



The Democratization of Invention in the American South: Antebellum and Postbellum Technology Markets in the United States

William H. Phillips

Patenting expanded rapidly across the postbellum South as its transportation network filled in and city growth extended markets. This was consistent with the findings of Kenneth Sokoloff and Zorina Khan, who demonstrated the elastic supply of patentable ideas in early America. Successful innovation required that inventors could or did sell their property rights through “assignment” to those who commercialized new technology. The assignment characteristics of 1912 southern patents were examined for this essay. Southern “border” state patents had a higher rate of marketable assignments than those issued to residents in the Deep South. Greater commercialization of patents in border state cities accounted for most of this difference.

A notable characteristic of early industrialization in the United States was the rapid spread of patenting in the Northern States before the Civil War. Documented by Kenneth Sokoloff and Zorina Khan, this expansion encouraged entrepreneurship in developing new products and processes to bring to market.¹ From the beginning of the new nation, the public policy of an accessible patent system made clear that “creative destruction” would be welcomed. At the same time, patent activity in the antebellum American South languished relative to the northern region. Poor transport networks and a lack of cities constrained market size for products other than the great export staples. Although those staples created strong

¹ Kenneth L. Sokoloff and Zorina B. Khan, “The Democratization of Invention during Early Industrialization: Evidence from the United States, 1790-1846,” *Journal of Economic History* 50 (June 1990): 363-78.

William H. Phillips <whphillips@wm.edu> is a visiting assistant professor in the Department of Economics at the College of William and Mary.

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economic growth, widespread entrepreneurship was discouraged because of the lack of small-scale profit opportunities.

Surprising then that after the Civil War, as the southern economy entered its extended relative decline, inventive activity in the region finally began to flourish. Patenting in the postbellum South spread across the region much as it had in the antebellum North. How can this patenting boom be reconciled with the South's economic problems, and why did it not lead to rapid economic growth? Though encouraging on its own terms, this southern expansion of inventive activity had less entrepreneurial potential in the postbellum market for technology that had developed in America.

The southern growth in depth and breadth of patenting is demonstrated first, while the second part of the essay will outline the evolution of the postbellum patent system described by Naomi Lamoreaux, Ken Sokoloff, and Margaret Levenstein.² Southern inventors after the Civil War needed to succeed in a national technology market. Furthermore, successful inventors increasingly had to get support from a social network for technology development that was located in the northern states. A database of southern patents in 1912 is classified based on these ideas, and, in the third part of the essay, is analyzed for its regional and urban patterns within the South. It is found that despite the spread of raw patent activity throughout the postbellum South, innovations from the urban areas of the "border" states displayed a much higher degree of commercialization. This implies that postbellum patents originating in the Deep South were relatively disconnected from the new American technology market. A final section looks at future research directions to examine the causes of this disconnect and its impact on southern economic development.

The Growth of Patenting in the American South

Overall Patent Growth Relative to the North

The per capita rate of patenting in the southern region was dramatically lower than for other areas of the United States. Naomi Lamoreaux and Ken Sokoloff calculated a southern patenting rate of 5.5 per million residents in the 1840s. This was merely 20 percent of the national average of 27.5 per million.³ Although the propensity to patent in the South tripled

² Naomi R. Lamoreaux and Kenneth L. Sokoloff, "Inventive Activity and the Market for Technology in the United States, 1840-1920," NBER Working Paper no. 7107 (May 1999); Naomi R. Lamoreaux and Kenneth L. Sokoloff, "Intermediaries in the U.S. Market for Technology, 1870-1920," in *Finance, Intermediaries, and Economic Development*, ed. Stanley W. Engerman et al. (New York, 2003), 209-46; Naomi R. Lamoreaux, Margaret Levenstein, and Kenneth L. Sokoloff, "Mobilizing Venture Capital during the Second Industrial Revolution: Cleveland, Ohio, 1870-1920," *Capitalism and Society* 1, no. 3 (2006): 1-64.

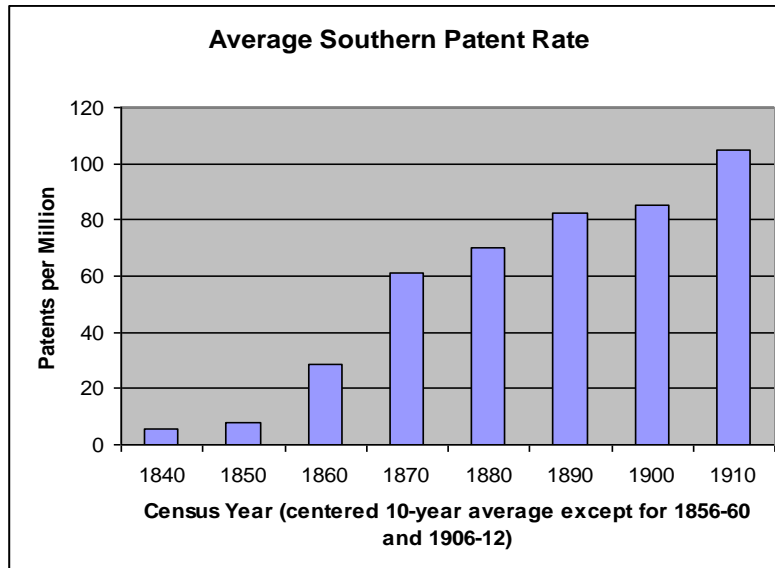
³ Lamoreaux and Sokoloff, "Inventive Activity," table 1.

in the prosperous 1850s to 15.5 patents per million, it was falling further behind relative to the U.S. average of 91.5 patents per million.

But after the Civil War, patenting in the South showed the same dramatic acceleration over antebellum levels seen in the northern states, and even improved its relative patenting rate to one-third of the American norm. The southern propensity to patent was 114.4 per million in 1910-1911, compared to 334.2 per million nationally. In particular, the South's inventors closed the gap with the traditional regional patent leaders, New England and the Middle Atlantic states. Only if judged by the growth in patenting rates in the West and West North Central regions did the South appear to lag, as these developing regions raised their patenting rates to near the U.S. average by World War I.⁴

The absolute growth in southern inventive activity over time is charted in Figure 1. The influence of business cycles was smoothed over with ten-

Figure 1



Source: Annual Reports of the Commissioner of Patents (Washington, D.C.) and *Historical Statistics of the United States, Colonial Times to 1970* (Washington, D.C., 1975). The southern region is defined as the eleven states of the Confederacy, plus Kentucky and (after the Civil War) West Virginia.

⁴ David Carlton and Peter Coclanis responded to a regression of Robert Higgs in which the South was significantly deficient in patenting after 1900 compared to other states. They found that the apparent lack of southern inventiveness (relative to urbanization and other control factors) went away when a dummy for Western and Great Plains states was included. The distinctive region of America in turn-of-the-century patenting was the West, and its unusually high inventiveness compared to its small urban population. See David L. Carlton and Peter A. Coclanis, "The Uninventive South? A Quantitative Look at Region and American Inventiveness," *Technology and Culture* 36 (April 1995): 220-44, and Robert Higgs, "American Inventiveness, 1870-1920," *Journal of Political Economy* 79 (May-June 1971): 661-67.

year averages, except for the removal of the Civil War years, and lack of data beyond 1912. Without the sharp reduction of 1856-1865 per capita patenting (centered at 1860 in the figure) that would have occurred if the war interruption were included, the southern rise in innovation was consistent with random variations around a constant growth rate of propensity to patent over the entire period. The largest number of annual southern patents before the war was 474 in 1860, which marked the ninth straight year of increase. In 1866, the southern states accounted for 269 patents, the third highest total ever, followed by a new record of 490 patents in 1867. Three new records were set in succeeding years, before the peak of 840 patents in 1870 was dampened by weak business cycle conditions in the early 1870s. There was no sign in this growth that the Civil War had any impact on long-term patenting activity in the South.

Internal Distribution of Southern Patenting Growth

Antebellum southern patenting was dominated by the states of Virginia and Kentucky. As populous states whose early transportation networks allowed invention to disperse into rural counties, they combined for half of the region's annual patent output as late as 1855. Outside those states, patenting in the South during this period was dependent on inventions coming out of major urban areas like Charleston and New Orleans. Did the postbellum growth of the propensity to patent in the South lack breadth, and reflect only a rise in innovation among these antebellum leaders?

Table 1 displays the geographic dispersion of invention rates by southern state for the periods 1836-1845 and 1906-1912. Virginia and Kentucky had the second and third highest propensities to patent before the Civil War, while Louisiana's leadership rested on innovative activity in New Orleans. By this period, Charleston had already entered into its relative decline, yet its inventions still put South Carolina's per capita patent rate above the average for the Deep South. Over 1836 to 1845, border state innovativeness in Virginia and Kentucky (8.42 per million) doubled the invention rate in the lower South (4.22 per million).

By the 1906-1912 period, patenting in the border states had increased by more than a factor of fifteen to 134.69 annual patents per million. However, the propensity to invent across the Deep South had risen even more rapidly, to about 70 percent of the border state rate. Texas and Florida were now among the South's leading patenting states, while Tennessee, Georgia, and North Carolina had dramatically narrowed the gap with the traditional leaders. The growth of southern inventive activity after the war had spread out geographically across its several states.

Table 2 addresses the spread of patenting away from the major southern cities into the hinterlands. Over the period 1846 to 1855, Charleston residents accounted for half of South Carolina's patents, while New Orleans had over three-fourths of Louisiana's inventions. On a per

Table 1
 Patenting Rate by Southern State and Region:
 1836-1845 and 1906-1912 Annual Average
 (per million census-year population)

Region Rank	State	Patent Rate (36-45)	Region Rank	State	Patent Rate (06-12)
2nd	VA	9.28	1st	WV	181.88
3rd	KY	7.05	4th	VA	124.95
			5th	KY	118.30
Border State Average		8.42			134.69
1st	LA	9.93	2nd	TX	141.51
4th	AL	6.09	3rd	FL	139.91
5th	SC	4.88	6th	TN	112.28
6th	TN	3.74	7th	LA	104.51
7th	MS	3.46	8th	GA	91.18
8th	GA	2.89	9th	AR	84.28
9th	NC	2.52	10th	NC	78.82
			11th	AL	75.49
			12th	MS	60.10
			13th	SC	48.57
Deep South Average		4.22			96.53

Sources: Annual Reports of the Commissioner of Patents (Washington, D.C.) and Historical Statistics of the United States, Colonial Times to 1970 (Washington, D.C., 1975).

Table 2
 Patenting Rate by Major City And Hinterland
 1846-1855 Annual Average and 1912
 (per million census-year population)

Patents (46-55)	Patent Rate (46-55) (per million)	Patents (1912)	Patent Rate (1912) (per million)
Charleston			
1.7 per year	39.55	8	135.98
Rest of South Carolina			
1.6 per year	2.56	76	52.18
New Orleans			
5.1 per year	48.82	80	235.94
Rest of Louisiana			
1.6 per year	3.99	123	93.37

Sources: Annual Reports of the Commissioner of Patents (Washington, D.C.) and Eighth Census of the United States for 1860, vol. 1, and Thirteenth Census of the United States for 1910, vols. 1-3 (Washington, D.C.).

per capita basis, Charleston's patenting rate was over fifteen times the hinterland rate, while in Louisiana, New Orleans held a ten-fold advantage. By 1912 Charleston had less than 10 percent of South Carolina's patents, while New Orleans' share of Louisiana was down to 40 percent. Although these urban areas still had a dominant edge on a per capita basis, patenting in the rural areas of the respective states had risen to over one-third of the core metropolis, and absolutely was innovating at a faster rate than Charleston and New Orleans prewar norms.

The final evidence on the breadth of postbellum southern patenting came from the percentage of southern counties reporting a patent over the period 1900 to 1912. Although in any single year, many relatively isolated southern counties would not have a resident patent recipient, the sporadic innovator counties changed from year to year, leading to a high percentage of patent recipient jurisdictions over the course of a few years. Over all the thirteen southern states studied, fewer than 5 percent of the counties lacked a patent from 1900 to 1912. If Texas and its many non-patenting counties located near the Mexican and New Mexico borders were excluded, the percentage of non-patenting southern counties falls to around 3 percent. The result was that many southern residents came to learn about local patent holders and would have understood that the patent system could be accessible to them or some of their neighbors.

The Sokoloff-Kahn Model

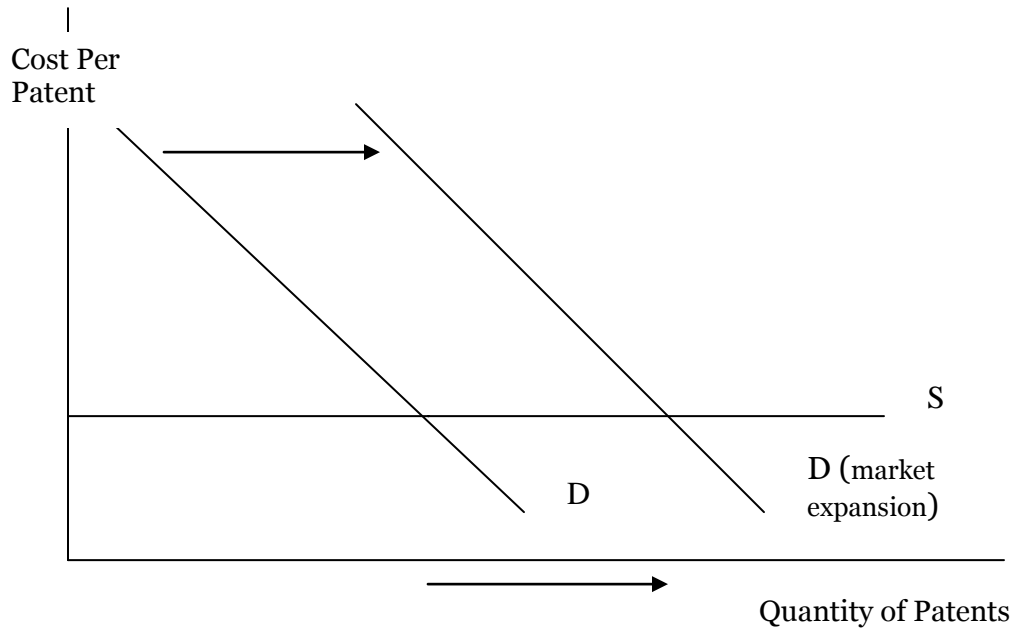
The postbellum southern increase in inventive activity was consistent with Ken Sokoloff and Zorina Kahn's model of the spread of antebellum patenting in the North. Because the knowledge necessary for invention in this era was widely available to the general public, the limiting factor to patenting was the extent of markets needed to make the introduction of novel products profitable. After the Civil War, as the South's transportation network was filled in and its population (particularly in cities) grew, its patenting started to spread out into the lower South and deeper into non-urban counties. I have documented this spread within Virginia before 1880, and Gavin Wright noted how the changed economic parameters of the post-Civil War South encouraged a rise in city formation, investment in railroad networks, and growth in manufacturing establishments. Entrepreneurship was re-channeled into location-specific activities. This meant that markets were created, which accelerated inventive activity.⁵

A representation of the Sokoloff-Khan model of patenting is shown in Figure 2. Given the modest scientific expertise required for much of the technology of the time, the supply of patentable ideas was elastic. The quantity of patents issued per period for a given market responded to the

⁵ William H. Phillips, "Patent Growth in the Old Dominion: The Impact of Railroad Integration before 1880," *Journal of Economic History* 52 (June 1992): 389-400; Gavin Wright, *Old South, New South: Revolutions in the Southern Economy since the Civil War* (New York, 1986), 39-46.

demand for new products and ideas driven by commercialization, expanded markets, and the business cycle. Another key to the elasticity in these

FIGURE 2



markets was the fact that a successful patent application did not have to prove future commercial viability or that it was the most economical solution to a problem or need. It only had to have some elements of novelty and usefulness on its own terms, in isolation from the other alternative ideas available.

Postbellum Technology Markets in the United States

The Role of Assignments

Recent research by Naomi Lamoreaux and Ken Sokoloff on the history of the American patent system shifted emphasis from its granting of temporary monopoly protection to the inventor. Rather, they highlighted the system's creation of a property right that could be used by the inventor as collateral for his or her own entrepreneurial efforts or to transfer the technology to others for commercialization. A market for technology was created by the ability of inventors to "assign" or sell full or partial rights to their inventions. Before the creation of national product markets, inventors typically commercialized their ideas locally and used assignments to effectively "license" their technology to entrepreneurs in other geographic regions. But shortly after the Civil War, assignments primarily came to be used for two purposes: first as a means by which financial partners were compensated for their venture capital, and second as a means by which technology was sold to firms for commercialization.

This research demonstrated that (before World War I) the most productive patentees, in terms of number of patents and length of patenting career, were those who made a full sale of their patent rights to a company.⁶ Since the rise of inventors as employees of a company was a post-1920s phenomenon, most of these assignments were to a firm that (based on name) was at least partially the inventor's own company, or to a firm that (based on name) was a company with no relationship to the inventor. In this essay, these company assignments are labeled marketable assignments. The sale by the inventor of his or her property right to a non-associated firm was clear evidence of greater commercial viability than a patent that never attracted any outside interest. The label of marketable to own company assignments was more problematic. This would include assignments like those of Thomas Edison (and other successful inventor-entrepreneurs) to their own enterprises, but also the proto-typical "mad" inventors who hawked worthless shares of their own company stock based on an unworkable idea.

Assignments made for financial motives were not classified as marketable. The most common example was the partial assignment (most typically one-half) of patent rights to an individual with no obvious relationship to the inventor. Although such assignments are interesting in their own right as evidence about venture capital markets, it was assumed that financial support was provided well before clear signs of commercial feasibility had been established.⁷ Of less importance quantitatively were assignments to apparent relatives (based on name), and assignments by one co-inventor to another co-inventor, whether of full or partial patent rights. Although these assignments may not have reflected purely financial transactions, there was no clear evidence of commercial success based on these property right transfers.

The most difficult classification issue was the marketability of a full sale of patent rights to a non-related (at least based on name) individual. Naomi Lamoreaux and Ken Sokoloff found some evidence in the early 1890s that patentees with those kind of assignments were productive, but not so in the early 1870s and just before World War I.⁸ The sample sizes they worked with for such assignments were small, making conclusions difficult. The lack of sale to a company made marketability seem less likely, but the full sale of rights made a purely venture capital relationship less probable. These assignments were ultimately included as marketable,

⁶ Lamoreaux and Sokoloff, "Inventive Activity," 17-20 and tables 7-8.

⁷ Many patent assignments to companies were transactions that replaced a previous financial support arrangement between an inventor and a partner. Payments by companies for these assignments went not only to the inventor but also to the partner for his share of the patent rights. Presumably venture capitalists supporting patents that never got these later company assignments did not do as well financially.

⁸ Lamoreaux and Sokoloff, "Inventive Activity," 20-21 and table 8.

because doing so biased the results against the hypothesis of unequal marketability of patents in different regions of the South.

The Database: Assigned Southern Patents in 1912

From the *Annual Report of the Commissioner of Patents*, information was collected on all patents issued in 1912 to inventors or co-inventors residing in thirteen southern states.⁹ This yielded 2,716 patents, of which, as listed in Table 3, 501 had assignments at the time of issue. The assignment rate at issue of 18.4 percent was comparable to the 22.7 percent at-issue assignment rate found by Lamoreaux and Sokoloff for a sample of 322 southern patents from 1910-1911. A major shortcoming of this paper's database was that it did not include assignments made after issue. Although Lamoreaux and Sokoloff reported a falling percent of after-issue assignments over time, their review of contracts filed with the Patent Office in January 1911 showed that close to half of those relating to southern patents were after issue.¹⁰ Only a follow-up search at the Patent Office for after-issue assignment contracts made in subsequent years for 1912 patents could confirm the results based on the at-issue data.

Table 3
Classification of Assigned Patents, Southern Inventors, 1912

Assignment Type	Number	Percent	Assignee Type	Number	Percent
Marketable Assignments	200	39.9	Independent Company	123	24.6
			Own Company	42	8.4
			Full Assign to Unrelated Person	35	7.0
			Other Assignments	301	60.1
Other Assignments	301	60.1	Partial Assign to Unrelated Person	263	52.5
			Relative	27	5.4
			Co-inventor	11	2.2
Total Assignments				501	

Sources: Annual Report of the Commissioner of Patents for 1912 (Washington, D.C.).

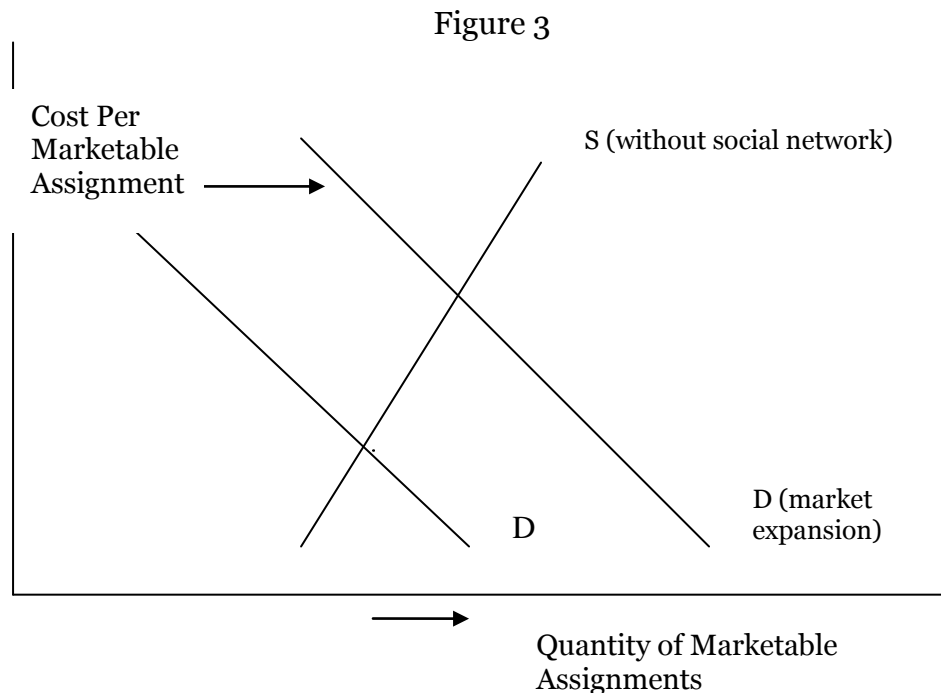
⁹ U.S. Commissioner of Patents, *Report of the Commissioner of Patents for 1912* (Washington, D.C., 1913).

¹⁰ Lamoreaux and Sokoloff, "Inventive Activity," tables 2-3. Approximately 20% of the southern assignments were secondary—that is, an assignment not from the original inventor, but from a previous assignee.

The most typical at-issue southern assignment in 1912 was the partial assignment to an unrelated individual, accounting for a proportion of 52.5%. Combined with small numbers of assignments to relatives and co-inventors, roughly 60 percent of the southern assignments were not marketable. The other 40 percent of the assignments were marketable, with assignments to independent companies making up a quarter of the assignments, and assignments to own companies just under 10 percent.¹¹ Full assignments to unrelated individuals, the most difficult to classify category, accounted for only 7 percent of southern assignments. A remaining weakness in the data was inventors who could have assigned their patents rights but did not do so. There were an unknown number of southern entrepreneurs who possibly made money from their inventions locally in small businesses, but did not choose to assign their patent to a company bearing their name, retaining their rights as an individual inventor.

The Patent System's Assignment Market

The maturing of the assignment market described by Lamoreaux and Sokoloff highlighted a narrower spectrum of the new technology created by the patent system. The ability to sell patents to companies provided a market test to identify patents showing the greatest potential to impact the new products and processes actually made and used in the economy. This model for marketable assignments is displayed in Figure 3.



¹¹ Percentages for these major categories were comparable to Lamoreaux and Sokoloff's results for their 1910-1911 sample. See "Inventive Activity," table 3.

Because of the limited potential for successful new products and processes among any forthcoming batch of patents, the supply of marketable assignments was relatively inelastic compared to the supply of patents. This meant that the market expansion that created dramatic increases in the propensity to patent might not lead in every region to large numbers of marketable assignments.

The degree of marketable assignment response in a region depended on the relative elasticity of its marketable assignment supply. This elasticity in turn depended on factors such as a region's human capital environment, its transportation infrastructure, the industrial mix of its products, and its degree of urbanization. A final determinant of marketable assignment response would be the absence or presence of a social network for commercializing innovation.¹² Figure 3 assumes that the postbellum American patent system did not have a network in which the participants in the market interacted to improve their long-term outcomes. This was a technology market of arms-length relationships between inventors supplying new technologies, businesses purchasing new technologies, and intermediaries such as patent attorneys providing secure property rights to buyers and sellers.

The postbellum American technology market did not maintain these arms-length relationships. Instead, as described by Lamoreaux and Sokoloff, intermediaries such as patent lawyers started to use their informational advantages to match inventors and potential buyers of their patents. Except for the acknowledged scams that were inevitable whenever principals and agents transacted business, the most successful intermediaries scouted out the most promising inventors and connected them with growing businesses that would be the most interested in their research. Lamoreaux and Sokoloff found that patentees matched in this way produced more patents, assigned more of their patents, and sold their inventions more quickly. Analysis of an active patent lawyer's diaries showed that these intermediaries could move beyond simple matching and start to pass inside information between businesses and inventors about what innovations they might like to buy and sell in the future.¹³

Further investigation by Naomi Lamoreaux, Margaret Levenstein, and Ken Sokoloff of Cleveland, Ohio, at the turn of the century demonstrated that this social network could expand to create 'incubator' firms such as the Brush Electric Company that attracted migrating inventors and connected them to local venture capitalists.¹⁴ This created a circle of patent

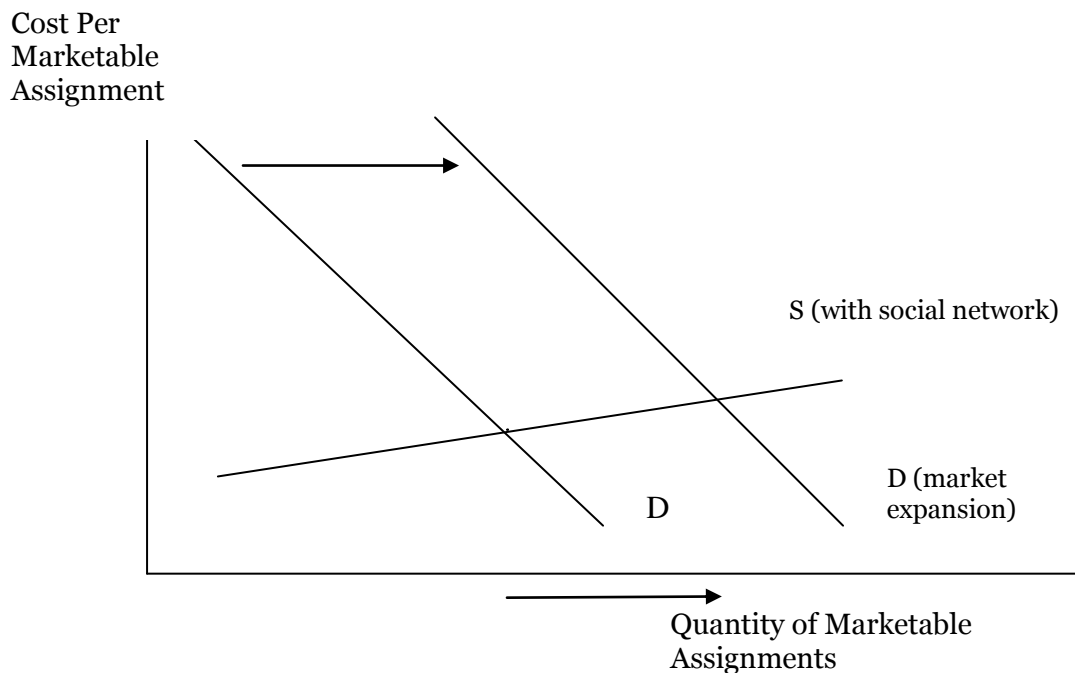
¹² The use of the term "social network" for facilitating innovation comes from Lisa D. Cook, "Inventing Social Networks: Evidence from African American Great Inventors," unpublished manuscript (2007), who cites Emilia J. Castillio et al., "Social Networks in Silicon Valley," in *The Silicon Valley Edge*, ed. Chong-Moon Lee et al. (Stanford, Calif., 2000), 218-47.

¹³ Lamoreaux and Sokoloff, "Intermediaries in the U.S. Market." Much of this information was later internalized by firms in the corporate R&D lab.

¹⁴ Lamoreaux, Levenstein, and Sokoloff, "Mobilizing Venture Capital."

attorneys, prolific inventors, firms producing innovative products, and business people eager to invest in promising research. The result was acceleration in the rate of inventive activity as the nineteenth century progressed, but also an increasing specialization in who achieved entrepreneurial success through invention. Those who patented new ideas needed to attract the attention of knowledgeable people and firms in this market for technology in order to obtain proper financing or purchase of their invention by those best positioned to commercialize it. Figure 4 shows the hypothetical assignment market for a region with such a social network. The result was that market expansion would create a greater expansion of marketable assignments compared to areas where inventors and businesses could only react to publicly available information.

Figure 4



Regional Distribution of Southern Marketable Assignments: 1912

Since the social network described above was centered in the major industrial centers of the northern United States, it was expected that southern patents would lack marketable assignments as a result. This disadvantage would compound other factors limiting the commercial success of southern inventions such as a smaller human capital base and industrial concentration on matured technology products. Although a direct comparison with northern marketable assignments was not possible with the southern database, Table 4 can compare the per capita rate of

marketable assignments by the different southern states. It was found that with the exception of Florida, the rate of commercial assignments in the border states of West Virginia, Kentucky, and Virginia dominated those of the Deep South. Given the more equal rates of raw patenting activity evident in Table 1 for this period, the disparity in marketable assignment rates was largely accounted for by the greater percentage of border state patents that had a marketable assignment at issue.¹⁵

Table 4
Assignment Rates by Southern State, 1912
(per million 1910 population)

State	Marketable Assign. Rate (per million)	% of Patents with Market Assn.	Marketable Assignment Number	Total Assign. Rate (per million)
Border States				
WV	18.02	10.5	22	37.67
KY	14.85	14.3	34	24.02
VA	14.55	10.8	30	30.07
Deep South				
FL	13.29	8.1	10	29.90
TX	7.44	5.3	29	24.12
LA	7.24	5.9	12	19.32
GA	6.13	6.7	16	15.14
NC	5.89	7.7	13	13.14
TN	5.49	5.7	12	18.77
SC	5.28	9.5	8	10.56
AL	3.74	4.5	8	15.43
AR	1.91	2.2	3	13.34
MS	1.67	3.0	3	5.56

Source: *Annual Report of the Commissioner of Patents for 1912* (Washington, D.C.) and *Historical Statistics of the United States, Colonial Times to 1970* (Washington, D.C., 1975).

Except for the extra-large state of Texas, the southern border states also dominated the Deep South in the absolute number of marketable assignments. Whereas the high marketable assignment rates of the border states were not overly dependent on the assignments from any one

¹⁵ In Lamoreaux and Sokoloff, "Inventive Activity," table 3, the authors reported by region (for their 1910-1911 samples) the percentage of patents assigned and the percentage of those assignments to a company. This implied that the *minimum* percentage of marketable assignments by region was: New England, 37.5%; Middle Atlantic, 26.2%; East North Central, 14.7%; West North Central, 8.1%; South, 7.8%; and West, 8.9%. Their southern percentage was consistent with the average of the marketable assignment percentages reported in table 4 of the text.

location, the majority of Florida's marketable assignments in 1912 came from the boom town of Jacksonville. The robustness of Florida's commercialization of patents would need to be confirmed by adding adjacent years to the database. The last column of the table lists the per capita rate of total assignments by state, including those assumed to be primarily for financial reasons. By this measure, the gap between the border and non-border states was reduced, but, except for Florida and Texas, the border states still clearly had higher assignment rates than the average southern state.

Table 5 looks at the issue of whether the border state advantage in marketable assignments can be explained by a greater degree of urbaniza-

Table 5
Marketable Assignment Rates by Region and Urbanization, 1912
(per million 1910 population)

Region	Marketable Assign. Rate (per million)	Urban/Rural	Marketable Assignment Number	Marketable Assign. Rate (per million)
Border States	15.43	Urban	63	61.45
		(13 counties)		
		Rural	23	5.06
Deep South States	5.61	Urban	60.5	22.39
		(26 counties)		
		Rural	53.5	3.03

Source: Annual Report of the Commissioner of Patents for 1912 (Washington, D.C.) and *Thirteenth Census of the United States for 1910*, vols. 1-3 (Washington, D.C.). Border states' urban counties (by state) are: *Kentucky*: Campbell (Newport/Cincinnati), Fayette (Lexington), Jefferson (Louisville), and Kenton (Covington/Cincinnati); *Virginia*: Alexandria (Washington, DC), Campbell (Lynchburg), Henrico (Richmond), Norfolk (Norfolk/Portsmouth), and Roanoke; *West Virginia*: Brooke (Wheeling/Pittsburgh), Cabell (Huntington), Marshall (Wheeling/Pittsburgh), and Ohio (Wheeling/Pittsburgh). Deep South states' urban counties (by state) are: *Alabama*: Jefferson (Birmingham), Mobile, and Montgomery; *Arkansas*: Pulaski (Little Rock); *Florida*: Duval (Jacksonville) and Hillsborough (Tampa/St. Petersburg); *Georgia*: Bibb (Macon), Chatham (Savannah), DeKalb (Decatur/Atlanta), Fulton (Atlanta), and Richmond (Augusta); *Louisiana*: Orleans (New Orleans); *Mississippi*: none; *North Carolina*: Mecklenburg (Charlotte); *South Carolina*: Charleston; *Tennessee*: Davidson (Nashville), Hamilton (Chattanooga), Knox (Knoxville), and Shelby (Memphis); *Texas*: Bexar (San Antonio), Dallas, El Paso, Galveston, Harris (Houston), Parker (Ft. Worth), Tarrant (Ft. Worth), and Travis (Austin). Selection procedures for urban counties are described in the text.

tion. Urbanized counties in each state were selected based on the presence of a city with 30,000 population in 1910, or high-assignment counties located next to urbanized areas.¹⁶ Over all the counties of the three border states, the rate of marketable assignments was 15.43 per million, compared to only 5.61 per million for the ten states of the Deep South. When each region was divided into urban and rural county areas, it was found that the low rates of marketable assignments in rural locations were similar in both the border and Deep South states. Most of the difference in the higher assignment rate of the border states resulted from a much higher rate of marketable assignments in border state urban areas (61.45 per million versus 22.39 per million).¹⁷ These high-assignment urban counties in Kentucky and West Virginia were located at or near the industrial centers of Louisville, Cincinnati, and Wheeling, right on the border with the North. Only the state of Virginia showed high rates of patent commercialization away from the immediate border, with many marketable assignments coming from Norfolk, Richmond, and Lynchburg, in addition to its Washington, D.C. suburbs.

Conclusions and Future Research

Before the Civil War, raw patent activity in the American South was exceedingly rare. In addition, this activity was concentrated in the two most industrial states, Kentucky and the antebellum Virginia that included the later state of West Virginia. Further south, the inventiveness in other southern states emanated mainly from a small scattered collection of major cities. The result was that most people in the antebellum South would not have had an opportunity to meet a local resident who had patented.

This situation changed dramatically after the Civil War. The initial act of obtaining a patent for new technology thrived in the postbellum South. The relative share of per-capita patenting in Virginia, its new neighbor West Virginia, and Kentucky all declined, as several states in the lower South closed the gap with the border states, despite the high absolute growth in inventiveness near the Mason-Dixon line. The extreme dominance of the older commercial centers in Deep South invention declined, as rural counties throughout the South saw residents receive patents, if not every year, at least over the course of a few years. By its very nature, the awarding of patents was an elite occurrence, but inventiveness in the South did 'democratize' in the sense that residents would have learned that patents were not reserved just for the far-away scientific giants like Edison.

¹⁶ Examples include Alexandria County, Virginia, located next to Washington, D.C., and DeKalb County, Georgia, located next to Atlanta.

¹⁷ The only urbanized Deep South county to have a marketable assignment rate above the average urbanized border state rate was Duval (Jacksonville), which for reasons given in the text might have been a temporary occurrence.

The database of assignments to southern patents in 1912 demonstrates that when it came to commercialization of new technology, the states of the Deep South still lagged far behind the border states. The pattern was similar to the lower South's gap in raw patenting that existed in antebellum times. The research of Naomi Lamoreaux and Ken Sokoloff would indicate that the per capita rate of marketable assignments in the northern states was in turn much higher than those of the border states. This made it much more likely that the rapid city growth at the turn of the century based on rising new technologies would occur in the North, as in the case with Cleveland, rather than in a 'New South' metropolis such as Atlanta.

In related work, Zorina Khan and Ken Sokoloff documented the relationship between high geographical mobility and "great inventors."¹⁸ Technology market success was related to those who moved when needed to regions where invention rates and commercialization rates of those inventions were high. Although the overall level of migration from the South to the North before World War I was still low, the incentives for "brain drain" exit by prolific southern inventors was growing.¹⁹ This would compound the South's lack of a local technology community, cited by Gavin Wright as a factor making it difficult for southern industry to adapt advanced technology to southern conditions.

Future research would need to expand the database to additional years to check for robustness. After-issue assignments have to be checked to ensure that Deep South inventors did not quickly catch up in commercialization in later years after the patent was awarded. How much of the marketable assignment gap or delay in the Deep South was due to human capital deficiencies, lack of infrastructure, or other fundamental factors in generating inventive activity, versus a lack of social networks to commercialize the patents produced? Patent citations are being matched to the database to measure the correlation between assignments and later assessments of technological significance. High-citation southern patents without marketable assignments could indicate the degree to which successful southern inventors chose not to assign, or could be evidence of the South's disconnect from the patent system's social network that prevented promising technologies from profitable commercialization.²⁰

¹⁸ Zorina Khan and Kenneth L. Sokoloff, " 'Schemes of Practical Utility': Entrepreneurship and Innovation Among 'Great Inventors' in the United States, 1790-1865," *Journal of Economic History* 53 (June 1993): 289-307.

¹⁹ Wright, *Old South*, chaps. 6-7.

²⁰ Southern inventors could have chosen to license or rent their technology, which would not have shown up in the Patent Office records. However, it would be expected that northern inventors would have had greater licensing activity than southern patentees, similar to their advantage in assignments. See Lamoreaux and Sokoloff, "Inventive Activity," 10. In their table 4, Lamoreaux and Sokoloff found a shortage of patent attorneys in the South, which could be associated with social network isolation. David Carlton and Peter Coclanis have

Finally, if lack of access to a social network was preventing southern entrepreneurs from starting new technology-based firms, how much impact could it have had on southern economic growth?

connected this attorney deficit to a general shortage of intermediary institutions in the South. See David L. Carlton and Peter A. Coclanis, *The South, the Nation, and the World: Perspectives on Southern Economic Development* (Charlottesville, Va., 2003), 115.