New Data and New Metrics for Evaluating Impact

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Innovation Sector in Perspective

R&D Personnel (2021) = 2.4 Million

Full-Time Workers (2021) = 130 Million

Most experience innovation policy impacts **indirectly**

How can we measure broad based economic effects?

Economic Impacts of Innovation Policy

(1) Indirect Method

→Evaluate innovation policy impacts on **innovation** outcomes

→Indirectly obtain Economic Impact by adding up innovation economic impact

(2) Direct Method

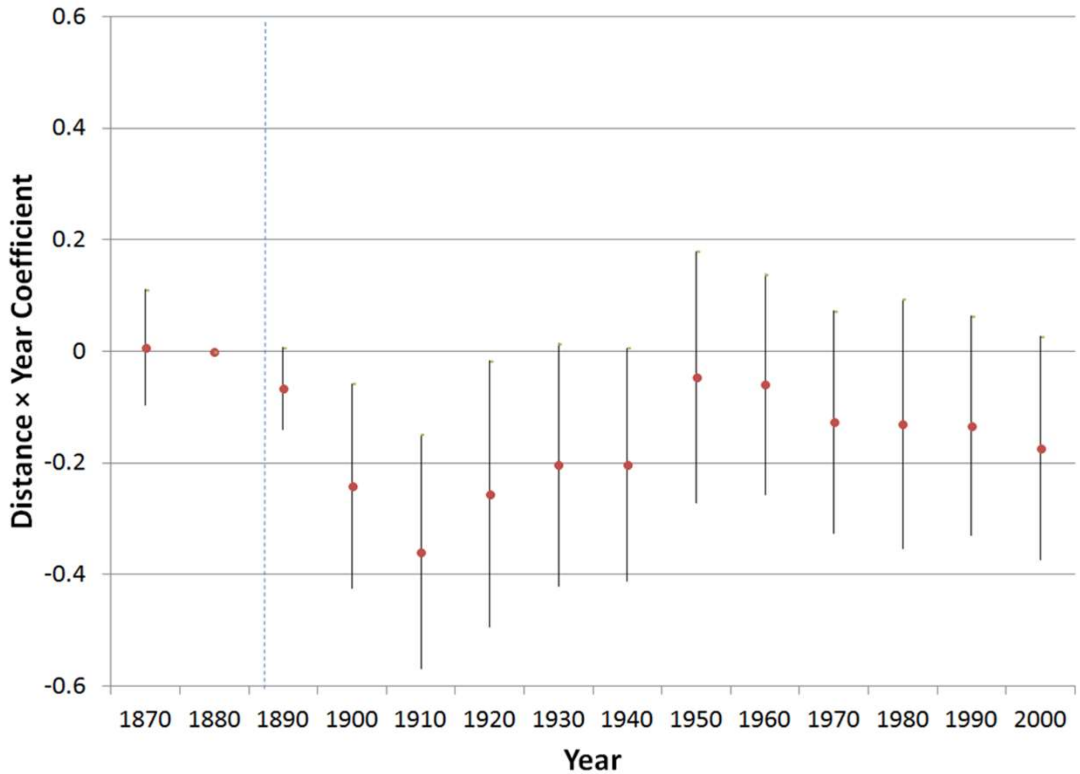
→Evaluate innovation policy impacts on **economic** outcomes

→Directly estimate the overall Economic Impact of the policy

University Agricultural Research

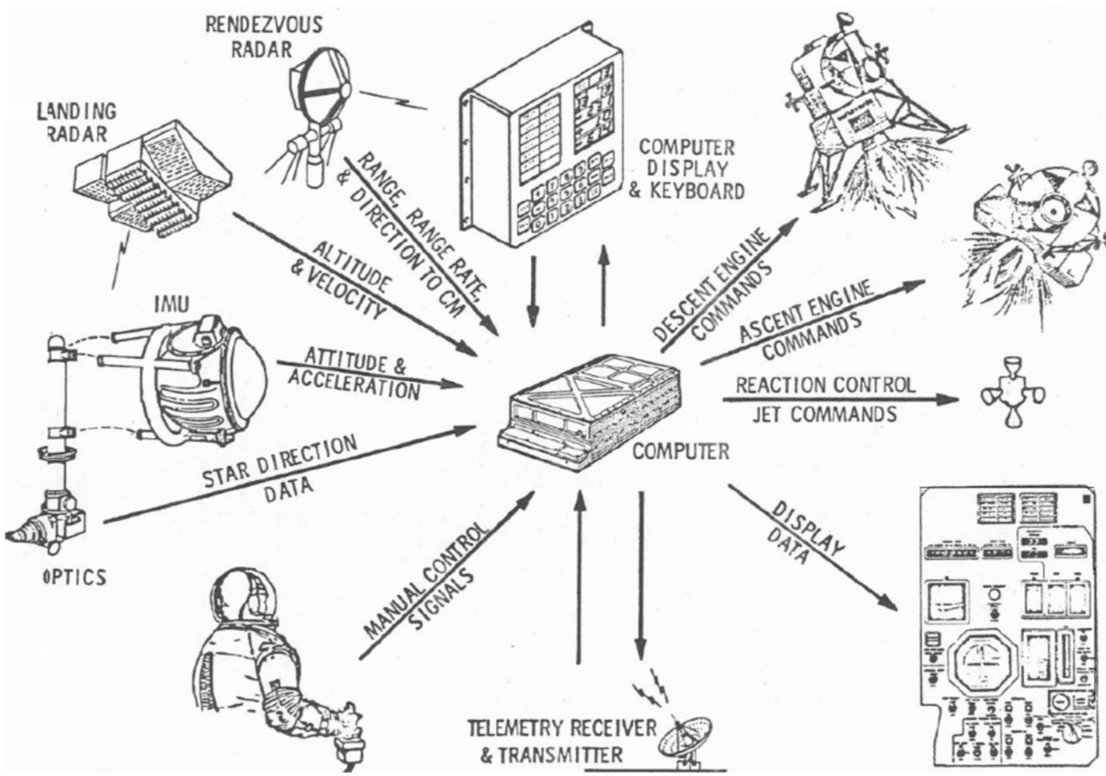
Kansas Corn Trials 1915

University Agricultural Research



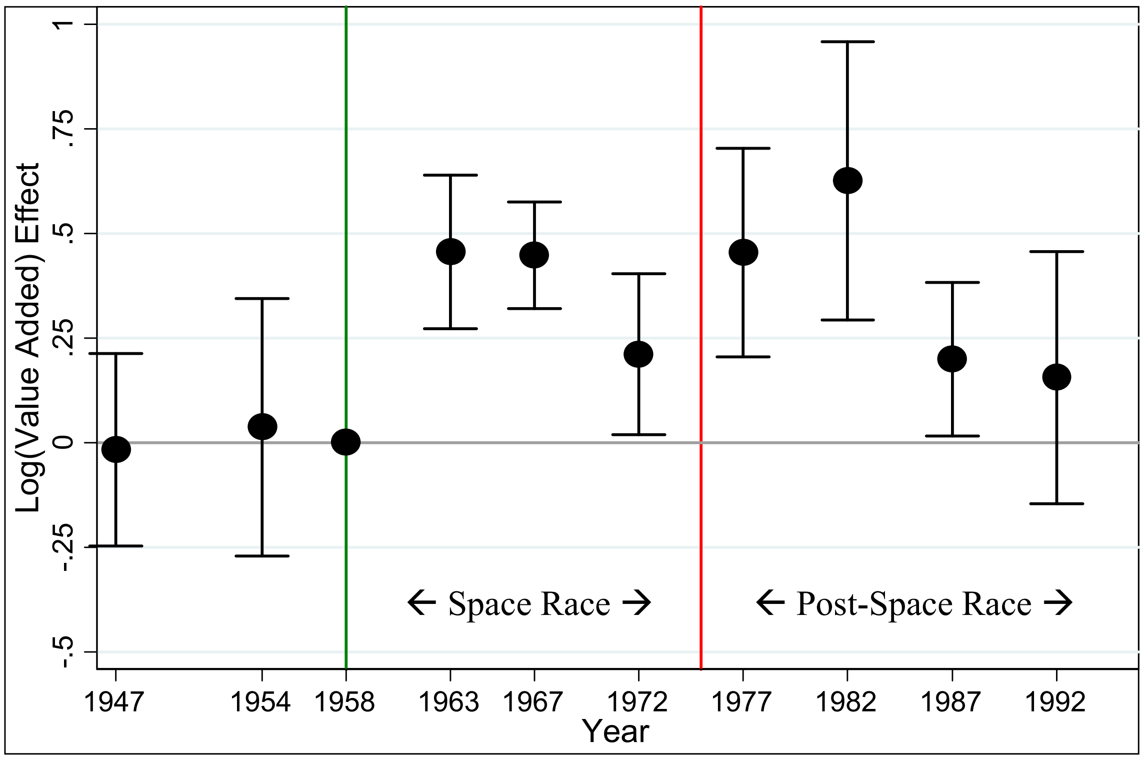
Kantor and Whalley (2019) “Research Proximity and Productivity: Long-Term Evidence from Agriculture”

Space Race



Apollo Guidance Computer 1969

Space Race



Kantor and Whalley (2023) "Moonshot: Public R&D and Growth"

Direct Method

<u>Advantages</u>:

(1) Clear conclusions on economic magnitude of innovation policy
  → Comparisons to returns of other government expenditures possible

(2) Includes responses by firms and workers to innovation policy
  → Can see context specific results and policy complementarity

(3) New data and methods make it easier to implement

<u>Disadvantages</u>:

(1) Significant data requirements and lags in estimates
(2) Clear linkage between innovation policy and economic outcomes needed
(3) Hard to capture all economic effects of an innovation policy

Text and Technology in the Supply Chain

Patent

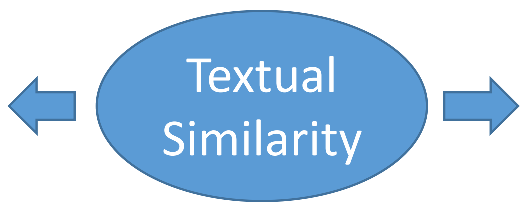
3,232,560
RECOVERABLE SPACE VEHICLE
John C. Moise, Carmichael, and John Eut Tileston, Sacramento, Calif., assignors to Aerojet-General Corporation, Azusa, Calif., a corporation of Ohio
Filed Feb. 25, 1963, Ser. No. 260,355
3 Claims. (Cl. 244—1)

This invention relates in general to space vehicles and more particularly to a space tanker or freighter which may be recovered and reused.

It is expected that within the next decade space stations will be in use either for military or for scientific purposes or for both. Such space stations will be set up for purposes of refueling space craft, effecting transfer of personnel from one mission to another and for other such uses. It is seen, then, that a vehicle capable of placing these stations in orbit and keeping them supplied, at a minimum total operating cost per pound of payload in orbit, is needed. It is to this latter requirement that the present invention is primarily directed.

Various means have been proposed for conveying large payloads to low orbit space stations, some including water recoverable vehicles and others winged vehicles such as an aerospace plane. However, in expected cost per pound of payload the present invention is greatly superior to any of the above.

The device of the present invention is fundamentally an aerodynamically configured grouping of liquid fuel and liquid oxidizer storage tanks plus propulsion means sufficient to permit vertical take-off, rendezvous and docking at a space station, payload transfer, retro-thrust and re-entry at a shallow angle followed by a controlled glide landing.



CIA Document

43. There are several likely near term applications of the automatic rendezvous and docking system. When Soyuz 4 and 5 docked, the Soviets claimed that they had fulfilled the rendezvous techniques that would be used to assemble space stations in earth orbit; they would also be used for resupply of such stations and crew rotation. Moreover, the Soviets have indicated that rendezvous and docking would be used to assemble lunar and planetary spaceships in earth orbit.

44. The need for a cooperating target limits the use of the automatic rendezvous and docking technique in many applications such as rescue and in-orbit repair and maintenance. However, the Soyuz automatic rendezvous and docking system equipped with suitable sensors could be used by a maneuverable satellite for passive targets.

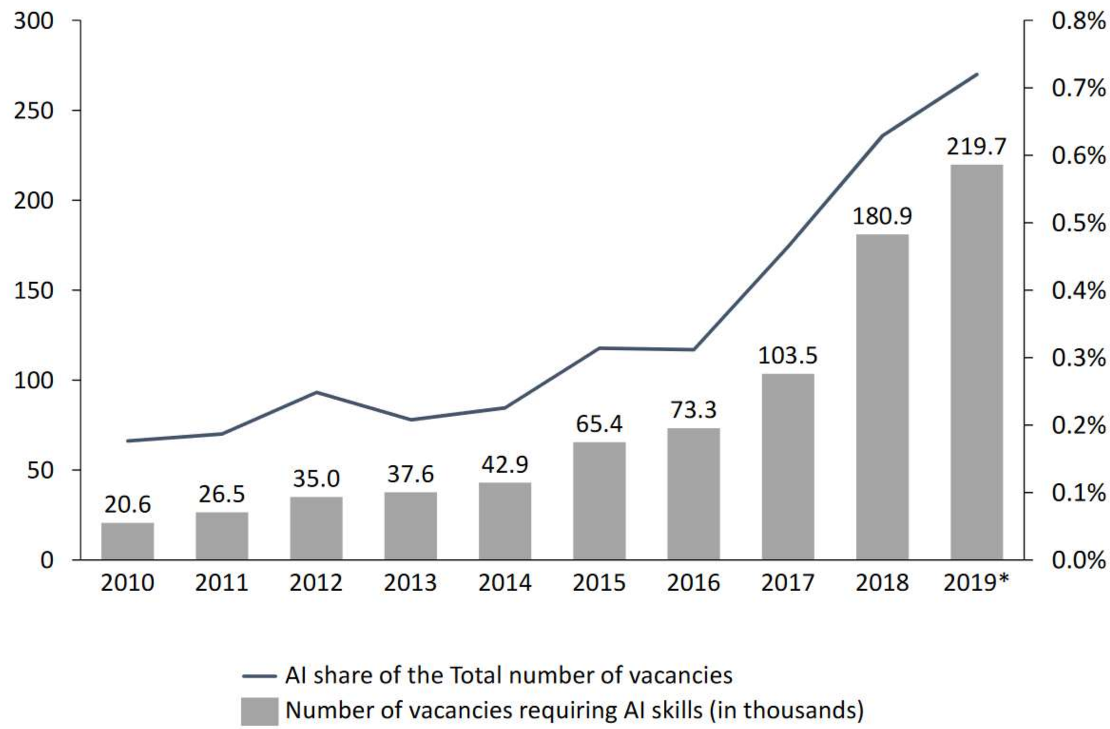
45. In the Soyuz and Zond programs the Soviets employed aerodynamic lift re-entry techniques similar to those used in the Gemini and Apollo missions. The Soyuz vehicle is designed to follow a preprogrammed deceleration profile, which is calculated to reduce re-entry "g" loadings during re-entry and to provide some control over the point of landing. The Zond re-entry is more complicated. The spacecraft normally re-enters over the Indian Ocean, and its lifting capability is used to move the landing point some five thousand miles north into the Soviet Union. The lifting re-entry techniques indicate a desire to recover manned lunar spacecraft in the Soviet Union rather than to rely regularly on a water recovery system. The ocean recovery capability is probably provided mainly as a backup.

46. The prime electric power source for the Soyuz and the Zond is solar energy. Solar power, however, is inadequate for some interplanetary missions and orbital missions having high continuous power requirements in excess of 50 kilowatts; nuclear powered systems will be required for such flights. The Soviets are actively engaged in R&D on various nuclear electric power systems. By the mid-1970's they could have a nuclear auxiliary power system generating a few kilowatts.

47. The Soviets have made significant strides in improving the reliability of their planetary spacecraft. They are using an improved thermal control system and also are equipping spacecraft with redundant component subsystems for backup in the event of failure. In their discussions of the Venus 4, the Soviets for the first time mentioned the use of a space simulator to check out the completed spacecraft before launch. These modifications should improve spacecraft and insure better success in the future.

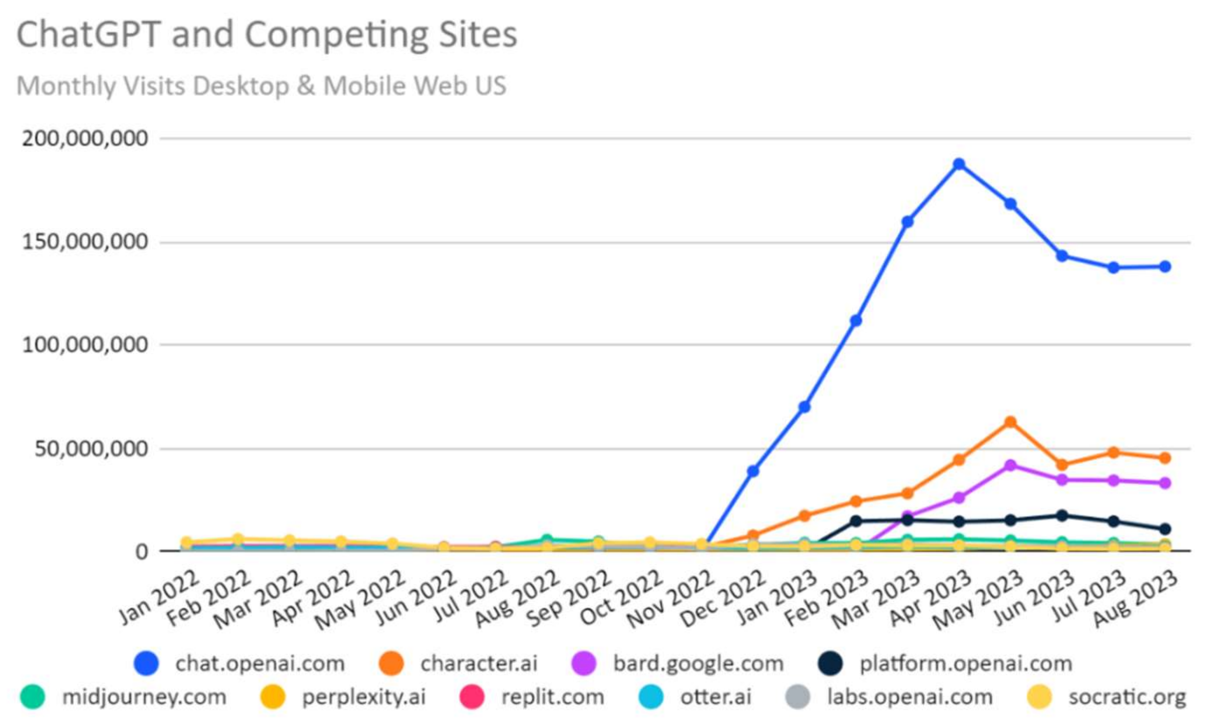
Kantor and Whalley (2023) "Moonshot: Public R&D and Growth"

Text and AI Job Creation using Job Ads



Alekseeva, Azar, Giné, Samila, and Taska (2021) “The Demand for AI Skills in the Labor Market”

Website Traffic to measure Firm Value growth



Source: https://dig.watch/updates/openais-chatgpt-sees-third-consecutive-monthly-traffic-drop

Innovation Policies, People, and Human Capital

Jennifer Doudna
2020 Nobel Prize for Chemistry

Translated her discoveries to multiple ventures

Involved with:

Genentech

Editas Medicine

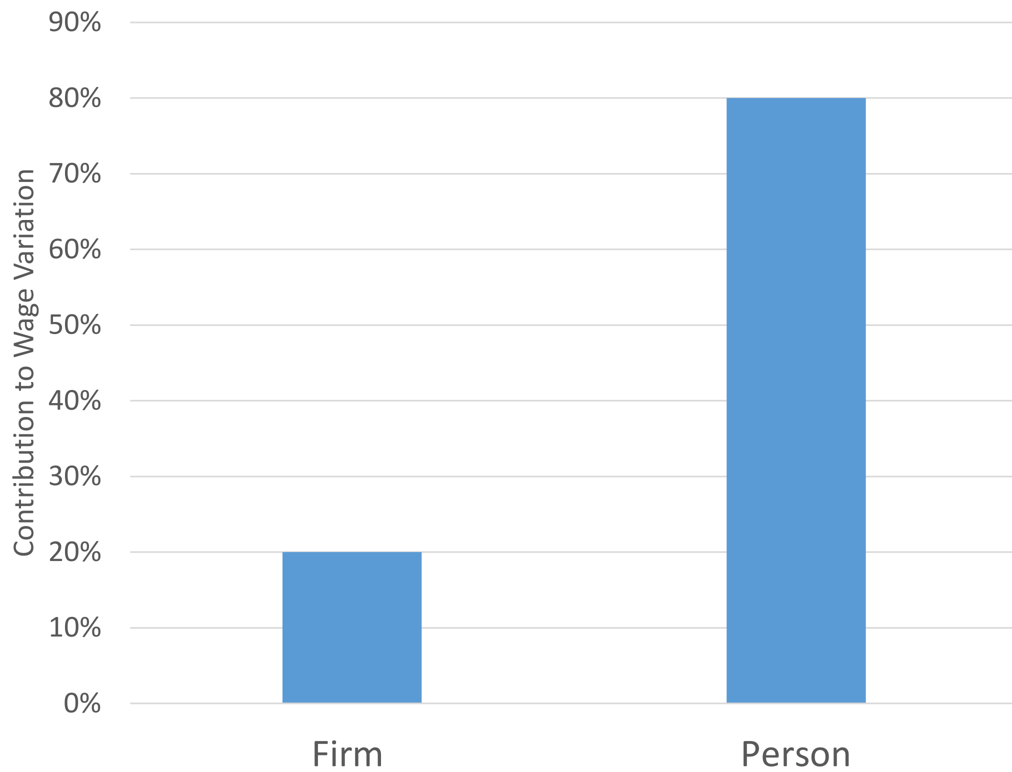
Intellia Therapeutics

Scribe Therapeutics

Mammoth Biosciences

Her **human capital** plays a role the success of each of these ventures

Worker and Firm Characteristics in Wage Determination



Abowd, Kramarz and Margolis (1999) “High Wage Workers and High Wage Firms”

Summing Up

(1) Direct approach can capture broad based economic impacts of innovation policy

(2) New data and methods → new opportunities to apply the direct approach more easily

(3) Understanding where innovation policy impacts occur can improve evaluation

→ i.e. Are primary impacts on firm revenue or worker human capital?