

Economics and Exploration: A Bit of Historical Perspective

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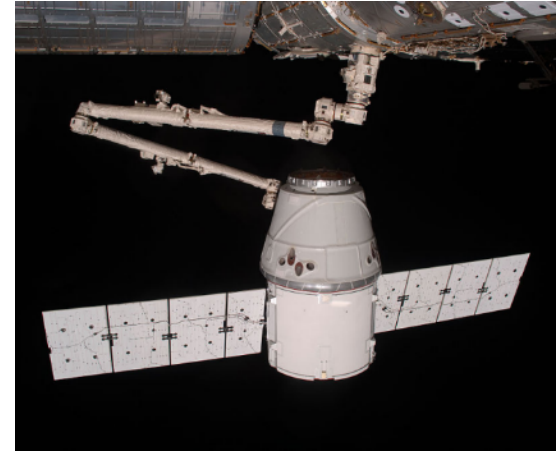
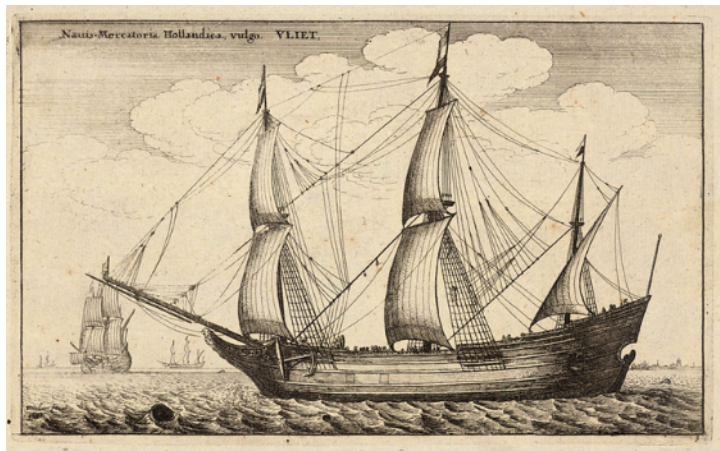
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Looking forward by looking back.....

- We are at the start of a new era of exploration.....it is useful to look at the previous exploration era for lessons.
- The western great age of discovery began with Columbus and continued for hundreds of years.....but the details are interesting.

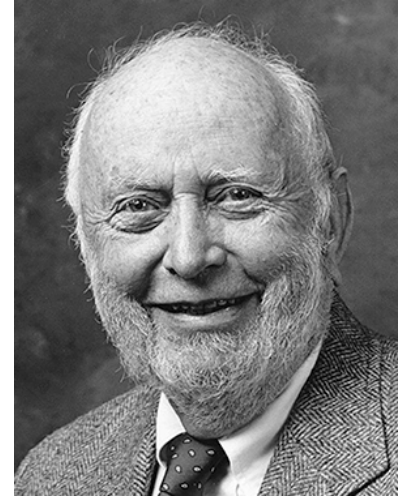


It bothered me...



- **In grade school I learned the dates....**
 - **Columbus discovers the Western Hemisphere in 1492**
 - **Then.....fast forward 115 years.**
 - **Jamestown was founded in 1607**
 - **Massachusetts settlement began in 1620**
- **Why so long between Columbus and North American Settlement?**

Apply a few economic principles



- **Risk-Return Matrix**
 - Investors assess expected return and discount return by associated risks.
- **Investment/Entry Costs**
 - Are there barriers (legal, physical, social, technological, etc.) to entry and/or high initial investments?
- **Opportunity Cost**
 - What is the next best alternative to your proposed investment?
- **Externalities**
 - What are the unintended costs of the investment and who bears the costs?

Start with Columbus....



- **Risk-Return Matrix**
 - The original investment was a grant from a research proposal. The proposal was highly speculative, reviewed very poorly, but with the potential of high return.
- **Investment/Entry Costs**
 - Advances in shipping technology 15th century (development of the caravel and galleon) greatly extended range.
- **Opportunity Cost**
 - With the conclusion of the Moorish War unemployment was high and there was a funding “peace dividend”.
 - Low crewing and ship rental costs.
- **Externalities**
 - Unknown and largely unexpected.

1491 Proposal Review Cycle

Castile Royal Academy of Sciences

Pre-Decisional and Confidential

PI:	Christopher Columbus	Proposal No.:	XXXVII
Institution:	ISTITUTO NAZIONALE DI EXPLORA		
Title:	NEW ROUTE TO THE INDIES		

BRIEF SUMMARY OF RESEARCH OBJECTIVES:

The proposal would develop a new route to the Indies by sailing west and avoiding conflict with Portugal and Turkish interests.

BRIEF SUMMARY OF OVERALL EVALUATION:

While the goal is very attractive the proposal has a number of major weaknesses. The proposer asserts that the Earth's circumference is substantially smaller than observational data has shown over the last 1900 years. This seems to be based on simple errors in units. The realistic distances to be sailed puts the proposed goals far beyond the effective range of shipping technology. The PI does not demonstrate the relevant navigation, scientific, and mission leadership experience required for success of this proposal.

Intrinsic Merit¶

Major Strengths¶

- None¶

Major Weaknesses: · ¶

- The proposal has made several major errors on the expected distances to the Indies. The PI has underestimated the circumference of the Earth by 25%. The Earth's circumference was accurately estimated by Eratosthenes et al (3rd century BC) and confirmed by stellar observations from Posidonius et al. (1st century BC). ¶
- The distance the expedition will need to cover are substantially larger distance than proposed. Sailing times are beyond supply storage capacities of the proposed shipping. It is unlikely that the expedition will be able to cover the realistic distance before consumables are exhausted and crew health is endangered. ¶
- The estimate of the distance from the Canary Islands to Japan in the proposal is stated to be about 3,000 Roman miles. An estimate from Posidonius et al. is about 14,000 Roman miles. ¶
- The proposal apparently confuses published distances that were in Arabic miles and assumes they were in the much shorter Roman mile. ¶
- The PI has substantial experience as a merchant and trader; however he has (1) no relevant experience as the leader of a major exploration mission, (2) no academic or scientific credentials or peer-reviewed published works that would support the proposed expedition, and (3) no relevant navigation experience. ¶

Shipping Technology: The Galleon

- For its time this was pretty good technology.
 - Unprecedented level of stability
 - Reduced wind resistance, strongly built
 - Faster and more maneuverable
 - Capable of very long voyages (annual trading voyages from Mexico to Manila were 14,300 km one way!)
- Designed for the high threat environment of the Mediterranean.
 - Heavily armed and high freeboard.
 - Particularly useful to the Spanish since their cargos were small but high-value
- Space for large crews
 - Fight the ship
 - Allow for “wastage”
- Expensive to build, maintain, and crew.
- But the returns from the Americas made this worth it



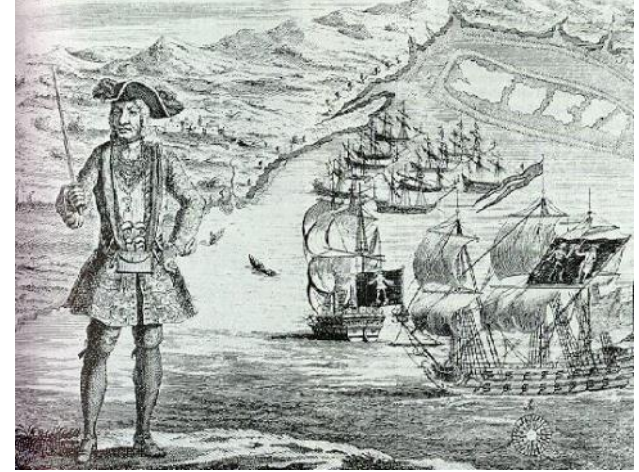
Risk/Return: The Treasure of the Americas

- **HUGE return from a trivial investment.**
 - The Spanish encountered organized and very wealthy civilizations....which they looted.
 - Silver from the Americas accounted for one-fifth of the Spanish Empire's budget for the next 200 years. Enabled a completely crazy and over-extended foreign policy.
 - Gold and silver from the Americas roughly tripled the world's stock of precious metals.
- These kind of returns set off a frenzy of investment and settlement
- In the 16th century about 500,000 Spaniards emigrated America....note that this is about 5% of Spain's population.
- It also encouraged competition.....



Risk/Return: Security

- The Age of Exploration was also the Age of Piracy....
- Lots of high-value cargos going thru sparsely populated areas with no effective rule of law.
- The Anglo-Saxon world calls Francis Drake a great man, but the Hispanic world loathes him as the worst sort of pirate, thug, and bandit (the jurisdiction problem).
- He was just one example of a huge collection of freebooters that existed because shipping technology outran the reach of institutional control.



Opportunity Costs: The Resource Curse

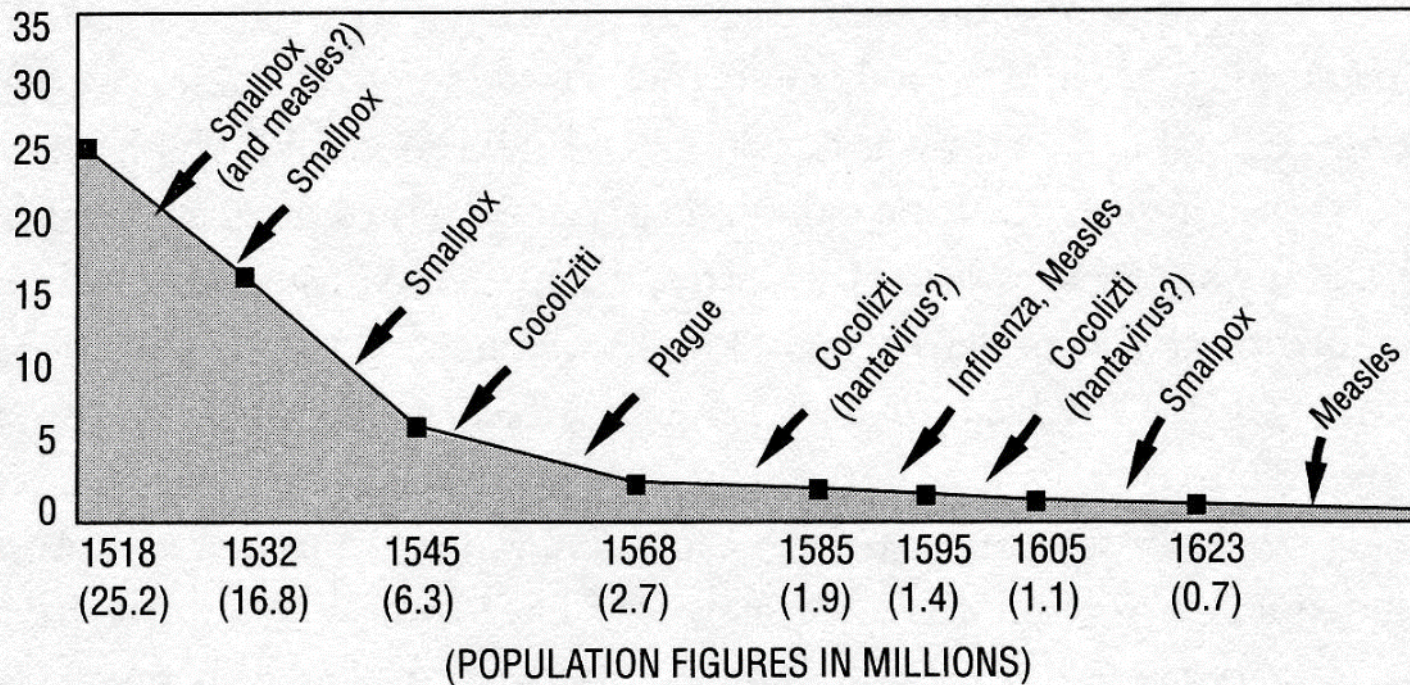


- Turns out that natural resource-rich countries tend to have less economic growth and worse development outcomes (easy to think of a few recent examples).
- The problem is that a huge influx of resource wealth does a bunch of economic damage.
 - The influx of cash (gold/silver) allows for more imports, damaging local industries and causing unemployment.
 - Increased governmental revenue and regulation increases the opportunities for graft and corruption.
 - Large fiscal resources encourage political and military overreach.
 - Strong incentive for labor and resources to go to the natural resource sector at the expense of other sections of the economy.
- The result for Spain was high unemployment, depopulation, erosion of the skill base, stag-flation, corruption, centralization....
- In a real sense, Spain is only now getting over the problems caused by the wealth of the Americas.

Externalities: The Columbian Exchange



POPULATION LOSSES IN CENTRAL MEXICO



- In 1491 the population of the Americas was probably around 100-120 million....that was about 20% of world population at the time
- By 1600 it had collapsed to around 5 million
- Population of central Mexico was around 25-30 million before Cortes, it dropped to 800,000 by 1600 (Spain had 10 million people in 1492)
- It was not until the 20th century that the population of Mexico recovered.

ISRU-1500's Style

- A serious problem for all the early expeditions was basic support....food, ship repair, crew replacement.
- You cannot carry enough food and supplies from Europe to support extended stays and exploration in the new territories (the gear-ratio problem).
- All the European exploring countries quickly established advanced bases to support their exploration goals.
 - Havana was developed as a central supply and refit hub for the Spanish Caribbean.
 - Manila served that role in the far east.....advanced bases were critical.
- Same story for other European exploring countries
 - New England served that role for the English possessions
 - Goa in India for Portugal
 - Cape Town and Java for the Dutch

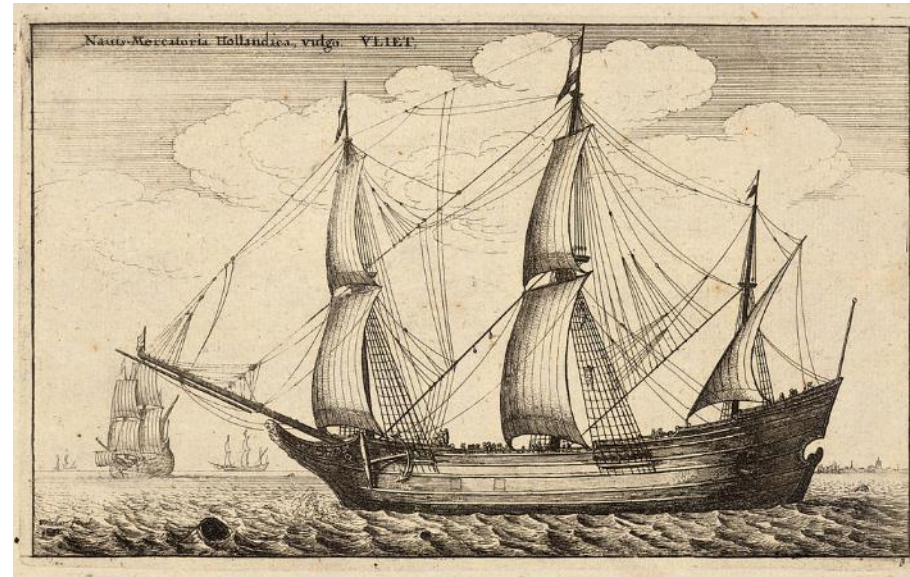


What was happening in North America during the 1500s?

- It is not that English and others were ignoring the Americas
 - John Cabot was hired by English merchants to explore North America and made two voyages in 1497 and 1498
 - He was actually Italian. Real name Giovanni Caboto
 - He just did not find much except lumber and fishing grounds
- Risk/Return: The shores of North America were thickly settled by with warlike and well-organized natives. Getting a foothold was very tough.
- Investment-Entry: The Spanish claimed everything and were known to discourage other explorers.
- Opportunity Cost: Wages and shipping costs were high
- This does not mean that North America was not visited
 - Grand Banks fishing
 - Lumbering
- It is just that the economic factors need to change in order to allow continued exploration and development

The Dutch Fluyt

- Designed for a more benign threat environment than the Galleon (North Sea vs. Med).
- Was cheaper to build, carried twice the cargo per ton as a galleon, and could be handled by a much smaller crew.
- The fluyt design used block and tackle (new technology in the 1500's) extensively to facilitate ship operations.
- Minimized or completely eliminated armaments to maximize available cargo space.
- These factors combined to sharply lower transportation costs and made transatlantic shipping of bulk cargos profitable.



Jamestown 1607

- **Risk-Return**
 - Risk: Native clashes, Spanish interference; but by this time the natives were dying off and the Spanish had other problems
 - Return: Production of staples (rice, lumber) and drugs
 - 1612 Tobacco cultivation was introduced at Jamestown. By 1627 exports were 500,000 pounds/yr
- **Investment-Entry Costs**
 - Transportation costs dropped by a factor of ~3 over the last 100 years due to the technology of the Dutch Fluyt
 - Land was increasingly expensive in Europe....very cheap in America
- **Opportunity Cost**
 - Population had recovered from the Black Death. Real wages have been falling for 80 years.
 - Effective wages for laborers in Virginia were more than double that in England
 - The major European export was people.
- **Externalities**
 - Still largely unknown or ignored

Plymouth 1620

- **Risk-Return Matrix**
 - With the revolution in transportation costs you could make money shipping raw lumber and salted fish to Europe and the Caribbean Islands
 - One attraction for immigrants was local political power (to religious fringe groups.....i.e. Puritans)
 - From 1630 through 1640 approximately 20,000 Puritans came to New England
 - Not all liked it..... about 10% returned to England after 1640, including about a third of the clergymen.
- **Investment-Entry Costs**
 - Land was cheap, the Spanish were less of the threat, the natives were mostly dead
- **Opportunity Cost**
 - Wages and transport costs were low
 - The major European export was people
- **Externalities.....still bad**

An Atlantic Economy

- **What developed was an integrated Atlantic economy based on the production of bulk agricultural staples in the Americas**
 - **Sugar in the West Indies**
 - **Lumber and fish in New England**
 - **Tobacco, indigo, rice and cotton in Virginia and the Carolina's**
- **Low transport costs, cheap land, few barriers to entry or investment, good legal protection made this possible.**
- **Suggested reading**
 - **1491: New Revelations of the Americas Before Columbus, Charles Mann, 2005**
 - **1493: Uncovering the New World Columbus Created, Charles Mann, 2011**
 - **Why the West Rules-For Now, Ian Morris, 2010**
 - **The Rise of the Western World: A New Economic History, Douglass North, 1973**

A Few Historical Thoughts

- **Externalities** are VERY IMPORTANT and often very poorly understood
 - Inadvertently killing 20% of the world's population
“discovering” the Western Hemisphere is not encouraging.
 - Think about that the next time you complain about planetary protection.....
- **Unintended consequences** are the RULE, NOT THE EXCEPTION in exploration and new settlement.
 - Part of the down side of success and riches is resource disease.
 - Spain is only NOW getting over the unintended economic consequences of its bout of resource disease.....again not very encouraging.

A Few Historical Thoughts

- **Institutional and legal frameworks are very important.**
 - Nothing turns off explorers faster than blurry property rights.
 - But, watch out for lax enforcement. The Age of Exploration was also the Age of Piracy.
 - Note that piracy is a problem of jurisdictions. Drake was a pirate to the Spanish, a great explorer to the English.
- **Development of local resources (ISRU) are huge!**
 - All the exploring countries depended on local resources and advanced bases (Havana, Manila, Goa, Boston....)
- **Transportation costs are key.**
 - They were key in the 1500's, they are key now. The revolution in shipping technology made a wide range of exploration and development possible.
 - This may be a strong analogy to what is happening now. Lockheed and Boeing are building the present-day galleons. Space-X and others are building the fluyts.