1999 BHC Presidential Address Quantitative and Qualitative Evidence in the Weaving of Business and Economic History: Western River Steamboats and the Transportation Revolution Revisited

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This paper breaks somewhat with the tradition of the recent past by limiting (if not eliminating) autobiographical detail. Some particulars, however, are essential to the story in that they show what drew me into this profession and set the broad themes for my presidential address.

I came to this country in 1971, fresh out of Cambridge with a BA degree in economics, under the sponsorship of Ross M. Robertson of the Indiana University School of Business. My original intent was to do an MBA and Ross had arranged a tuition and fee waiver and a small graduate research assistantship for me. It did not, however, take me long to discover that I was not MBA material—temperamentally, at least. Consequently, at the end of the Fall semester that first year, I switched into an obscure joint Ph.D. program at Indiana in Economics and Business. Money was tight and my search for support led to me to the door of Fred Bateman who at the time had two ongoing NSF projects and employed an army of research assistants. I became one of them and that is where this narrative really begins.

Much of the work I was doing got no more exciting than reading the faded antique orthography of census manuscripts on blurry microfilm readers, collecting data for the Bateman-Weiss samples from the manuscript censuses of manufactures. These records were filled out by U.S.Assistant Marshals of questionable literacy and penmanship. Some were also of questionable intelligence. I have in mind, in particular, one Reuben Dawson, an Assistant Marshal in Louisville, Kentucky. Mr. Dawson in his wisdom decided that the steamboats lining perhaps 2 miles of the Ohio River waterfront that particular day in 1850 somehow fit the Census definition of manufacturing establishment.[1] Consequently, he decided to assert his legal authority to inquire into the nature of their business, undeterred by the fact that most of the responses he received failed to fit the categories printed on his enumeration forms. To its credit, the Census Office in Washington D.C. ignored this erroneous information and it is

[1] Though precisely when in 1850 is unknown as Mr. Dawson neglected to date his forms.

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Table 1
Manuscript Data for the Steamboat *Telegraph No. 2*

Steamboat Characteristics		*Costs*		*Revenues*	
Construction Cost	$40,000	Provisions	$21,600	Freight	$18,000
Horsepower	1,000	Fuel	$20,000	Passenger	$72,000
Months of Operation	12	Insurance	$2,500		
Route	Louisville - Cincinnati	General Expenses	$7,800		
Employment		*Monthly Wage Bill*			
Male	50	Men	$1,600		
Female	2	Women	$40		

unknown whether Mr. Dawson was paid the 15 cents for each of these "establishments" that he enumerated. Happily, however, the archives preserved these records along with the other, legitimate, census data.

The result of Mr. Dawson's over-zealousness, however, is a detailed body of largely quantitative information about western river steamboating. For each boat tied up in Louisville that day, we have its name, its trade route, crew size and wages, the original capital cost of the vessel, months of operation, engine horsepower, the amounts spent on provisions, fuel, insurance, lockage and other general expenses and the freight and passenger revenues which it earned during the year ending June 1, 1850. The census data for just one of these steamboats, the *Telegraph No. 2,* is shown in Table 1. In all, these data were collected for 46 steamboats before Mr. Dawson called it quits.

These data sparked my curiosity although they were not what I was supposed to be collecting either! I had some early interest in steamboats from childhood vacation trips on River Clyde sidewheelers but my real and abiding passion in them began only after reading Louis C. Hunter's brilliant book, *Steamboats on the Western Rivers* [1949] after finding these data. Fifty years after its publication, Hunter's book, in my opinion, is still perhaps the finest book ever written in economic and business history. Brilliantly conceived, researched and documented, this book is a veritable cornucopia of testable hypotheses and inferences for a "data hound" like me. For a while these data seemed likely to become my dissertation topic but I went in other directions after others used them for their book on steamboats [Haites, Mak and Walton, 1975]. Still, I have never lost interest in the topic and I have taken advantage of the opportunity afforded by my presidential address to reflect on a subject which I think is important.

The advent of the western river steamboat revolutionized and refocused economic activity throughout the Midwest which was served by some 10,000 miles of navigable, or potentially navigable, river. Transport costs, originally a large fraction of the selling price of most products, fell drastically (see, for example, Berry, 1943, 557-62; Hunter, 1949, pp. 658-9). River ports grew rapidly, developing commercial links as well as large and diversified manufacturing activities, and farms—even those some distance from the rivers—were encouraged to produce for export to distant markets. The net effect was nothing short of a revolution, drawing resources into the area, and these changes were still ongoing at mid-century despite the growing encroachment of the railroad [Taylor, 1962].

Forty-six observations does not sound like very many—certainly to me. But it was, in fact, about ten percent of the western river steamboat fleet at the time and perhaps a slightly higher proportion of the total fleet tonnage, that is to say the sample is skewed towards larger, particularly trunk river, steamboats. These data are still the largest—indeed almost the only—extant body of consistent quantitative economic information on western river steamboats. These data, however, are just numbers. Cold and impersonal, they tell us little or nothing. One might infer something about the size distribution of vessels on the Ohio

River from them on that day and the trades which they plied. One might also compute some statistics such as the ratio of earnings between freight and passenger traffic but the census data on their own and in isolation are remarkably uninformative despite all the numbers which they provide. To unlock their riches requires their linkage to other data both quantitative and qualitative and some flesh and color to surround the bones. Only then do they become truly useful and illuminate some aspects of the operation of this industry.

One important such source is the "Lytle List" [Lytle, 1952] which lists, by name, all steam-powered vessels built in the United States between 1807 and 1868. For a variety of technical reasons having to do with construction and draft, western river steamboats could not venture onto open water. Likewise, deep-water vessels built for the Great Lakes or the ocean found very limited use on the rivers, especially the higher reaches. Consequently it is not too difficult to match up the steamboat names from the census to those in the "Lytle List" despite duplicate names. The "Lytle List" provides the vessel's tonnage, its date and place of construction, and the date and manner in which the boat ceased service. For example, the "Lytle List" tells us that the *Telegraph No 2* was a vessel of 375 tons[2], built in 1848 which ceased service in 1855 as a result of an accident.

Each of these scraps of supplementary information is important in making use and sense of the census data. For example, from the date of construction we can infer the age of the vessel in 1850 which, in turn, provides a basis for estimating depreciation. One such set of estimates is given by steamboat Captain Davis Embree in his testimony before Congress [U.S. Congress, 1852, p.117]. According to him, the wear and tear on steamboats was considerable—24 percent per year of the original cost in the first and second years—after which the steamboats required extensive repairs. The wear and tear reflected both generally shoddy construction of the boats where substance was sacrificed for appearance and the hazards of western river navigation which included snags, rapids, and shifting sandbars not to mention rafts and other steamboats.

Depreciation charges are an important component in calculating the current value of any vessel in the trade and in properly allocating costs to current operations. They are thus critical in calculating profitability, appearing in the numerator as a current cost while simultaneously appearing in the denominator as a part of accumulated lifetime depreciation. Every steamboat in the sample reported revenues that exceeded costs including the cost of wage labor but excluding depreciation. Two other cost items are, however, unknown. The census gave no information about the compensation paid to steamboat captains and other officers who may also have had a partial interest in the boat so as to minimize incentives for opportunistic behavior. Second, there is no information on the working capital required to keep a steamboat in operation.

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[2]Tonnage at this time was not calculated as displacement, the measure most often used today, but rather refers to what was known as "measured tons" and is a measure of enclosed volume for cargo or passengers above and below the waterline. See Hunter [1949, 643] and Lyman [1945].

The capital costs of western river steamboating were large, a fact that I have come to appreciate only relatively recently. The cheapest boat in the sample—the *Mustang,* a vessel of 138 tons that plied its trade on the Tennessee River—cost $6,000; the most expensive, the *Ben Franklin,* a 473-ton mail packet belonging to the Louisville to Cincinnati Mail Line, cost $56,000. By today's standards these do not sound like particularly large sums—many of my neighbors drive cars that would have put the *Ben Franklin* to shame both in initial cost and size—but, in fact, these capital requirements were extraordinarily large by the standards of time. The capital invested in the *Mustang* exceeded that in 85% of the nation's manufacturing establishments of the time or would have bought a half dozen average farms; the capital invested in the *Ben Franklin* if made in manufacturing would have put the business in the top 1% nationally in terms of capital.[3] In short, entry into the steamboating was hardly free and unfettered so long as capital requirements represented a potentially serious impediment. Moreover depreciation is a "large" number that must have materially affected the economic rewards of the business.

More than half of the vessels in the sample—25 of the 46—met their end by accident. On average, these boats were in service less than 22 months before being sunk. The oldest of those lost by accident, the *James Hewitt,* survived for 7 years by which time it was probably fully depreciated, but many steamboats were sunk or so badly damaged that they were scrapped within a year or so of being built—for example, the *Tribune* and the *Oregon.*

Steamboating accidents were a common occurrence. The experience among my sample steamboats does not appear to be markedly different from the norm. Indeed, one of the more serious accidents on the river involved one of my sample boats, the *Glencoe,* which exploded in 1852 with the loss of 60 lives [Hunter, 1949, p.287n]. Overall, about 40 percent of the boats built before 1849 were lost; most to snags but many burned or exploded, often with considerable loss of life [U.S. Congress, 1852A, pp. 88-108]. Those of us who occasionally worry about the risks of being killed or injured while traveling today should perhaps reflect upon the revealed low levels of risk aversion among mid-nineteenth century travelers. According to Captain Embree there "is not one in one thousand who are killed or wounded in traveling one thousand miles on our western rivers" and he asked rhetorically "Can any other mode of conveyance compare with this for safety?" [U.S. Congress, 1852A, p. 115] I certainly hope so! For by today's standards this is probably equivalent to between six and nine injury accidents per motorist per year or the equivalent of one trans-Atlantic passenger per wide-bodied jet NOT making it off the plane alive at the trip's end. The safety of travel has drastically improved over the last 150 years.

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[3] See the modified Bateman-Weiss samples available from http://www.vanderbilt.edu/Econ/atackj/atackj.htm. The original 1850 sample was collected by Fred Bateman and James D. Foust then of Indiana University and Thomas Weiss of the University of Kansas under grants 95-2450, 95-2456, SOC 75-18917 and SOC 75-20034 from the National Science Foundation. These samples have been supplemented and modified by Jeremy Atack and Fred Bateman using funds provided by the NSF, Vanderbilt University, and the University of Georgia

In the mid-nineteenth century, however, western river navigation was a hazardous undertaking. Dealing with the hazards was complicated by externalities and free-ridership problems and compounded by overlapping federal and state jurisdictions and competing economic interests. In particular, there were problems in recovering the costs spent on river improvement, particular for the removal of hazards to navigation such as snags and sand bars. As navigable waterways, the western rivers fell under federal jurisdiction. They also formed the borders between many states. Sometimes the border essentially ran down the middle of the river as between Illinois and Missouri but other times states failed to agree on the boundary—the Kentucky-Illinois border, for example, is the Illinois bank of the Ohio River and has been the subject of repeated and continuing dispute by Illinois.

Moreover, in the period about which I am writing, the western rivers ran free although wing dams occasionally concentrated the river's flow. Notwithstanding the lower river's great depth, there were numerous shallows on the higher reaches—something we would not generally suspect looking at the rivers today. For example, the Ohio River was notoriously shallow around Wheeling where from 1838 through 1849 the minimum stage of the river varied from just 11 inches to 28 inches and averaged only 18 inches. Such river levels prevented passage by all but the smallest and lightest boats. Similarly, Muscle Shoals obstructed navigation of the Tennessee River. Indeed, natural river features now only memorialized as names on maps such as the Falls of the Ohio at Louisville and the Rock Island Rapid on the Mississippi in Illinois were serious shipping hazards.

The Falls of the Ohio at Louisville were the single most important barrier to navigation on the western rivers. Here, a series of rock ledges totaling 22 feet in height in the space of two miles made the river virtually impassable especially by the largest steamboats except when the river was in flood (which was only for about two months of the typical year). This natural barrier led to the creation of two distinct shipping markets: the Ohio River above Louisville and the Ohio and Mississippi Rivers below the falls. Moreover, although a canal around the Falls was opened in 1830, its lock chambers which limited boats to a beam of 49.5 feet and a length of 183 feet, drawing no more than 6.5 feet eventually proved too small to accommodate boats of a size that proved optimal for navigation elsewhere on the rivers [Trescott, 1957-58; U.S. Congress, 1844, 1846, 1852B].

If western river steamboats, like other ships, were subject to increasing returns to scale then larger boats were more efficient than smaller boats.[4] If so, then constraints upon vessel size, whatever their source which prevented use of the optimally sized vessel, generated increased social and private costs. Absent these constraints, the rapid wear and tear upon steamboats and the sundry other hazards to navigation which depleted the steamboat fleet would

[4] The existence of scale economies in western river steamboating is the subject of some dispute. See Haites and Mak [1976 and 1978] and Atack [1978].

have generated rapid convergence on the optimal size vessel for each trade and generated the requisite transportation services at the lowest private and social cost [Saving, 1961; Shepherd, 1967; Stigler, 1958; Weiss, 1964]. We do not know how this implicit tax of higher than necessary costs was split between producers and consumers but an essential first step is the measurement of scale economies to establish the existence and magnitude of this cost differential. The tonnage of each vessel from the "Lytle List" is an essential component in the calculation. Indeed, I view estimation of economies of scale in steamboating as the Rosetta Stone for an analysis of the interplay between western river steamboating and public policy. It was this interplay which eventually led to the system of levees and dams that today control the rivers with the consequences memorialized in John Barry's critically acclaimed book, *Rising Tide* [1997], about the Great Mississippi Flood of 1927 and the more recent devastating 1993 floods.

The kind of data in the census steamboat sample is grist to the cliometrician's mill and exactly the sort of information that I have spent my life analyzing. But just as Robert Heilbronner is credited with once lamenting that while mathematics had brought rigor to economics it had also brought mortis, the theoretical modeling and econometric techniques of cliometrics have often lost the history from economic history. It has certainly lost the story in favor of a set of stylized facts but it is the story itself with all its complexities and nuances that is interesting.

Such is the case here. While the census data give us the broad picture they tell us absolutely nothing about the economics of the day-to-day operations in the industry. Nor, really does Hunter, except for what he gleaned from a diverse and disparate group of newspaper stories, travel diaries, court and congressional testimony and the like. Some evidence does, however, exist in the form of steamboat logs and records. I focus here on just one of these, the *Freight Book for the High Flyer* held as a part of the Howard Shipyard manuscript collection at the Lilly Library at Indiana University in Bloomington. These records cover two periods; the first from mid-1854 through 1855; the second from mid-1859 through January of 1860.

The *High Flyer* was a vessel of 472 tons constructed at Madison, Indiana in 1854. When it entered service in May of that year, the *High Flyer* found itself trapped on the Upper Ohio by low water which prevented passage over the Falls of the Ohio while its size made it too large to pass through the lock chambers of the Louisville and Portland Canal. As a result it spent the first part of its life, from necessity if not by choice, operating between Louisville and Cincinnati in competition with the Louisville and Cincinnati Mail Line, the largest and most successful shipping group on the western rivers [Hunter, 1949, pp. 506-8]. During this period, the *High Flyer* made 55 round trips between Louisville and Cincinnati between May 22 and December 31, 1854.

Not all were uneventful. On July 23, the *High Flyer* broke a wheel and was laid over in Louisville for four days, and on July 29, the *High Flyer* was holed at Rising Sun, Indiana but managed to limp back to Cincinnati for repairs. This lat-

ter accident appeared to cause the owners to suspend service until the fall when the river stage was higher.

Although the *High Flyer* was of comparable size to other first class trunk river steamboats of the time, it may have been a superior vessel since it held a U.S. Mail contract during the first period of its life. In the last years of its life, the *High Flyer* seems to have lost its glamour as a first class steamboat and, rather than operating on one or two major routes, took on the appearance of a transient. May and June, 1859, for example, were spent operating between Louisville and St. Louis, switching in July to operating on the Mississippi to points between St. Louis and New Orleans. With the coming of fall and winter the *High Flyer* made trips between New Orleans, Louisville, Vicksburg and Memphis. It was finally abandoned as scrap in 1861 having had at least two masters.

Little else is known about this boat. The *Freight Book* is the only one of the *High Flyer* records known to have survived. Presumably the ship's captain also kept a daily log and the clerk would at minimum have also kept a count of passengers if not an actual log of names. Based upon the census sample data for other boats running between Louisville and Cincinnati in 1850, freight revenue for boats on this run made up only 20 percent of earnings compared with half or more on other routes. These freight book data are therefore just the tip of the proverbial iceberg, particularly earlier on. Still, they provide a variety of evidence about steamboat operations, some of it hitherto largely unknown or undocumented.

The freight books have columns for the name of the shipper and their residence, the consignor, the destination, a place for the shipper's mark, a description of the goods, the rate charged and whether payment was in cash or on credit. The originals are relatively easy to read—or at least I found them to be so some 25 years ago. On the other hand, the microfilm that I currently use is much harder to read, basically consisting of sepia ink on sepia-colored film.

The maiden voyage of the *High Flyer* seems typical of the 55 trips she made to Cincinnati in 1854, although freight volume was somewhat lighter than later on as her business relationships and reputation developed. Upsteam she carried freight for way stops at Vevay, Maysville, Lawrenceburg as well as goods for Cincinnati and freight to be forwarded on to Wheeling and Pittsburgh. Downstream she carried freight for Vevay, Madison, Jeffersonville and Louisville. Other than the absence of other downstream destinations, this pattern of destinations came as no surprise. It is interesting, however, to note that the *High Flyer*'s size and elite status did not prevent stops along the way to offload or receive cargo, making the typical point-to-point time of 11 to 12 hours even more remarkable. The record on this route was held by the *Telegraph No. 2*, another of the sample vessels, which managed Cincinnati to Louisville in just 6 hours 26 minutes, making no stops, at an average speed of 21 miles per hour [Hunter, 1949, p. 24].

What did come as a very big surprise to me was the diversity of cargo both upsteam and even more especially that downstream. A typical upstream cargo

consisted of linseed oil, tobacco, sugar, coffee, dressed hemp, rope, various packages, boxes and chests of general merchandise and a refrigerator. On another trip (June 19) she carried cigars, salt, sugar, lots of cement, wheat tobacco, bacon, apples, rope, sasparilla, fish, tallow, lime, empty beer barrels, and hams, as well as general merchandise. On one downstream voyage, she carried a box of clothing, some rolls of leather, 7 packages of general merchandise, 4 kegs of rivets, 2 dozen hat boxes, a bundle of mahogany, a barrel of oysters, 4 cases of shoes, a cask of brandy, 15 barrels of ale, 4 barrels of whiskey, assorted furniture, a bundle of papers, some bales of hay, and a number of hogsheads of tobacco. On yet another randomly-chosen trip, she carried hardware, broom handles, sugar, boots and shoes, malt, copper, books, a printing press, 3 carriages, clothing, perfume, beer, rolls of leather, sugar, beer, iron, oil, eggs, hay, and 3 melodeons as well as the ubiquitous general merchandise. What is so remarkable about this list of downstream cargo is the preponderance of manufactures rather than agricultural commodities, although I suppose one might reasonably argue that whiskey was simply a higher value-to-weight and thus more cost-effective way of shipping corn. Still, I think the downstream sale of ale, rivets, melodeons, carriages, perfume, shoes and hats are something of a surprise.

I note three other items of general interest from the freight books. First the receipts show clearly the existence of what was known as the "back-haulage" problem—an imbalance in trade between upstream and downstream. Early on, the demand for upstream passage outstripped that for downstream but by the 1840s the situation reversed and boats competed vigorously for upstream freight that paid anything above marginal shipping cost while charging high rates on downstream freight. This situation is apparent in the *High Flyer* freight books. Upstream voyages generally carried less freight and at lower rates than downstream shipments. Thus, for example, the *High Flyer* realized $105.20 on its upstream maiden voyage and $171.80 downstream. On another round trip, the figures were $85.05 earned on upstream freight; $294.31 on downstream. Total earnings per trip in the early trade were probably five times higher.

Second, upstream shippers made little use of credit while the bulk of downstream freight was carried on credit. Indeed on the June 20, 1854, trip from Cincinnati to Louisville virtually the entire $294 in shipping costs was on credit. What is not known at this time is how these credits were resolved whether through correspondent bank accounts or from the proceeds of sale. These data suggest large money transfers, whether through or outside the region's financial institutions, that have not before been traced or remarked.

Third, while the variation of freight rates over the shipping season is well documented—for example in Thomas Senior Berry's study of the Cincinnati market [Berry, 1943]—what these meant in terms of actual shipping costs is less well appreciated. The freight books for the *High Flyer* reveal the same general seasonal drift of shipping rates shown by Berry but instead of aggregate freight volume declining, shippers switched to even higher-valued freight that paid still higher freight rates.As a result the average freight rate paid by all class-

es of merchandise combined shows an even more pronounced cyclical peak than that implied by Berry's data which are for individual commodities. This in turn has implications for the level of shipping services—ton-miles of freight—implied by the freight revenues reported for the sample steamboats.

Mississippi and Ohio navigation collapsed during the Civil War and failed to recover afterwards—at least to anything approaching its former glory. This decline had much to do with the apparently insoluble free-ridership problems alluded to earlier though the proximate cause was the successful river blockade by the Union at a time when river transportation faced stiff and growing competition from the railroads. One response was technological change from sidewheel multipurpose cargo/passenger vessel to sternwheel towboat of barges. The real solution, however, lay in a change in public policy that brought about a fundamental change in the nature and character of the rivers and their navigation through the activities of the Army Corp of Engineers—changes still not very well documented or analyzed.

It is now almost 50 years since the first publication of George Rogers Taylor's book, *The Transportation Revolution* and the phrase transportation revolution has pretty much gone the way of the industrial revolution, agricultural revolution, and all the other assorted rhetorical dinosaurs that we talked about as the origins of the modern economy and economic growth. I think this has been a mistake. I would emphasize the revolutionary rather than the evolutionary nature of the western river steamboat industry in the impact that it had upon the entire economy and our culture. This is also a story that ties into some of the current fads in economics dealing with externalities and free-ridership and with increasing returns to scale. It thus provides those of us in economics departments with an opportunity to re-engage our colleagues. Second, I think we have neglected important aspects of government-business relations in which steamboating and the western rivers can serve as an exemplar. These include the failure of government, particularly of the federal system, to act to remedy problems created by imperfectly-specified or improperly-assigned property right, externalities, and the like. Moreover, spectacular and graphic accidents in this industry help give rise to government intervention in other areas—for example, boiler inspection, the nation's first effort to monitor and regulate safety—that eventually spilled over into the rest of the economy. Lastly, I have tried to use my address to illustrate a finding that most of you probably already knew but one which I am just belatedly appreciating—perhaps its my age: Large bodies of quantitative data, theorizing, and econometric modeling cannot tell the whole story. The particular—the individual and the firm—and singular documentary records play a central role in enriching the analysis and interpretation of data.

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