Fueling the Fires of Genius: Women's Inventive Activities in American War Eras

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"Fueling the Fires of Genius" uses the history of women inventors to link the world of business, invention, and technological change to the history of American culture and society. It relies on patent data, case studies, and a plethora of historical evidence to identify and account for the patterns of women's inventive activities during the Civil War, World War I, and World War II.[1] Business historians, economists, and historians of technology have associated wars with profound bursts of invention, innovation, and technological change. Women's historians and social historians have interpreted wars with greater ambiguity. Some have stressed their liberating effects on women's economic experiences, while others have emphasized the various social constraints associated with domestic turmoil and postwar reconversion. This study suggests that with the notable exception of women inventors in the Civil War era, American wars were detrimental to short-term patenting rates and to most forms of non-military invention for both men and women. Most patented inventions grew increasingly complex and technically sophisticated over time, but the total number of newly-issued patents decreased during wartime.[2]

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[1] I utilized two major historical sources to compile the patent data that I analyzed in this dissertation. For the years between 1849 and 1871, I relied on the comprehensive list of patents included in the *Annual Report of the Commission of Patents* for each respective year. For the years between 1872 and 1951, I used the *Official Gazette of the United States Patent (and Trademark) Office.* The *Official Gazette* was issued by the Patent Office on a weekly basis beginning in 1872, and included a complete list of all patents (with the names of the corresponding patentees) that were issued in the preceding week. My completed data sets include 14,716 patents, with the names of 17,530 individual patentees.

[2] Notable studies on women inventors in America include Merritt [1991]; Macdonald [1992]; Stanley [1995]; and Khan [1996].

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The wars analyzed in this dissertation are significant to the history of technological change because they bracketed three of the most distinctive periods in the evolution of America's inventive culture. Wars spurred the dissemination of inventive information; fueled the creation of new institutions to safeguard invention; and stimulated the formation and manipulation of commercial networks that connected many women to the market for new technologies. These wars also shaped the popular values, public attitudes, and gendered beliefs that fueled society's perceptions of technology in American life. During the Civil War, America's inventive culture was rooted in ideas about the lone male inventor who patented for the good of the country and the advancement of the sciences and mechanical arts. During World War I, the suffrage movement coupled with organized attempts to broaden women's rights contributed to a distinctive inventive culture among women. By World War II, the inventive cultures for both men and women converged on the "institutional inventor" - the federal government, the modern corporation, and the scientific research laboratory - as the new haven for high-powered inventors and inventions.

The history of war and invention illuminates the complex issues associated with the evaluation of technological change. Most scholars have assessed the importance of "genius" inventors and their "exceptional" inventions based on various criteria. Some quantifiers have counted the number of patents filed by well-known inventors (Thomas Edison and his record-setting 1,328 patents) [Hughes, 1986, p. 150]. Other patent-watchers have traced the economic impact of a given invention on a particular business, industry, or economy (Eli Whitney and his revolutionary cotton gin). Still other scholars have focused on the popularity of a specific inventor or invention (Abraham Lincoln and his elaborate device for lifting vessels over shoals). These criteria marginalize women inventors because so few women patented their inventions (women accounted for 0.2-5.6% of all U.S. patents across the nineteenth and twentieth centuries) and even fewer women filed multiple patents or acted as "repeat inventors." Most women, whose primary sphere of influence remained in the home and family over time, were more detached from business and industry than men and thus lesser-known in commercial networks and emerging technological markets. Women typically invented in domestic fields, such as clothing and household items, that raised the standard of living or improved the quality of American life. Such inventions cannot easily be measured by the traditional methods used to assess the rate of growth, technological change, and business development in more industrial sectors of the economy. Therefore, the significance of women's inventive activities rests in the histories of social, cultural, and commercial development, rather than in the studies of quantifiable economic growth.

Several institutions shaped the intricate processes and varied outcomes associated with the history of invention and innovation. Since the 1790s, the U.S. patent system has served as the promoter of technological change and regulator of intellectual property rights. Rather than perform as a "sleepy institution" as some critics suggested ["Progress of Woman's Rights," p. 7], the patent

system was sensitive to the social, economic, and technical changes brought about by America's war environments. Since the Patent Act of 1790, Congress passed four major statutes that revised the rules and practices of the patent system in 1793, 1836, 1870, and 1952. The 1793 and 1836 statues were the most significant legislation for aspiring patentees because these laws altered the application procedure by eliminating and reinstating the examination process respectively. Although a steady stream of minor laws and amendments refined patenting procedures over time, the changes enacted by the laws and major statutes occurred when the Patent Office was inundated with applications; the country experienced major crises such as wars; the federal government underwent significant organizational changes; or the patent system proved to be inefficient, ineffective, or ambiguous in some specific patenting procedure. These developments demonstrated that the patent system adapted to wartime adjustments in the federal bureaucracy and actively sought to guarantee economic incentives for inventors as a means to ensure continuous technological change.

The fluid exchange of inventive information and technical data also contributed to the development of America's inventive culture. Beginning in the 1840s and 1850s, Americans witnessed the popularization of the patent system and the growth of other inventive intermediaries. Many patent attorneys, agents, and solicitors began to circulate written information about the rules, procedures, and practices of the Patent Office for the first time. In the early nineteenth century, a genre of popular writing known as "technical journalism" evolved from the technological enthusiasm associated with the expanding manufacturing, agricultural, and transportation networks [Mott, 1938, pp. 104-116]. Other antebellum developments, including the state-level reforms that improved married women's property rights, positioned women inventors for substantial wartime advancements [Khan, 1996]. Indeed, most women patentees of the nineteenth and twentieth centuries resided in geographical areas, such as western urban centers and eastern port cities, that had laws, political policies, and cultural attitudes that were conducive to women's market activities in general [see Sokoloff, 1988]. The development of these various institutions facilitated the dissemination of inventive information and spurred the corresponding technological advances associated with the Civil War and postbellum eras.

The Civil War marked a turning point in the history of women's inventive activities because it fueled the first significant surge of female patenting rates in American history. More women received patents during the four years of the domestic crisis than during the entire seventy-one years between the Patent Act of 1790 and the onset of the war in 1861. The pattern of women's inventive activities during the war era can best be understood and interpreted within the context of the family unit, legal confusion, and limited personal markets. Women were most likely to invent devices that related to their traditional roles as mothers, wives, and care-providers or simple mechanical inventions that centered around their personal and industrial experiences outside of the home. The Civil War also commenced at a time when technological markets

were still relatively localized. As a result, familial relationships and social connections grew increasingly crucial to women's opportunities to patent inventions and enter into the market for new technologies. Similarly, a series of postbellum changes such as the expansion of the women's press, the growth of the women's movement, and the extension of more liberal property laws, exaggerated and prolonged the war's initial impact on the patterns of women's inventive activities. These combined factors increased the demand for new technologies and loosened some of the traditional constraints that prevented many women from engaging in economic activities and technological pursuits outside of the home.

By the onset of World War I, the public debates and cultural arguments surrounding women's inventive activities gained unprecedented attention and saliency for at least four interrelated reasons: the emphasis on "inventiveness" and technological development as a means to ensure victory and postwar prosperity; the flood of women workers into industrial jobs and service occupations at the same time that men left for war; the rapid growth of the woman suffrage campaign and public attempts to redefine "woman's place" in society; and the widespread movement to quantify, systematize, and organize information for the individual, the federal government, and society as a whole. Most Americans recognized that World War I would be won on the basis of industrial productivity and technological superiority. Accordingly, popular writers manipulated the relationship between the war and technology to rationalize their respective views of suffrage, women's industrial labor, and female intelligence in general.

World War I, along with the social and political consequences of the suffrage movement, provided women inventors with an opportunity to enter into the public discourse and in some cases the market for new technologies. Yet the changes in the rate and nature of women's inventive activities were more subtle and complex than the popular literature of the war era suggested. The number of women's patents (and total U.S. patents) rose in the years leading to 1917, decreased after the U.S. entered the war, then began to approach prewar levels after 1921. Many scholars of invention have relied on patent rates in order to measure and assess changes in inventive activities over time. This study argues that it is equally important to track and examine what is happening to patents (in this case women's patents) in the complicated world of commercialization and technological diffusion. Females who were granted patents with male co-patentees were 2-3 times more likely to assign (sell) their patents than females who were granted patents alone or with female co-patentees. Women who inherited or administered men's patents were over 3-4 times more likely to assign these patents than women who were granted their own patents. Male patentees provided some female inventors with crucial links to commercial, legal, and political networks. Women who patented with men invented in economic sectors that were experiencing more growth and technological change than women who patented alone or with other women. Therefore, cultivating economic relationships with men and establishing sound

business reputations improved some women's chances for commercializing their new patents through assignments.

During World War II, the public emphasis on invention and innovation grew increasingly important as a means to ensure sustained economic development and technological superiority in the wake of the international crisis. In 1940, the Department of Commerce established the National Inventors Council (NIC) to facilitate the war effort by soliciting new inventions from the American public on the home front. The idea of a centralized inventors council or "sifting machine" that would channel new inventions into appropriate government agencies had its roots in the World War I era, when Thomas Edison and the Secretary of the Navy Josephus Daniels formed the Naval Consulting Board to solicit and develop military ideas for that particular branch of the service [Scott, 1920, p. I]. The most significant wartime contributions of the NIC were that it inspired independent inventors at a time when technological development became institutionalized in such massive undertakings as the Manhattan Project and the Radiation Laboratory; and nurtured an inventive culture that was conducive to research, development, and individual inventors. The lone inventor - male or female - did not possess the time, money, staff, research facilities, or knowledge to execute major engineering feats. Yet the individual still produced many novel ideas that governmental and industrial institutions could transform into wartime realities. By facilitating the exchange of radical ideas, revolutionary theories, and technical information, the NIC fostered an environment that had many Americans convinced that even the strangest recommendation from some lone inventor might help to win the war.

Contemporary writers also suggested that the industrial environment that welcomed many women into the factory and exposed them to new technical materials provided a favorable climate for an immediate increase in women's patenting rates. The major interpretive challenge revealed in the analyses of the patent data is that World War II did not fuel dramatic increases in the rate of women's inventive activities, despite the rise of a distinctive inventive culture and the substantial increase in the size of the female labor force. The most significant wartime developments for women inventors stemmed from new business opportunities and expanding commercial networks that provided promising avenues to assign or market their inventions.

The primary relationships that women developed with individuals in the market for new technologies during the three war eras were not necessarily based on business first. Women's commercial relationships typically stemmed from their complex social lives and various personal contacts. Women inventors used their relationships and reputations as respected members of the community to bolster support for their economic activities and business pursuits. They focused a significant proportion of their patenting efforts on producing new manufacturing devices at a time when national welfare and domestic security depended on American industrial success [Marovich, 1998]. While women inventors were particularly sensitive to the growing demand for improved wartime technologies, they also continued to fulfill their social

responsibilities and familial obligations at home. Some enterprising females also welcomed the rise of the modern corporation, though not necessarily as a benevolent employer. For women inventors, the corporation represented a growing market for their patented inventions and a powerful vehicle for rapid technological diffusion.

The most striking trend in the history of women's inventive activities across the three wars is a general pattern of stability in terms of what women invented, where they invented, and the proportion of women's patents to total U.S. patents. Women's patents comprised 0.6% of total U.S. patents during the Civil War era. This figure climbed to and remained at 1.5% during both World War eras. Yet these data mask other important changes occurring in the business world and technological environment that prompted more women to assign and market their inventions. During the Civil War, 6.6% of all women's patents were assigned at the time that the patents were issued. This figure climbed to 9.9% during World War I and more than doubled to reach 25.6% during World War II.[3] Moreover, the percentage of women's patents assigned to companies and businesses as opposed to individuals rose dramatically between the Civil War and World War II. These commercial developments would have most likely occurred in the absence of the three wars, but they would have been far less pronounced for women. The increased assignment rates also suggest that the wars affected women's economic decisions and shaped their commercial attitudes over time. Therefore, the incremental shifts in the patterns of women's inventive activities, when analyzed within the context of evolving technological institutions, business networks, and social climates, illuminate how a fluid inventive culture shaped the history of invention and innovation in American war eras.

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[3] Part of this trend is also attributed to the time elapsed between the receipt of a patent application by the U.S. Patent Office and the issuance of the resulting patent. During the 1870s, it took an average of 4.22 months from the receipt of the application to issue the patent. This figure climbed to 1.69 years by World War I and 2.81 years by World War II.

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