International Trade and Renewable Resource Use

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Why study Renewable Resources?

• Renewable resource industries employ hundreds of millions of people worldwide and feed billions.

• Renewable resources are some of our most precious assets: forests, fisheries, aquifers, wildlife, soil, and the atmosphere.

• Several ongoing policy debates require input about likely effects of the effect of trade restrictions, the elimination of subsidies, the role markets could play in fostering sustainable use of wildlife, and the links between trade and climate change.
Trade and Natural Resources

• For the entire post war period, the share of Natural resource products in overall trade has been falling while the share of manufacturing has been rising.

• Recently this trend has either stopped or slowed: Natural resource products are becoming more important in world trade.

• Most developing countries rely heavily on natural resource exports, and in aggregate these flows are large.
But there are concerns

• Does liberalizing trade put natural resources at risk? Are there large environmental costs of freer trade?

• If so, can these losses be large enough to make a natural resource rich country lose from trade liberalization?

• Have we ever observed losses like those suggested by theory?
Today’s lecture

• Goal: Use both theory and empirics to address these issues. Answers are incomplete but the method and models are useful.

• Introduce a Case study of the role of International Trade in the almost complete extinction of the American Bison (Buffalo kill).

• Ask whether this example contains general lessons about trade’s impact on renewable resources.
Economics as a Forensic Tool
Buffalo Hunt
Buffalo Biology
Buffalo History

• Pre-European contact population of somewhere between 25 - 30 million animals.

• Habitat destruction and subsistence hunting slowly removed the populations east of the Mississippi by approximately the 1830s.

• By the 1860s, buffalo only on the Great Plains. West of the the 98th meridian, East of the Rockies. By 1865: 10-15 million buffalo left.
• Completion of Union Pacific Railroad in 1867 divided the herd into small Northern and large Southern herds.

• Slaughter on the “Great Plains”. Southern herd eliminated from 1871-1879. Northern herd eliminated from 1881-1883.

• In a little more than 10 years, population fell from perhaps 10 million to 100.
To the Present

• Several ranchers in the U.S. began private herds in the late 1870s and 1880s.
• These herds repopulated Yellowstone, and other bison reserves.
• 1905, William Hornaday and Teddy Roosevelt created the American Bison Society.
• Today there are over 250,000 in private herds and 50,000 slaughtered annually.
Who Killed the Buffalo?

- Settlers came, bison habitat was reduced, buffalo numbers fell.
• The Army came, wanted the bison dead to “civilize” the Indians, they facilitated hunting, and buffalo numbers fell.

“Kill every buffalo you can...every buffalo dead is an Indian gone.”

Colonel R.I. Dodge
• The Railroads came, they created a market for their meat, robes and hides, they facilitated hunting, and buffalo numbers fell.
New rifles came, allowing hunters to shoot from 600 yards away and kill 100 buffalo in a “stand”. The Sharp’s Big 50 facilitated hunting, and buffalo numbers fell.
Whiskey and White traders altered Native hunting practices. Native hunting & drought killed the buffalo.
What needs to be Explained?

• Why was the slaughter a slaughter?
  Tanning innovation

• Why didn’t prices adjust to limit the slaughter?
  US was small on world markets

• Where did all the buffalo products go?
  France, Germany & the U.K.
The Economic Model

- Large number of potential hunters
- Hunters differ in hunting skill
- Hunters hunt or produce outside good
- Killing is easier if the herd is larger
- No regulation of buffalo kill
- Tanning Innovation raises the value of buffalo products
- Natural growth plus harvesting determines herd size dynamics.
Prop. 3: Innovation creates excessive entry, and then exit along transition path. Herd size falls.
Empirical Evidence

Problem: There is no data!
“Had there been a deliberate plan for the suppression of all statistics relating to the slaughter of buffalo in the United States, and what it yielded, the result could not have been more complete barrenness than exists to-day in regard to this subject. There is only one railway company which kept its books in such a manner as to show the kind and quantity of its business at that time. Excepting this, nothing is known definitely.”

William Temple Hornaday, Smithsonian National Museum Washington, 1889
• Some numbers from Northern shipping points.
My Solution to the Data Problem

• Hide Exports from United States to all countries annually over 1850-1890 Period
• Data includes country specific destination of exports
• Data mostly in value terms, but some quantity data as well.
• Problem: Hides include cattle hides & probably deer and goat skins.
• Eliminate cattle hides using well known model of the cattle industry by Murphy, Rosen and Sheinkman, JPE (1994)

• Cross-check constructed export series against other historical data.

• Exploit the country, time and port of export variation in the data to look for further evidence.
The Innovation

• Tanners in England, Germany and perhaps France discovered how to tan buffalo hides into useful leather.

• Buffalo leather could then be used for industrial belting and for sole leather.

• This new use for buffalo, raised the value of a kill tremendously. Demand must now include demand by Europe.
As I came back in camp, I told the other fellers it was getting too warm too get the meat to market without spoiling. They says "Why don’t you just skin them and let the meat lay". I says "What the devil would I do with the hide". They say "Ship it to W.C. Lobenstein in Leavenworth and he will send me a check". So next day, Burdett and I went a skinning.
Palo Pinto, Texas.

Keeps none but the best of Wines, Liquors and Cigars.

W. C. LOBENSTEIN,
J. L. HICKEY Agent,
FORT WORTH ---- TEXAS,

Pays the highest prices in cash for Bison and Beef Hides, Peltries, Furs and Wool.

HENRY WARREN.

J. L. KANE, Cashier.

HENRY WARREN & CO.
STILL-HUNTING BUFFALOES ON THE NORTHERN RANGE.
From a painting by J. H. Moser, in the National Museum.
BUFFALO HIDES.—Some eight or ten months ago a few enterprising New Yorkers conceived the idea that the buffalo hides might be tanned for leather, so they went West and procured all the hides they could, and sent them to this city and Baltimore to have their exact value ascertained. These hides were sent to several of the more prominent tanners, who experimented upon them in various ways, but they met with no success. Either from want of knowledge or a lack of proper materials, they were unable to render the hides soft or pliable, and therefore they were of no use to them. Under these circumstances several bales of these hides were sent to England, where they were readily taken up, and orders were immediately sent to this country for 10,000 additional hides. These orders were fulfilled, and since then the trade has continued. The first lots that were sent out were bought upon this market at 10c. per lb., and readily brought in England 10d. sterling. The great difference between the price of these and other hides will undoubtedly account for the manner in which they were taken up; but as far as their practical value is concerned the matter is different. The American tanners were unable to make anything out of them, and it is not positively known now to what use these hides are put in England. It is supposed, however, that when tanned they are split and used for carriage tops or for patent leather. However this may be, the English dealers are coming to the conclusion that the hides are not so valuable as they at first supposed, for the price has declined materially, and now these hides sell in the English market at only 6d. per lb. Notwithstanding this decline, the trade continued good. The hides are collected in the West by the agents of Eastern houses; they are simply dried, and then forwarded to either New York or Baltimore for export. The dealer realizes but a small profit, for the excessive cost of railroad transportation, and the cost of hauling them in many instances to the railroad for shipment, reduces the margin materially. The low price that these goods have reached on the English market, and the prospect of a still further decline, may in time put an end to this trade, but at present the hides are hunted for vigorously, and, if it continues, it will take but a few years to wipe the herds out of existence.—New York Bulletin.
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Notes: W.P. is hide prices found using the Warren and Pearson price index. N.Y. is hide prices found using data drawn from the Annual NY Chamber of Commerce reports. H.P. is the price-to-hunters series.
The Construction of Buffalo Hide Exports

- Total Hides
- Breeding Stock
- Implied Cattle Hide Export
- Buffalo Hide Export
- Cattle
- Cattle Slaughter

Yearly data for Hides and Cattle ('000) from 1867 to 1886.
The Construction of Buffalo Hide Exports

Texas, Oklahoma, New Mexico Slaughter

Kansas Slaughter

Montana Slaughter

Southern Herd Gone 5,000,000 exported

Northern Herd Gone 1,000,000 exported

Tanning Innovation
Over Time Variation

- London Times Article of 1872 dates U.K innovation to November 1871

- Account of George “Hodoo” Brown dates it to May 1871.

- Timing of Destruction is correct for both North and South

- Pause from 1879 to 1881 as Hunters move North
Magnitudes

- Relative size of Northern versus Southern herd accords with other accounts.

- Kill in 1872, 1873, 1874 accords well with Dodge’s numbers.

- Approximate kill for exports is 9 million over the entire period.
Geographic Variation

• Numerous Historic Accounts link W.C. Lobenstein with sales to England & J.N. Dubois with sales to Germany.

• Export data shows exports to U.K. boom first, followed by Germany and then France.

• English Business Directories list many tanneries offering Buffalo leather products; also show French tanneries offering buffalo products. Buffalo hide price quotes in Hamburg.
HEPBURN & GALE,
MANUFACTURERS OF
WIRE-SEWN AND OTHER MACHINE BANDS,
LEATHER HOSE PIPES, CUP & HYDRAULIC LEATHERS.

Prepared HIDE LACES, Strap Butts,
Sole Butts, Pipe Butts, Walrus and
Hippopotamus Hides, and Leather
Goods for all Mechanical purposes,
and for Ships’ Use.

Their “Composite” Double Band of LEATHER and Prepared HIDE will
carry more strain than any other
Band, and will stretch much less.

SINGLE, DOUBLE, AND COMPOSITE WIRE-SEWN LEATHER BANDS FOR PORTABLE ENGINES.
INDIA RUBBER BELTS, AND RUBBER GOODS FOR ALL MECHANICAL PURPOSES.

Their WATERPROOF LEATHER for PUMP BUCKERS retains its shape, and remains perfectly solid in water. It is in
general use in Mines and Collieries, and may be had of all Dealers in Leather. Each Butt bears the above stamp.

EXCELSIOR COMPOUND,
FOR PRESERVING LEATHER BELTS AND INCREASING THEIR GRIPPING POWER.
“Effects a large saving of Power.”
“Were the usefulness known, the use of it would become
general in all Manufactories.” — Fido Testimonials.

LONG LANE, SOUTHWARK, LONDON, S.E.
HAMBURG, Sept. 7.

HIDES.—Imports during the past two weeks 29,368, and 353 bales kids. Sales, 12,162; hides, 24 bales kips; stock, 47,000 hides and 46 bales kips. Latest quotations $1 2-10 American lbs (1 lb German): Dry Buenos Ayres and Montevideo heavy, 21@26c; do light, 19@33c; do Rio Grande and Rio Janeiro heavy, 20@21c; do light, 19@20c; green salted Buenos Ayres heavy bull, saladero, 16@17c; do cow, 13@14c; do horse $2 60@$3 08 $ hide; green salted Montevideo and Uruguay heavy bull, saladero. 15@16c; do cow, 12@13c; do Rio Grande, heavy bull, saladero. 12@13c; do cow. 11@12c; do horse, $2 37 @ $2 60 $ hide; dry North American and Texas, 15@17c; do bison. 7@9c; green salted do, 7@9c.

—J. & M. Popert's Price Current.
On Thursday next, the 29th instant, at Twelve,
At the Public Sale Room, 14, Cook-street,
750 Dry River Plate Horse
520 Dry West India
3180 Dry East India Buffalo
9500 North American Bison
1850 Salted River Plate Ox and Cow
1000 Salted West Coast
860 Salted North American Ox and Cow
1200 East India Kips,
288 Sides Oporto Leather.
Apply to GOAD, RIGG & CO. Brokers,
28, Exchange-street East.

On Thursday next, the 29th instant, at Twelve,
At the Public Sale Room, 14, Cook-street,
1700 Dry River Plate Horse, &c.
5000 Dry Mexican Ox and Cow
1000 Dry West Coast Cow
600 Dry Salted Brazil Cow
3000 Dry Singapore Buffalo
1000 Dry Singapore Cow
3000 Dry Bison
8000 Salted American Ox and Cow
1000 Salted American Pig
1000 Dry American Calf
Apply to JAMES GORDON & CO. Brokers.
JOHN TULLIS & SON,
TANNERS, CURRIERS, AND
LEATHER BELT MANUFACTURERS.

SPECIAL MACHINERY FOR MANUFACTURING MAIN DRIVING BELTS. ALL STRAPS INDIVIDUALLY STRETCHED & TRIMMED BEFORE FITTING UP.

The Leather we use is all Oak Bark Tanned, and being from the primest of Native Fresh Hides, is necessarily of the best selection and description possible, well grown and well seasoned. Our Manufactory embraces:—Belting, both Single and Double, with Lace Sewing, Wax Thread Sewing, Copper Wire Sewing, Copper Riveted, or Cemented only, just as may be required; Hose Piping, light and heavy, for Brigade and other purposes; Pump Butts; Press Butts; Picking Bands (Oak Tanned and Green); Skips; Crown, Antelope, Cordovan, Cowhide and White Laces; Leather and Buffalo Pickers of all kinds and dimensions, with every variety of Mechanical Leathers generally.

We are the largest Makers in the Trade. Our Works, in extent and thorough completeness and efficiency of productive facilities, are unsurpassed.

"Manufacturing Mechanical Leather has been our Sole Business for Forty Years." 

PRICE LISTS AND SAMPLES ON APPLICATION.

ST. ANN'S LEATHER WORKS, GLASGOW.
Manchester Office, 6 New Market Lane—EDWARD ASHWORTH, Manager
Maybe I am wrong.

• Magnitudes could be wrong, yes there were exports but…

• Two obvious alternatives: European demand and U.S. supply shock.

• Methods thus far constructed exports but no method to construct a confidence intervals around these figures.
European Demand Shock

• Collected data from all European countries that were large destinations for U.S. hide exports.
• Data is the complete set of U.K. and French hide imports from all countries from 1866 to 1888.
• Data is on raw hide imports.
• Construct US shares of European markets. Is this share stable over time?
U.S. Supply Shock

- Collected UK, French, Canadian and German import statistics. German data useless.
- U.K, France as Treatment with Innovation
- Canada as control without Innovation
- Share of Raw Hide imports from U.S. as dependent variable.
3D Estimation

\[ s_{it} = \alpha_i + \beta_{it}t + \gamma T_{it}^S + \delta T_{it}^N + \varepsilon_{it} \]

\( i = \text{Canada, France, U.K.} \)
\( t = 1, 2, 3, \ldots \)
\( s_{it} \) share of raw hide imports from the U.S. in total raw hide imports

For the U.K and France
\( T_{it}^S = 1 \) when Southern herd eliminated, 1872 - 1879, and 0 otherwise
\( T_{it}^N = 1 \) when Northern herd eliminated, 1882 - 1886, and 0 otherwise

For Canada
\( T_{it}^S = T_{it}^N = 0, \text{ always} \)
Table 4 – A Quasi Experiment

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Implied Buffalo Hide Imports into the UK

Assumes 4 Hides per 112lbs
Conclusion from Trade Data

• There is a feature of US trade data consistent with my hypothesis.

• Same finding with two different methods and data sources.

• Extent of trade is the only thing in dispute; my data suggests it was very large.
Who killed the Buffalo?

• Tanning Innovation created in Europe

• Robust demand comes from Europe

• Are Europeans responsible for the most shameful event in US Environmental history?
Not quite!

• US policymakers are complicit but not causal.

• Railroads were helpful but probably not critical.

• New rifles helped, but hunt led to new rifles not the reverse.

• Little evidence that environmental change or native over hunting did much at all.
Conclusion

• Standard accounts of the “Slaughter on the Plains” are incomplete.

• Empirical evidence strongly in favor of the export driven slaughter explanation.

• Economics is a powerful tool for understanding the world.
Caveat 1: Losses from trade?

• There are no claim of overall losses from trade; just environmental losses in terms of buffalo.

• In some sense the buffalo were an under-exploited resource, and the availability of trade brought new technologies to the US to exploit it.

• Even if this is true, the rate and method of exploitation were surely not first best.
Caveat 2: Pattern of Trade

• Cattle hides could have been cheaper than buffalo hides, and then pattern of trade would be reversed.

• Poor control over renewable resources sometimes makes them more, and not less, expensive since over use lowers productivity.
Raises a Question

• Could tighter control over natural resources provide so large a productivity improvement as to lower the unit costs of production?
• Yes. Trade can work as a back stop technology for badly managed resources.
Caveat 3:
The Demsetz Hypothesis

• The degree to which economic agents protect resources depends on their value.
• As their value rises, agents will have an incentive to protect them more completely.
• Property rights become more complete when resources rise in value.
• Higher values on international markets can create the right incentives for resource protection and control.


**Raises a Question**

- Under what conditions, if any, can we expect management of renewable resource industries to be successful in trade but a failure without it?
- In situations where the government’s enforcement power is great; where over capacity in the resource sector is smaller; and where private agents’ incentive to extinguish the resource is large.
- (See Trade, Tragedy and the Commons, AER 2010).
Conclusion

• International Trade can destroy even vast natural resources in very short periods.

• But trade can also work as a backstop technology and provide strong incentives for better management.

• Empirical work should focus on identifying those country or resource characteristics that make each of these cases more likely.

• Empirical evidence is never easy to obtain, and empirical work is very difficult to conduct, but we have no choice: theory alone will not convince any policy maker.
References


