Space Economics in Law and Policy

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The George Washington University

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# Economic Topics and the Outer Space Treaty

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

<table>
<thead>
<tr>
<th>Government</th>
<th>Commercial</th>
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<td>Mission success</td>
<td>Operational system</td>
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</table>
| 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

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<tr>
<th>Economic Models</th>
<th>Actual Market</th>
<th>Space Economic Activity</th>
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<tbody>
<tr>
<td>Measuring returns to Research &amp; Development</td>
<td>Government demand and supply for space exploration</td>
<td>• 1960s: NASA R&amp;D: jobs created; multipliers, spin-offs</td>
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<tr>
<td>Returns to R&amp;D + Measuring effect of government incentives and outlays for private activities and purchases</td>
<td>Supply side more diversified but government space remains leading funder and indicator</td>
<td>• 1970s: NASA and ESA: added productivity and macro justifications to counter budget cuts</td>
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<td>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.</td>
<td>Speculative private activity based on potential markets</td>
<td>• 1970s: Telecommunications: private but regulated and controlled by government agencies</td>
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<td>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</td>
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<td>• 1980s: Beginning of government incentives--buying private services (Mainly in remote sensing and then launch vehicles)</td>
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<td>• 1990s: Telecom services and DTV; GPS potential</td>
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<td>• 2000s: “Tourism,” defense applications dependent on space</td>
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<td>• 2010s: Private companies with launch and developing operations capabilities on-orbit</td>
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### Important Economic Shift Since 2000

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<th>2000</th>
<th>2017</th>
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<td>• Most commercial and many government uses of space were in R&amp;D stage</td>
<td>• Industrialized economies have a growing dependent on space</td>
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<td>• Military and defense dependent on space</td>
<td>• Space is essential to the efficiency and operations of critical infrastructure (water, electricity, etc.)</td>
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<td>• Information</td>
<td>• Crowding of space and possibility of space sustainability being threatened</td>
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<td>• Position, navigation, timing</td>
<td>• Lack of resilience: no real measure of risk</td>
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<td>• Trend began in early 1990s</td>
<td>• Legal lacunae and uncertainty in dealing with these changes</td>
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<td>• Space was not particularly crowded; debris was a recognized issue by not a pressing one</td>
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<td>• International space law not challenged by private sector opportunities and plans</td>
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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

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