to dominance in the mid-19th century, and the subsequent decline of the industry in the mid-20th century.⁴ Other research focuses on why the U.S. struggled to compete with British shipbuilders, particularly after U.S. iron and steel prices fell to comparable levels around the turn of the century. Harley (1973), for example, examines the persistent survival in wood shipbuilding in the U.S. and concludes that it continued because of the existence of locked-in skills specific to wood ship construction. However, even as wood shipbuilding survived, U.S. firms were beginning to move into modern metal ship construction. Protectionism certainly played a role in this process; U.S. shipyards were protected from British competition for ships operating directly between U.S. ports, which provided a small market that was reserved entirely for vessels of U.S. construction.⁵ While this protection propelled the growth of U.S. shipyards, they still faced important challenges in moving into large-scale iron and steel shipbuilding.

Chief among these challenges was the scarcity of skilled metal shipbuilders in the U.S.⁶ 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. For example, the shaping of large metal plates and beams into various irregular shapes

⁴See, e.g., Lorenz (1991).

⁵Shipyards in the Great Lakes were also protected by natural barriers that made it difficult for large vessels to transit between the Great Lakes and the Atlantic.

⁶See Pollard & Robertson (1979) and Culliton (1948).

was an operation that was central to metal shipbuilding but of limited importance in most other sectors. How fast beams and plates could be formed into the desired shape determined the speed with which a ship could be built, while errors in the process contributed to delays and waste.⁷ Skills of this type, those unique to the industry, 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. One important factor during the period covered by this study is that most ships were unique bespoke orders. 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.⁸

Also, shipbuilders faced volatile demand and a highly competitive market.⁹ With the exception of the largest ocean liners, which could only be constructed by a few specialized yards, shipbuilding was a fragmented industry where 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

⁷Thiesen (2006) p. 101-112 provides an excellent description of the various stages involved in metal ship construction and how they were accomplished during the 19th century.

⁸These conditions were very different from those experienced during both WWI and WWII, studied by Thompson (2001), where the production of repeated standardized designs allowed shipyards to expand by using lower skilled workers trained to do just one type of task.

⁹(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.

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).

These features meant that leading shipyards depended on having access to skilled workers. 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). Also, the importance of skilled workers, together with the fact that skills were mainly gained through apprenticeships and on-the-job experience meant that locations with a longer history of metal shipbuilding maintained a distinct advantage. This led to regional concentrations of ship production in locations 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.

We know from research by Berthoff (1953) and others that at least some skilled British shipbuilders migrated to the U.S. However, assessing the magnitude of these flows and their importance for American shipyards has proven difficult. Most of what we know come from anecdotal sources which, while informative, are difficult to

quantify. One aim of this study is to provide us with a better idea of the quantitative importance of these skilled immigrant shipbuilders.

2.1 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 railroad. 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. He became the president of the C&O in 1869. Soon after, 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 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.

Newport News offered several advantages as a sea terminus for the C&O. First, it possessed an excellent deep natural harbor. Second, the area was almost completely

undeveloped, consisting mainly of farmland and a small fishing village. This 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, which he did through his Old Dominion Land Company. Another advantage of this location was that 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.¹⁰

The Newport News 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. 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.

¹⁰Newport 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.

3 Data

A central challenge in understanding the early workforce of NNS is the paucity of direct information from corporate records. While some records have survived, mainly as part of the extensive Huntington papers, these contain mainly personal correspondences. Among these records, the more concrete challenges faced by the management in Virginia make only an occasional appearance.¹¹ Newspaper articles also offer some information, but reporters paid relatively little attention to the common workers at the yard. Thus, if we want to understand how the firm assembled a workforce it is necessary to look for other, less traditional, sources of information.

The main source of information drawn on by this study is a set of hand-collected data from the U.S. Population Census of 1900 manuscripts.¹² I focus on data from the 1900 census in part out of necessity. Records for the 1890 Census, the first one taken after the founding of NNS, have been lost to a fire. However, as we will see, the details contained in the 1900 census can help shed light on the firm's workforce, even going back to its founding in 1888.

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 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

¹¹Smith (1965) provides a thorough review of the information available from both company records and other sources.

¹²These manuscripts were accessed using the genealogy website Ancestry.com. While census data is available in transcribed form, hand-collecting the data from the original manuscripts allows me to take advantage of additional details that are often unavailable in the transcribed databases while limiting the effect of transcription errors.

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. While a few of these must have been employed at the shipyard, most of them worked at the C&O's port facility. As a result, the 3,155 shipyard workers identified in the 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 either those shipyard workers with occupations that do not clearly identify them as such, or people for whom the census occupation category was not filled out or was filled out incorrectly. Many of these would likely have been relatively unskilled workers, so it is probable that the data set is mildly 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.¹³

¹³The main distinction between skilled craftsmen and specialists is that the former typically ac-

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.¹⁴ 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.

To provide a point of comparison, I also construct similar data for two other major American shipbuilding centers. One of these, the Groton-Noank area of Connecticut, remained entirely focused on wood shipbuilding. Thus, as a comparison case this can be used to illustrate the different challenges, and responses, involved in moving into metal shipbuilding. A second comparison case is provided by Bath Iron Works (BIW) in Bath, Main. BIW differed from NNS in important ways. It was located in the heart of the traditional U.S. (wood) shipbuilding areas, and, because it originated from a producer of metal machinery (thus the name), it had access to a pool of skilled metalworkers. 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

quired their skills on the job or through apprenticeships while the latter may have had some more formal education.

¹⁴E.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.

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 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 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.¹⁵

4 Composition of the NNS labor force

Operations at NNS really began in late 1888, with the dry dock ready for use in 1889. The first payroll made by the yard was in December, 1888. By September 1889 there were 104 workers employed at the yard and by 1900 this had grown to around 4,500. 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 1900. By

¹⁵It 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.

far the two largest occupation groups were unskilled laborers, which made up about 43% of the workforce, and skilled craftsmen, which accounted for about 49%.¹⁶ The very elite worker groups – managers and specialists – are much smaller. NNS also employed a number of apprentices who were learning a variety of skilled trades.

The data in Table 1 lead to a first useful finding: relative to British shipyards, NNS was using a substantially higher share of unskilled workers. For comparison, data from Pollard & Robertson (1979) (Table 8.1, p. 153) show that in 1892 unskilled workers made up just 29 and 22 percent 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. This suggests that the ratio of skilled to unskilled workers at NNS was substantially below the ratio in British yards, consistent with a scarcity of skilled metal shipbuilders in the U.S.

The share of unskilled workers obtained from the census data roughly matches the share reported for different periods by Smith (1965) based on information from correspondence and surviving shipyard records. A letter from Mr. Smith, the shipyard Superintendent, to Mr. Orcutt, the President, indicates that in January, 1898, the yard employed 1259 mechanics to 2057 laborers, an unskilled share of 62%. A decade earlier, shipyard records from October of 1889 report 38 laborers out of a total of 97 workers, a share of 39.5%, while in April of the same year there were 60 laborers reported out of a total of 98 workers, a 61% share.¹⁷

¹⁶In fact this number likely understates the true unskilled share since it may not include casual laborers.

¹⁷The periods with very high unskilled shares were likely times at which there was substantial construction going on in the yard.

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/foremen	44	0.014
Specialists	111	0.036

Data from the 1900 Census of Population for workers residing in Newport News, VA and holding shipbuilding-related occupations.

There is evidence that this substitution of unskilled for skilled work was accompanied by greater capital intensity. 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...” 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). An article in the *Cleveland Marine Review* in 1893 described the plant as, “representing the latest in engineering achievement in the way of labor saving machinery...”¹⁸ Among the new technologies being used at the shipyard were hydraulic and compressed air tools and electricity.¹⁹

Another feature that emerges from the census data is the the vital role played by African-Americans, who provided the backbone of the shipyard’s unskilled labor force. Table 2 shows how important black workers were for the shipyard, as well as

¹⁸Quoted from Smith (1965), p. 54.

¹⁹See, e.g., Smith (1965) p. 91, which cites an article from *Marine Engineering* describing the yard’s compressed air plant as one of the largest and best equipped in operation.

how few of them were able to move into more skilled positions. These differences are not driven by foreign workers; if we compare blacks just to native-born whites in the third column, the differences are just as stark. Historical sources have indicated the openness of NNS to employing African-American workers.²⁰ For example, Evans (1954) states that blacks “received equal pay for equal work, and are retired with pensions upon the same qualifications as the white men.”

Table 2: NNS workers by race and job type

	Black	White	Native-born whites
Laborers	1124	208	168
Apprentices	1	59	54
Skilled craftsmen	44	1477	1123
Office workers	0	44	41
Managers/foremen	1	43	34
Specialists	0	111	97

Data from the 1900 Census of Population for workers residing in Newport News, VA and holding shipbuilding-related occupations.

The data show stark differences in the origins of workers fitting into the different occupational categories. Among unskilled laborers working at NNS in 1900, 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. Among more skilled

²⁰Huntington was active in supporting the advancement of African-Americans. In the 1880s, in one of his relatively few acts of charity, he contributed funds to establish an industrial department at the Hampton Normal and Agricultural Institute, a school for blacks and Native Americans in Hampton, VA. He later served as a trustee for the institute while his wife was a contributor to Booker T. Washington’s Tuskegee Institute (Evans, 1954).

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 workers, for example, 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. Migrants from 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. These findings enrich and quantify available narrative evidence from historians such as 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 3 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. These are the two quintessential skilled occupations of metal shipbuilding. British workers also formed a substantial share of machinists and chippers/caulkers.

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. 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.

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 and Groton-Noank, Connecticut. This comparison takes advantage of the fact that Groton-Noank was a major wood shipbuilding center with essentially no metal ship production, while Bath was a center of both wood and metal shipbuilding as well as host to an extensive iron products industry.

Table 3: Share of British-born and foreign-born workers by occupation, 1900

Occupation	Share British born	Share foreign born	Total workers	Occupation	Share British born	Share foreign born	Total workers
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 for residents of Newport News, VA. Table includes all shipyard occupations with more than fifteen workers.

Table 4 looks at the fifteen most important skilled occupations in Newport News and compares occupation shares there to the shares in Bath and Groton-Noank. Based

on this comparison, 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.²¹ Other occupations were 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 3, it is notable that these occupations tended to have high shares of foreign workers. Moreover, of the foreign workers in these occupations, a large share came from Britain. For example, 86% of the foreign-born boilermakers were British as were all of the foreign-born riveters in Newport News.

There are also some occupations that were clearly associated with wood shipbuilding only. 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. It is also 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. Unfortunately, the available data do not allow us to separate iron workers in Bath based on whether or not they worked in a shipyard.

²¹Chippers/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.

Table 4: 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%

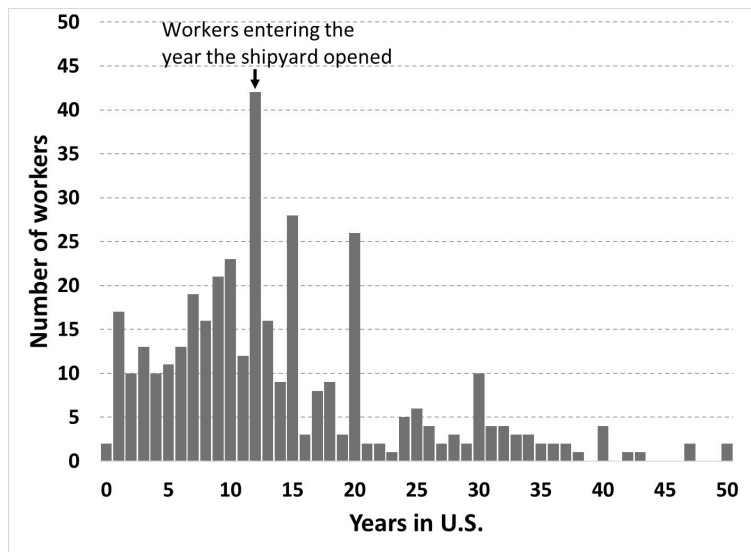
Data from U.S. Population Census of 1900 for residents of Newport News, VA, Bath, ME and Groton-Noank, CT.

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 important, we are particularly interested in the impact of skilled workers earlier in the shipyard’s life. It is possible 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. It is difficult to explain this distinctive spike in year 12 other than as a result of the opening of the Newport News Shipyard. Thus, this pattern 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 12.

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



Data from U.S. Population Census of 1900 for foreign-born residents of Newport News, VA holding shipbuilding occupations.

The spike in year twelve in Figure 1 suggests that around 20-30 more NNS shipyard workers entered the U.S. in that year 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 seems likely that these foreign workers comprised most of the skilled 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 1888/1889, the vast majority (35) were from Britain. Three others were from Germany, the second largest metal shipbuilding area in Europe.

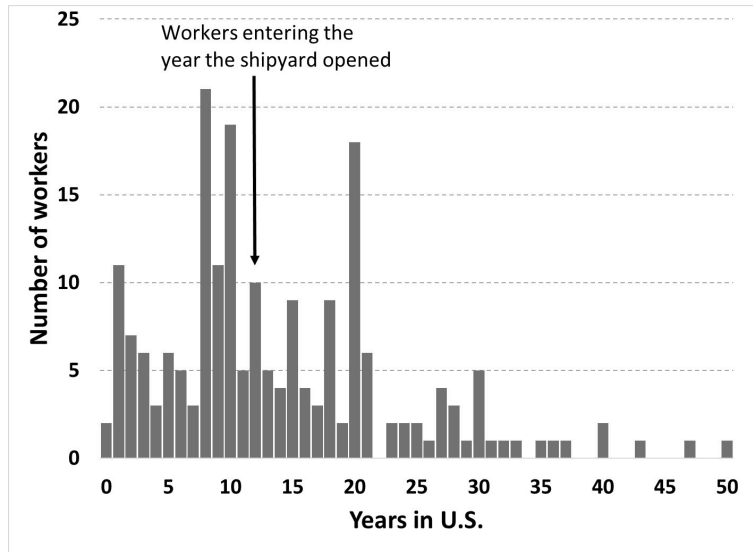
The occupations of the immigrant workers that arrived in the U.S. in 1888-9 essentially covered the range of skills needed for metal shipbuilding: 9 machinists, 6 riveters, 2 boilermakers, 4 ship fitters, 2 ship joiners, 2 draftsmen, 2 chipper & caulkers, a coppersmith, a millwright, a rigger, etc. Compare these to employment in the yard in April of 1889 given by Smith (1965) based on firm records: out of 98 workers the yard employed a foreman boilermaker and two regular boilermakers, two machinists, a foreman plater and two regular platers, 8 caulkers, etc. Together, these facts suggest that NNS likely drew a substantial portion of its initial skilled workforce from abroad.

Another sign of the importance of the 1888-89 immigrant cohort can be found by looking up individuals listed as foreman at the shipyard in 1900 from a list given by the *Newport News Daily Press* (Smith, 1965, p. 109-10). The three foremen overseeing the key metal shipbuilding trades at his time were A. Shankland, the Foreman Riveter, William McCallum, the Foreman of Plumbers and Pipefitters, and Charles White, the Foreman Anglesmith. Looking these up in the Census shows that all three were born in Scotland. Shankland immigrated to the U.S. in 1888 at age 28, McCallum came in 1887 at age 31, while White came in 1886 at age 24. All of them would have been old enough to have completed an apprenticeship before coming to the U.S. This pattern is particularly striking given that most of the other foremen on the list, who worked in areas less unique to metal shipbuilding, were born in the U.S.

or had immigrated at a young age.

The timing of immigration of shipyard workers in Figure 1 can be compared to the timing of entry for foreign-born residents of Newport News working in other (non-shipyard) occupations. Figure 2 plots number of years in the U.S. for these other 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 foreign-born non-shipyard workers



Data from U.S. Population Census of 1900 for foreign-born residents of Newport News, VA holding non-shipbuilding occupations.

To quantify the number of excess shipyard workers that arrived in the U.S. in 1888, compared to the pattern observed for non-shipyard workers resident in Newport News, I run some simple linear regressions. The results of this exercise are presented in Table 5. 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. and 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. All regressions in Table 5 include fixed effects by arrival year and a fixed effect for shipyard workers. Thus the immigration timing for shipyard workers is being compared to the timing observed for non-shipyard workers resident in Newport News. The regressions in Columns 2 and 4 also interact an indicator for shipyard workers with three quadratics of arrival year, to allow the pattern of arrivals to differ for this group.

Columns 1-2 of Table 5 show the number of excess workers shipyard workers present in Newport News that arrived in the U.S. the year the shipyard opened. These results indicate that there was an excess of 25-27 arrivals of immigrant shipyard workers in 1888, compared to what we would have expected given the immigration pattern observed for non-shipyard workers. Given that there were 104 workers on the NNS payroll at the end of 1889, this tells us that roughly one quarter of the total shipyard workers at that point were likely to have been immigrants. Since only around half of the shipyard workers were skilled, 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 the skills were specific to the metal shipbuilding industry and foreign workers tended to be disproportionately concentrated among those skills. Thus, we can conclude 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.

Columns 3-4 present results where the dependent variable is in logs. In this case the estimated coefficients can be interpreted as percentage increase. Thus, these estimates tell us that among the NNS workforce there were 80-100 percent more

Table 5: Testing the difference in immigrants in the year NNS opened

Dependent variable:	Count of immigrants		Log count of immigrants	
	(1)	(2)	(3)	(4)
Ship wkrs × NNS opens	27.14*** (0.929)	25.28*** (2.074)	1.007*** (0.128)	0.851*** (0.168)
Ship wkrs	0.857 (0.929)	3.236 (1.969)	0.0458 (0.128)	0.319 (0.212)
Ship wkrs × arrival yr		0.636 (0.768)		0.102 (0.0829)
Ship wkrs × arrival yr. sq.		-0.0764 (0.0527)		-0.0129* (0.00651)
Ship wkrs × arrival yr cub.		0.00165* (0.000947)		0.000297** (0.000131)
Constant	1.571** (0.640)	0.382 (2.002)	0.670*** (0.0682)	0.533** (0.202)
Year-of-arrival effects	Yes	Yes	Yes	Yes
Observations	72	72	72	72
R-squared	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.

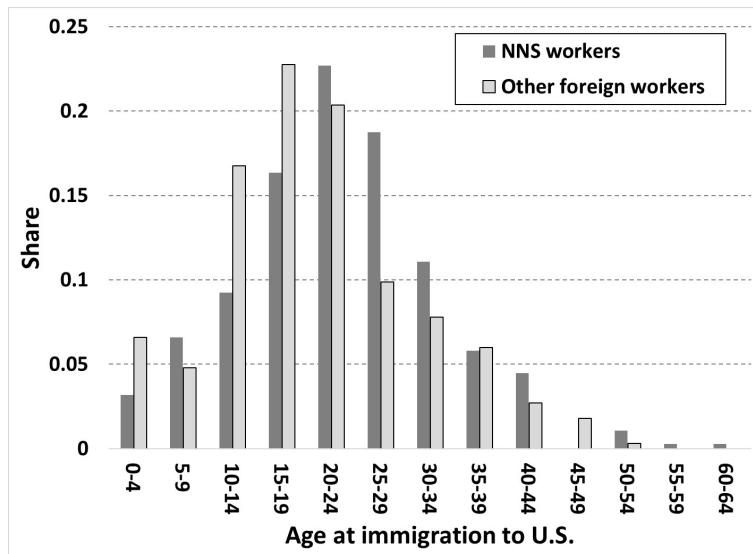
shipyard workers that arrived in the country in the year NNS opened than we would expect given the migration pattern of non-shipyard workers.

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 may have moved to the U.S. to work at the Pennsylvania shipyards, and then relocated later to work at the new NNS shipyard.

Immigrant shipyard workers were more experienced when they arrived than other immigrant workers in Newport News. This can be seen in Figure 3, which plots the age at migration for immigrant shipyard workers in Newport News and other non-shipyard immigrant workers. These data show that those foreigners who worked at NNS were much more likely to have migrated in their late 20s or early 30s than foreign workers outside of NNS. This suggests that NNS workers had more previous work experience by the time they migrated than the other foreign workers in Newport News.

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. Data from 1900 Census of Population.

Immigrant shipyard workers in Newport News were much more likely to hail from major European metal shipbuilding nations than other immigrant workers during this period. This fact is illustrated in Table 6, which provides a comparison between immigrant shipyard workers at Newport News, other immigrant workers 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.

Table 6 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, while Irish and German immigrants were not overrepresented relative to national trends.

The origins of shipyard workers also contrasts with the origins of foreign residents of Newport News working in non-shipyard occupations, shown in the middle columns of Table 6. While England, Ireland and Germany are also important among this group, the shares are spread much more evenly across origin countries. The differences 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. The shares in the middle columns of Table 6 are also closer to the national average for migrants from Poland, Ireland and Canada.

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).

Table 6: Top ten countries of origin for different groups of workers

Newport News shipyard wkrs.		Newport News other foreign wkrs.		Groton-Noank shipyard wkrs.	
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

Data from U.S. Population Census of 1900 for foreign-born residents of Newport News, VA (columns 1-2) and Groton-Noank, CT (column 3).

The census data also show that, while NNS initially drew heavily on foreign workers, it soon began training local workers to move into higher-skilled positions. Evidence for this can be seen 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.

This pattern contrasts sharply with what we see for European-born workers, in the right panel. The most important feature in this figure is the high level of European-born workers in their late 30s. Workers in this age category would have finished their apprenticeship period – typically 5-7 years in British yards – around the time that NNS was opening. There are also relatively few European-born workers under age 29 but many more around 29-32. Workers around 29-32 would have been moving into 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. 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 wood shipbuilding workers of Groton and Noank.

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

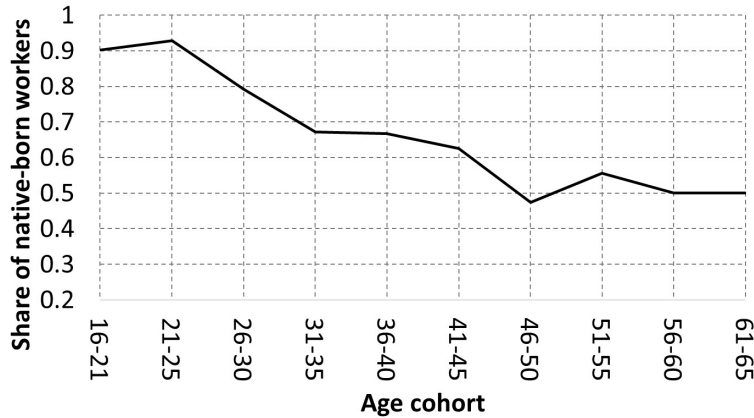


Data from U.S. Population Census of 1900 for residents of Newport News, VA holding shipbuilding occupations.

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). 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 the 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.²²

²²An alternative explanation is that native-born workers were more likely to drop out of these occupations as they grew older, but this seems unlikely.

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. Data from 1900 Census of Population for residents of Newport News, VA.

The data in these figures augment anecdotal historical evidence suggesting that NNS began training local workers to fill skilled positions soon after the yard opened. For example, we know that the first apprenticeship at NNS began in 1889 and the first completion certificate was issued to Norwood Jones in 1894 after a four-year program (Smith, 1965, p. 22). In the 1900 Census data, 60 workers are listed 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, we have seen 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 Discussion

This study shows that immigrant workers made a substantial contribution to the emergence of Newport News Shipbuilding, the most important new industrial shipyard to emerge in the U.S. during the late-19th century. Immigrants, hailing primarily from Britain, provided key skills early in the firms life, while over time there is evidence that native-born workers were trained to fill skilled occupations. These developments set the stage for the crucial role that NNS would play in the two World Wars, particularly WWII, when NNS built many of the aircraft carriers that won the Pacific War.

The fact that Newport News was a “company town” allows a novel analysis approach that uses the Census of Population to examine the firm’s workforce. Using the census data in this way overcomes the scarcity of direct firm records. In addition, the census contains details on the background of individual workers that are not likely to be included in firm records, thus illuminating aspects of the firm’s workforce that are difficult to observe in other ways.

Nevertheless, there remains the counterfactual question of whether the modern shipbuilding industry would have developed in the U.S. during this period in the absence of access to skilled immigrant workers. This paper should not be interpreted as claiming that without access to foreign workers metal shipbuilding would not have emerged. 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 even when access to skilled immigrant workers was possible. Given the number of skilled immigrant workers employed by the firm, without immigration, skilled shipbuilders would have been even more scarce. This tells us that the ability to attract foreign skilled workers likely lowered the firms cost early in their development, while over time these workers contributed to the training of a new generation of skilled native-born workers. Thus, access to skilled immigrant workers expanded, over time, the employment opportunities available to the native-born population.

References

- Abramitzky, R, & Boustan, LP. 2017. Immigration in American Economic History. *Journal of Economic Literature*, **55**(4), 1311–45.
- 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.
- Berthoff, RT. 1953. *British Immigrants in Industrial America, 1790-1950*. Harvard University Press.
- Borjas, G. J. 2014. *Immigration Economics*. Cambridge, MA: Harvard University Press.
- Culliton, James W. 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.
- Evans, Cerinda W. 1954. *Collis Potter Huntington*. Newport News, VA: The Mariners' Museum.
- Fones-Wolf, K. 2004. Transatlantic Craft Migrations and Transnational Spaces: Belgian Window Glass Workers in America, 1880-1920. *Labor History*, **45**(3), 299–321.
- Hanlon, W Walker. 2018 (February). *The Persistent Effect of Temporary Input Cost Advantages in Shipbuilding, 1850-1911*. Mimeo.
- Harley, C. K. 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, John G.B. 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, Douglas A. 2003. Explaining America's Surge in Manufactured Exports, 1880-1913. *The Review of Economics and Statistics*, **85**(2), pp. 364–376.
- Jones, B, & Lewis, RL. 2007. Gender and Transnationality among Welsh Tinsplate Workers in Pittsburgh: The Hattie Williams Affair, 1895. *Labor History*, **48**(2), 175–194.

- Kerr, SP, & Kerr, WH. 2011. Economic Impacts of Immigration: A Survey. *Finnish Economic Papers*, **24**(1).
- Lorenz, Edward H. 1991. An Evolutionary Explanation for Competitive Decline: The British Shipbuilding Industry, 1890-1970. *The Journal of Economic History*, **51**(4), pp. 911–935.
- Margo, RA. 2014. *The Economic History of Migration: The Pre-WWI USA as Lens*. Edward Elgar Publishing. Pages 42–64.
- Moser, P, Voena, A, & Waldinger, F. 2014. German-Jewish Emigres and U.S. Innovation. *American Economic Review*, **104**(10), 3222–55.
- Pollard, S., & Robertson, P. 1979. *The British Shipbuilding Industry, 1870-1914*. Cambridge, MA: Harvard University Press.
- Smith, Edward O. 1965. *History of the Newport News Shipbuilding and Dry Dock Company*.
- Tazewell, William L. 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.
- Thiesen, William H. 2006. *Industrializing American Shipbuilding*. University Press of Florida.
- 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.
- 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.