



The Role of Private Investment in Space Exploration

Invited Testimony to the
President's Commission on
the Moon, Mars, and Beyond

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Introduction

Private Equity

History Lessons

Legacies

Moon & Mars

Space Access

Stimulating
Investment

Private Investment in Space

- Manned spaceflight still a monopoly of governments.
- A handful of entrepreneurs are pursuing X-Prize on shoestring budgets.
- **Minimal interest from Wall Street.**

Where did we go wrong?



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Transcontinental Railroads

A “National Railroad Program” in the 1870s would have been doomed to failure.



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Automobile Industry

A “National
Automobile
Program” in the
1910s would have
been doomed to
failure.



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Airline Industry

A “National
Airplane
Program” in the
1930s would have
been doomed to
failure.



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Space Travel Industry

So... why did we
wind up with a
National Space
Program in the
1960s?



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Space Travel Industry

- Until the 1960s, it was assumed that space would follow the same pattern...
 - Government as customer, regulator, military presence.
 - Pan Am would run spacelines, Hilton would build hotels.



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Space Travel Industry

- 2001 came and went...
- ... and it didn't quite work out that way.
- Private industry never fully engaged.
 - In 2004, *still* no privately-operated human flights to space!
 - Compare 40 years after the Wright Brothers...



We wound up with a space *program*, not a space *industry*...

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Where Did We Go Wrong?

The four most dangerous words in
the English language:

“It’s different this time.”

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Private Investment in Space

"I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the earth. No single space project in this period will be more **impressive** to mankind, or more important for the **long-range** exploration of space; and none will be so **difficult** or **expensive** to accomplish."

—Pres. Kennedy, May 1961

Not a collection of
adjectives likely to
attract Wall Street!

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The Legacy of Apollo

“Flags and
footprints”
make a lousy
business plan.



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The Legacy of Shuttle

- If Shuttle had a business case, Rockwell would have built a fleet!
- Fundamentally flawed from conception.
 - Mix of passengers and large cargo.
 - Salvageable, not reusable!
- Now obsolete.



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The Legacy of ISS

- Extraordinarily expensive.
- Justified by post-Cold War international cooperation.
- Decades of mission uncertainty.
- Minimal to zero interest from industry.



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Now... What About Mars?

- Extraordinarily expensive.
- Will we be driven by national prestige?
- Or the dream of transforming the American economy?
- **This commission will decide!**



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Now... What About Mars?

“Flags and
footprints” *still*
make a lousy
business plan.



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The Moon, Mars, and Beyond

- How can we minimize the impact on the American taxpayer?
- How can we create a **profitable** and **sustainable** space industry, not a series of spectacular stunts?



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The Cost of Space Access

- Today, putting anything in orbit costs nearly twice its weight in gold!
- \$10,000/pound must come down by 10x to 100x.
- **Single greatest barrier to space exploration.**



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What Does 100x Mean?

- Imagine trying to run a business with...
 - \$37.00 stamps.
 - \$1500 FedEx envelopes.
 - \$200/gallon gas.
- It's no wonder Wall Street isn't interested in space travel!



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Impact of Space Access Costs

- It's hard to build a factory using \$10,000 wrenches.
- Even harder when getting someone to the work site costs \$3 million!



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Impact of Space Access Costs

High launch costs
will doom us to
repeating "flags and
footprints"
missions on the
Moon and Mars!



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Reducing Space Access Costs

- 10× to 100× launch cost reductions are straightforward with current technology.
- Multiple approaches are promising.
 - Sustainable operations, *not* a series of missions.
- **Barriers are economic and political, *not* technical.**



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Investing in Space Access

- Equity investors are comfortable taking **technology** risk.
- We are very uncomfortable taking **market** or **regulatory** risk.



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Investing in Space Access

Reducing market and regulatory risks for private space access will lead to **vastly improved Moon/Mars exploration** mission profiles!



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Become a Valued Customer!

- Issue contracts that *guarantee*:
 - Launch frequency.
 - Payload sizes.
 - Price to orbit.
- Minimize regulatory burden.
- Don't insist on design control.



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Become a Valued Customer!

- Entrepreneurs can and *will* use these contracts to raise money from Wall Street!
- Private industry will finally develop **routine** space operations.



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Halfway to Anywhere

Profitable
industries are
sustainable;
government
programs are not.



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Halfway to Anywhere

With a private launch industry in place, missions to the Moon and Mars will become 10x to 100x cheaper.



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Halfway to Anywhere

“Reach low orbit,
and you’re
halfway to
anywhere in the
Solar System.”
—*Robert Heinlein*





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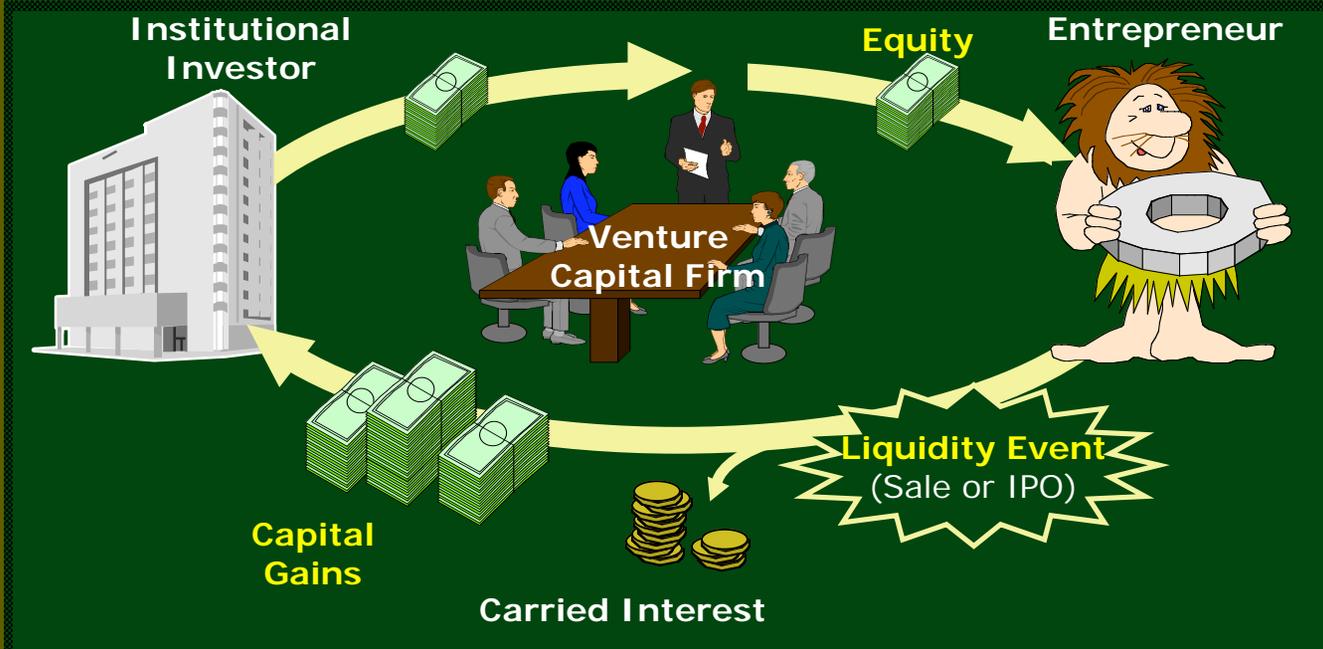
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Backup Material

Additional material that did not fit within time constraints.

(This is probably as good a place as any to mention... the large gold margins on these slides were mandated by the television broadcast requirements of NASA Select...)

The Venture Equity Cycle



Levels of Financing Available

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\$ Amount Mechanism

10,000	Visa card
30,000	Second mortgage
100,000	Angel investor
300,000	Angels and seed funds
1,000,000	Seed-stage venture capital
3,000,000	Early-stage venture capital
10,000,000	Later-stage venture capital
30,000,000	Mezzanine VC or IPO market
100,000,000	Corporate bonds
1,000,000,000	Bonds / Governments



Equity capital readily available for projects under \$100 million.

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Transcontinental Railroads

- Government did not build the railroads.
- Government (U.S. Army) contracted to be the largest customer.
- Also regulated, subsidized, guaranteed property rights.



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Automobile Industry

- Government did not build the auto factories.
- Focused on infrastructure (*highways*) and regulating the new industry.
- Government became a large and stable customer.



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Airline Industry

- Government did not build the airplanes.
 - NACA did research, not development or operations.
- Focused on infrastructure, regulation, safety.



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Airline Industry

- Government contracted to be the largest customer.
- Military contracts to expand performance envelope.
- Civilian contracts (*air mail*) to expand domestic reach.



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The Legacy of Apollo

Thirty years later, what remains of the moon missions?

- Zero presence.
- Zero industry.
- Zero infrastructure.
- Zero economic value.

Not a model which will get traction on Wall Street!



We went too early, and
we never went back.

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From Apollo to the Shuttle

"I have decided today that the United States should proceed at once with the development of an entirely new type of space transportation system [that] will reduce astronomical costs out of the sky and go a long way toward developing the benefits of practical space exploration and the valuable spinoffs from space to the daily lives of Americans."

—Pres. Nixon, January 1972



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From Apollo to the Shuttle

"I have decided today that the United States should proceed at once with the development of an entirely new type of space transportation system [that] will take the **astronomical costs out of astronautics.** It will go a long way toward delivering the rich benefits of practical space utilization and the valuable spinoffs from space efforts into the **daily lives of Americans and all people.**"

—Pres. Nixon, January 1972

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The Legacy of Shuttle

- Extraordinary expense.
- Justified by Cold War rivalry and payloads.
- “A camel is a horse designed by committee.”
- Never came close to meeting economic goals.



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From Shuttle to the Station

"Tonight, I am directing NASA to develop a permanently manned space station and to do it within a decade... Transportation could surge. Companies interested in space must have ready access to services... We'll soon announce executive initiatives to reduce regulatory constraints and to promote private sector investment."
—Pres. Reagan, Jan 1984



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From Shuttle to the Station

“Tonight, I am directing NASA to develop a permanently manned space station and to do it within a decade... The **market** for space transportation could surpass our capacity to develop it. **Companies** interested in putting payloads into space must have ready access to **private sector** launch services... We’ll soon implement a number of executive initiatives, develop proposals to **ease regulatory** constraints, and, with NASA’s help, promote private sector **investment** in space.”

—Pres. Reagan, January 1984

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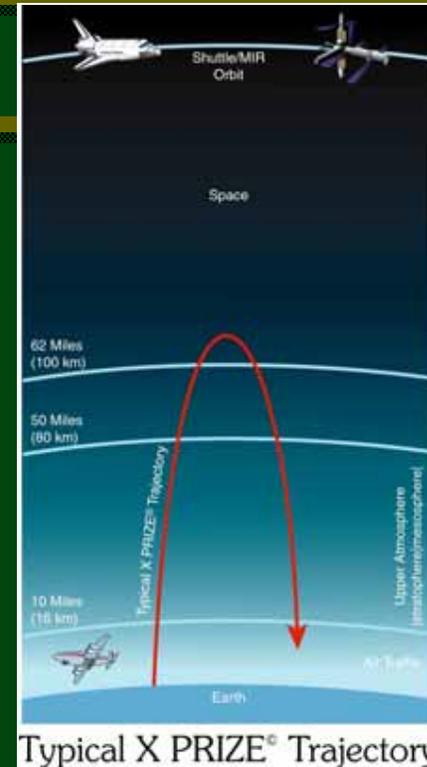
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The X-Prize

- Over 20 private teams competing for \$10 million prize.
- No government funding.
- Probably will be won this year.
- Leveraging over \$100M in R&D for a \$10M commitment.



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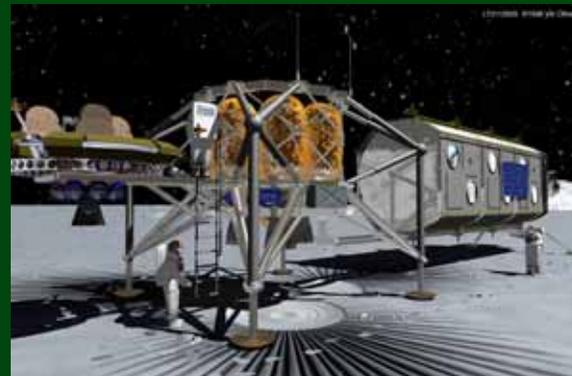
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The Moon Prize

"Be it resolved, the U.S. Treasury shall pay \$5 billion to the first U.S. entity to place and sustain six American citizens on the Moon for one year, then return them safely home."

Does anyone think American industry would fail to accomplish this?



A different approach to building a moonbase...