

Space Economics in Law and Policy

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Economic Topics and the Outer Space Treaty

Outer Space Treaty	Economic Topics	Economic Measures
Article I	Create <u>benefits</u> for all nations (mankind) and freedom to <u>access</u> and <u>use</u> outer space	Impact of space activities
Article II	Non-appropriation of space; Defining <u>property rights</u>	Profits, resource use, territorial rights
Article VI	Recognizes <u>private activities</u> & requires authorization (license?)	Gov't. incentives, permissions, regulations
Article VII	<u>Financial liability</u>	Risk
Article IX	Minimize <u>harmful</u> activities and <u>environmental</u> effects	Externalities

Government Perspectives

Economic Studies and Law

- Governments measure space benefits mainly to:
 - Brag
 - Justify budgets
- Governments develop space law to:
 - Protect governments, companies, and citizens
 - Safety of missions and operations
 - Financial responsibility is ultimately a government commitment
 - Moral and ethical concerns
 - Environmental and societal preservation

Industry/Government Think Differently

Government	Commercial
Mission success	Operational system
Longer-time frame but constrained by annual budget decisions	Short term focus: profit/cash flow Exception: private entrepreneur funding
Public welfare	Maximize profit
National security	Sustainable operations
Cost effectiveness	Least cost, maximum efficiency
Next engineering/science program	Next consumer/client product
Budget priorities	Private financing/ROI
Authorization/appropriations	Cash flow
Separate R&D, Construction, Operations budgets	Plan for life cycle funding
Treaties, Law, Regulations for the public good	Regulatory hurdles, compliance, taxes/user fees

Benefits

- Space benefits are not a gift or charity
- To benefit from space, nations need to invest to learn and use space applications
- Cooperation among nations is important to realize many of the benefits
- Cost/benefit analyses are not part of the discussion

Space Law

- International space law: by governments and for governments
- Very broad principles and characterized by a lack of prohibitions
- Recognizes private enterprise but no guidelines
 - Not an issue when treaties were written
 - Decisions at the national level, including basic definitions (e.g. space object, authorization, use vs. exploitation, etc.)

Benefits vs. Profits

- Benefits has different interpretations
- A fair return on investment is necessary for private sector activity
 - Can be part of social and national benefits
- Profits are not evil
- Free enterprise and competition in space is not a “free-for-all” grab without rules and norms

Economic Benefits

- The Big Picture:
 - Macroeconomic estimates of GDP and components
 - Multipliers
 - Productivity and impact
- At the industry and firm level:
 - Changes in consumer choices and market demand
 - Revenues and profits
 - Non-quantifiable returns
- We have no way of validating our estimates

Inaccurate and Misleading Numbers

- Macroeconomic studies: underestimates
 - Space impacts are often buried and lost in large numbers and measurement techniques
 - Especially in innovation and in resulting efficiencies and productivity
- Microeconomic studies: overestimates
 - Bottom-up approaches rife with accounting, data errors, and wishful-thinking
- Case studies: interesting, but numerical results can't be aggregated

Why?

- Lack of availability of adequate or accurate data
- Economic models limited by assumptions
- Measuring history; cannot measure marginal return to the next expenditure
- Misunderstanding of basics: cost vs. price; demand elasticity, etc.
- Political considerations
 - Security and defense aspects of space (dual use)
 - Policies (U.S. in particular) incentives, government enterprise, “competition”
- Hype and wish to “puff” the results in bottom-up studies
 - Even the lack of willingness to admit anomalies in space—emphasizes risk and may jeopardize customer base.

Example

- FAA launch projections
 - An overstatement bias that has existed over many years*
 - FAA response
 - “a demand forecast that tells launch companies what is the realm of the possible”
 - “if the forecast were ... about the international competitiveness ... it would certainly be done differently”
 - Also: The FAA both regulates and promotes space transportation.
- Recent data on new start-ups
 - \$7.6 Billion over 5 years invested**
 - About 1/3 of that is M&A—reflects mainly future earnings projections, not value-added to space investment
 - Another large percentage is launch vehicles and a lesser amount to remote sensing small satellites—is there really a new market demand for either?

*Boll, Sloan, Solem, Capstone Project, GW, 2017

FAA Response: e-mail correspondence

***Start-up Space*, Bryce, 2017

Evolution of Thinking About Space Economics

Economic Models	Actual Market	Space Economic Activity
<p>Measuring returns to Research & Development</p>	<p>Government demand and supply for space exploration</p>	<ul style="list-style-type: none"> • 1960s: NASA R&D: jobs created; multipliers, spin-offs • 1970s: NASA and ESA: added productivity and macro justifications to counter budget cuts
<p>Returns to R&D + Measuring effect of government incentives and outlays for private activities and purchases</p>	<p>Supply side more diversified but</p>	<ul style="list-style-type: none"> • 1970s: Telecommunications: private but regulated and controlled by government agencies
<p>Measuring sales and use of space applications in economic infrastructure; start of large private investments in launch vehicles and niche markets—still dependent on government demand.</p>	<p>government space remains leading funder and indicator</p>	<ul style="list-style-type: none"> • 1980s: Beginning of government incentives--buying private services (Mainly in remote sensing and then launch vehicles)
<p>Integration into economy; space information and “big data,” efficiency and productivity of private operations; venture capital and investment potential; possible economic activity in space itself</p>	<p>Speculative private activity based on potential markets</p>	<ul style="list-style-type: none"> • 1990s: Telecom services and DTV; GPS potential • 2000s: “Tourism,” defense applications dependent on space • 2010s: Private companies with launch and developing operations capabilities on-orbit

Important Economic Shift Since 2000

2000

- Most commercial and many government uses of space were in R&D stage
- Military and defense dependent on space
 - Information
 - Position, navigation, timing
 - Trend began in early 1990s
- Space was not particularly crowded; debris was a recognized issue by not a pressing one
- International space law not challenged by private sector opportunities and plans

2017

- Industrialized economies have a growing dependent on space
- Space is essential to the efficiency and operations of critical infrastructure (water, electricity, etc.)
- Crowding of space and possibility of space sustainability being threatened
- Lack of resilience: no real measure of risk
- Legal lacunae and uncertainty in dealing with these changes

Speculative Investment Mania

- Recent private space activity
 - Promises that don't materialize
 - Finance (VC) today
 - Media
 - Ambitious wealthy entrepreneurs
 - Government legislation and financial/contracting incentives

- Reality indicates caution
 - No change in market demand
 - Government budget risks
 - Possible oversupply of launch vehicles under development
 - Most business plans cannot close w/o subsidies

• History Repeating Itself?

- Commodities
 - Dutch tulips (1637)
 - Gold and oil rushes (1800s to early 1900s))
- Transportation
 - Canals in England (early 1800s)
 - Railroads in England (1840s)
- Finance
 - Roaring 20s and stock market crash of 1929
 - Technology in 2000
 - Real estate and finance before 2008



- Past speculative waves in space capabilities
 - Direct TV in 1980s
 - Business oriented R&D on Shuttle before Challenger accident in 1986
 - Launch vehicles in late 1980s and early 1990s
 - LEO Broadband in late 1990s
 - X-Prize and human suborbital space in 2004
- In the U.S. government, regulatory and incentive changes almost immediately enacted to stimulate private space, even if it didn't materialize
- All applications failed to deliver—or took far longer than predicted and longer than the 5-10 year business planning/investment horizon
- But, Each prior wave had a higher crest than prior ones—the long term trend is favorable
- The short-term reality may have many disappointments

Reality

- Government are the source of demand and Leading Investments
 - A terrestrial space economy, but not a “LEO economy”
- Most profitable are ground based applications, not space systems or activities on-orbit
 - Improvements on established markets & services
 - Telecommunications
 - Earth observations (mainly value-added products)
 - Location awareness information & PNT

Benefits

Reconciliation of Treaty Requirements and Economic Opportunities

- Benefits from new capabilities can be obtained in different ways
 - Aid exploration and science
 - More efficient and cheaper access to space and transport once in outer space
 - Aid the exploration of celestial bodies
 - By using in-situ resources and manufacturing
 - Lower prices and greater availability of scarce minerals
 - Obtaining and returning to Earth valuable resources found in space allowing many nations to benefit

Space is a Global Enterprise

- Meet obligations of UN Treaties and Resolutions that focus on aid to developing nations
- Provide opportunity for partnerships between companies and governments
 - Especially with focus on developing nations
 - Subject to some constraints such as export controls
- If done with treaty principles in mind,
 - benefits can accrue to all,
 - even allowing for profits
- Includes quality of life benefits for all

Partnerships and Benefits

Nations Benefits	Less Developed Nations	Smaller Industrial Nations w/ Space Capability	Large Nations w/ Advanced Space Capability
Direct economic and business benefits	Potential with partnerships	Some, likely related to investment/technology partnerships	Significant
Economic dependence on space infrastructure	Emerging	In selected sectors	Yes/benefits from efficiency and productivity
Vulnerability and Resilience	Through agreements with large nations	Some internally, otherwise depends on agreements with larger nations.	Yes, but dependent on cooperation among like nations

Summary

- Treaties apply to human activity for the exploration and use of space
- Economic methodologies are inadequate
- Economic data and analyses are useful but not accurate or reliable for decision-making
- By design, the law tends to change very slowly
- Technology and politics are the wild cards
 - Radical change can be relatively fast and may
 - Outrun either the law or economic frameworks
- Need to be realistic and prepared
 - “Stuff” will happen and neither law nor markets will maintain order