

Supplemental Materials for Adam B. Jaffe, Michael S. Fogarty, and Bruce A. Banks, “Evidence from Patents and Patent Citations on the Impact of NASA and Other Federal Labs on Commercial Innovation,” *The Journal of Industrial Economics* 46 (2), June 1998, pp. 183-205

This supplement consists of two items.

1. A mapping from three-digit U.S. Patent and Trademark Office patent classes to the five broad fields (Drugs and Medical Technology; Chemicals and Chemical Processes Excluding Drugs; Electronic, Optical, and Nuclear Technologies; Mechanical Technologies; and All Other) reported in our article.
2. Regression results supporting statements on p. 192 of the printed *Journal* article concerning the time trend of importance and generality of Other Federal and of NASA patents.

Mappings from Three-Digit Patent Classes to Fields

Field 1: Drugs and Medical Technology

| | |
|--|--|
| 128 Surgery | 600 Surgery |
| 422 Chemical Apparatus and Process Disinfecting, Deodorizing, Preserving, or Sterilizing | 602 Surgery: Splint, Brace, or Bandage |
| 424 Drug, Bio-Affecting and Body Treating Compositions | 604 Surgery |
| 433 Dentistry | 606 Surgery |
| 435 Chemistry: Molecular Biology and Microbiology | 623 Prosthesis (i.e., Artificial Body Members), Parts Thereof, or Aids and Accessories |
| 514 Drug, Bio-Affecting and Body Treating Compositions | 800 Multicellular Living Organisms and Unmodified Parts Thereof |

Field 2: Chemicals and Chemical Processes Excluding Drugs

| | |
|--|---|
| 008 Bleaching and Dyeing; Fluid Treatment and Chemical Modification of Textiles and Fibers | 203 Distillation: Processes, Separatory |
| 019 Textiles: Fiber Preparation | 204 Chemistry: Electrical and Wave Energy |
| 023 Chemistry: Physical Process | 210 Liquid Purification or Separation |
| 026 Textiles: Cloth Finishing | 222 Dispensing |
| 028 Textiles: Manufacturing | 223 Apparel Apparatus |
| 034 Drying and Gas or Vapor Contact with Solids | 239 Fluid Sprinkling, Spraying, and Diffusing |
| 038 Textiles: Ironing or Smoothing | 251 Valves and Valve Actuation |
| 044 Fuel and Related Compositions | 252 Compositions |
| 048 Gas: Heating and Illuminating | 260 Chemistry of Carbon Compounds |
| 055 Gas Separation | 261 Gas and Liquid Contact Apparatus |
| 057 Textiles: Spinning, Twisting, and Twining | 320 Electricity: Battery and Condenser Charging and Discharging |
| 065 Glass Manufacturing | 366 Agitating |
| 066 Textiles: Knitting | 401 Coating Implements with Material Supply |
| 068 Textiles: Fluid Treating Apparatus | 416 Fluid Reaction Surfaces (i.e., Impellers) |
| 069 Leather Manufacturers | 417 Pumps |
| 071 Chemistry: Fertilizers | 423 Chemistry of Inorganic Compounds |
| 087 Textiles: Braiding, Netting, and Lace Making | 427 Coating Processes |
| 106 Compositions: Coating or Plastic | 429 Chemistry: Electrical Current Producing Apparatus, Product, and Process |
| 110 Furnaces | 430 Radiation Imagery Chemistry: Process, Composition, or Product Thereof |
| 118 Coating Apparatus | 431 Combustion |
| 120 | 436 Chemistry: Analytical and Immunological Testing |
| 126 Stoves and Furnaces | 494 Imperforate Bowl: Centrifugal Separators |
| 136 Batteries: Thermoelectric and Photoelectric | 501 Compositions: Ceramic |
| 137 Fluid Handling | 502 Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making |
| 139 Textiles: Weaving | 512 Perfume Compositions |
| 141 Fluent Material Handling, with Receiver or Receiver Coacting Means | 518 Chemistry: Fischer-Torpsch Processes; or Purification or Recovery of Products Thereof |
| 156 Adhesive Bonding and Miscellaneous Chemical Manufacture | 521 Synthetic Resins or Natural Rubbers -- Part of the Class 520 Series |
| 159 Concentrating Evaporators | 522 Synthetic Resins or Natural Rubbers -- Part of the Class 520 Series |
| 162 Paper Making and Fiber Liberation | |
| 169 Fire Extinguishers | |
| 201 Distillation: Processes, Thermolytic | |
| 202 Distillation: Apparatus | |

Field 2 (continued)

523 Synthetic Resins or Natural Rubbers -- Part of the Class 520 Series
524 Synthetic Resins or Natural Rubbers -- Part of the Class 520 Series
525 Synthetic Resins or Natural Rubbers -- Part of the Class 520 Series
526 Synthetic Resins or Natural Rubbers -- Part of the Class 520 Series
527 Synthetic Resins or Natural Rubbers -- Part of the Class 520 Series
528 Synthetic Resins or Natural Rubbers -- Part of the Class 520 Series
530 Chemistry: Natural Resins or Derivatives; Peptides or Proteins; Lignins or Reacti
534 Organic Compounds -- Part of the Class 532-570 Series
536 Organic Compounds -- Part of the Class 532-570 Series
540 Organic Compounds -- Part of the Class 532-570 Series
544 Organic Compounds -- Part of the Class 532-570 Series

546 Organic Compounds -- Part of the Class 532-570 Series
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568 Organic Compounds -- Part of the Class 532-570 Series
570 Organic Compounds -- Part of the Class 532-570 Series

Field 3: Electronic, Optical, and Nuclear Technologies

033 Geometrical Instruments
073 Measuring and Testing
116 Signals and Indicators
174 Electricity: Conductors and Insulators
177 Weighing Scales
178 Telegraphy
191 Electricity: Transmission to Vehicles
200 Electricity: Circuit Makers and Breakers
205 Electrolysis: Processes, Compositions Used Therin, and Methods of Preparing the Co
246 Railway Switches and Signals
250 Radiant Energy
307 Electrical Transmission or Interconnection Systems
313 Electric Lamp and Discharge Devices
315 Electric Lamp and Discharge Devices: Systems
323 Electricity: Power Supply or Regulation Systems
324 Electricity: Measuring and Testing
328
329 Demodulators
330 Amplifiers
331 Oscillators
332 Modulators
333 Wave Transmission Lines and Networks
336 Inductor Devices

337 Electricity: Electrothermally or Thermally Actuated Switches
338 Electrical Resistors
340 Communications: Electrical
342 Communications: Directive Radio Wave Systems and Devices (e.g., Radar, Radio Navigation)
343 Communications: Radio Wave Antennas
350
351 Optics: Eye Examining, Vision Testing and Correcting
352 Optics: Motion Pictures
353 Optics: Image Projectors
354 Photography
355 Photocopying
356 Optics: Measuring and Testing
357
358 Facsimile or Television Recording
359 Optics: Systems (including Comm) and Elements
361 Electricity: Electrical Systems and Devices
362 Illumination
363 Electric Power Conversion Systems
367 Communications, Electrical: Acoustic Wave Systems and Devices
368 Horology: Time Measuring Systems or Devices
370 Multiplex Communications

Field 3 (continued)

371 Error Detection/Correction and Fault
Detection/Recovery
372 Coherent Light Generators
374 Thermal Measuring and Testing
375 Pulse or Digital Communications
376 Induced Nuclear Reactions: Processes, Systems,
and Elements
377 Electrical Pulse Counters, Pulse Dividers, or Shift
Registers: Circuits and System
378 X-ray or Gamma Ray Systems or Devices
379 Telephonic Communications
380 Cryptography

381 Electrical Audio Signal Processing Systems and
Devices
382 Image Analysis
385 Optical Waveguides
392 Electric Resistance Heating Devices
395 Information Processing System Organization
437 Semiconductor Device Manufacturing: Process
439 Electrical Connectors
445 Electric Lamp or Space Discharge Component or
Device Manufacturing
455 Telecommunications
505 Superconductor Technology: Apparatus, Material,
Process

Field 4: Mechanical Technologies

007 Compound Tools
010
015 Brushing, Scrubbing, and General Cleaning
016 Miscellaneous Hardware
029 Metal Working
049 Movable or Removable Closures
050
051 Abrasive Tool Making Process, Material, or
Composition
053 Package Making
056 Harvesters
059 Chain, Staple, and Horseshoe Making
060 Power Plants
062 Refrigeration
072 Metal Deforming
074 Machine Element or Mechanism
075 Specialized Metallurgical Processes,
Compositions for Use Therein, Consolidated Met
076 Metal Tools and Implements, Making
081 Tools
082 Turning
083 Cutting
091 Motors: Expansible Chamber Type
092 Expansible Chamber Devices
098
100 Presses
104 Railways
105 Railway Rolling Stock
122 Liquid Heaters and Vaporizers
123 Internal-Combustion Engines
125 Stone Working
134 Cleaning and Liquid Contact with Solids
138 Pipes and Tubular Conduits
140 Wireworking
142 Wood Turning

144 Woodworking
148 Metal Treatment
150 Purses, Wallets, and Protective Covers
152 Resilient Tires and Wheels
157 Wheelwright Machines
160 Flexible or Portable Closure, Partition, or Panel
164 Metal Founding
165 Heat Exchange
168 Farriery
173 Tool Driving or Impacting
180 Motor Vehicles
184 Lubrication
185 Motors: Spring, Weight, or Animal Powered
187 Elevator, Industrial Lift Truck, or Stationary Lift
for Vehicle
188 Brakes
190 Trunks and Hand-Carried Luggage
192 Clutches and Power-Stop Control
193 Conveyors, Chutes, Skids, Guides, and Ways
194 Check-Actuated Control Mechanisms
196 Mineral Oils: Apparatus
198 Conveyors: Power-Driven
206 Special Receptacle or Package
208 Mineral Oils: Processes and Products
209 Classifying, Separating, and Assorting Solids
212 Traversing Hoists
213 Railway Draft Appliances
215 Bottles and Jars
217 Wooden Receptacles
219 Electric Heating
220 Receptacles
221 Article Dispensing
224 Package and Article Carriers
225 Severing by Tearing or Breaking
226 Advancing Material of Indeterminate Length

Field 4 (continued)

- 227 Elongated-Member-Driving Apparatus
- 228 Metal Fusion Bonding
- 229 Envelopes, Wrappers, and Paperboard Boxes
- 232 Deposit and Collection Receptacles
- 234 Selective Cutting (e.g., Punching)
- 235 Registers
- 236 Automatic Temperature and Humidity Regulation
- 237 Heating Systems
- 238 Railways: Surface Track
- 241 Solid Material Comminution or Disintegration
- 242 Winding, Tensioning, or Guiding
- 244 Aeronautics
- 245 Wire Fabrics and Structure
- 249 Static Molds
- 254 Implements or Apparatus for Applying Pushing or Pulling Force
- 264 Plastic and Nonmetallic Article Shaping or Treating: Processes
- 266 Metallurgical Apparatus
- 267 Spring Devices
- 270 Sheet-Material Associating
- 271 Sheet-Feeding or Delivering
- 277 Joint Packing
- 279 Chucks or Sockets
- 280 Land Vehicles
- 281 Books, Strips, and Leaves
- 282
- 285 Pipe Joints or Couplings
- 289 Knots and Knot Tying
- 290 Prime-Mover Dynamo Plants
- 292 Closure Fasteners
- 293 Vehicle Fenders
- 294 Handling: Hand and Hoist-Line Implements
- 295 Railway Wheels and Axles
- 296 Land Vehicles: Bodies and Tops
- 298 Land Vehicles: Dumping
- 301 Land Vehicles: Wheels and Axles
- 303 Fluid-Pressure and Analogous Brake Systems
- 305 Wheel Substitutes for Land Vehicles
- 310 Electrical Generator or Motor Structure
- 318 Electricity: Motive Power Systems
- 322 Electricity: Single Generator Systems
- 335 Electricity: Magnetically Operated Switches, Magnets, and Electromagnets
- 341 Coded Data Generation or Conversion
- 346 Recorders
- 360 Dynamic Magnetic Information Storage or Retrieval
- 364 Electrical Computers and Data Processing Systems
- 365 Static Information Storage and Retrieval
- 369 Dynamic Information Storage or Retrieval
- 373 Industrial Electric Heating Furnaces
- 383 Flexible Bags
- 384 Bearings
- 388 Electricity: Motor Control Systems
- 402 Binder Device Releasably Engaging Aperture or Notch of Sheet
- 403 Joints and Connections
- 406 Conveyors: Fluid Current
- 407 Cutters, for Shaping
- 408 Cutting by use of Rotating Axially Moving Tool
- 409 Gear Cutting, Milling, or Planing
- 410 Freight Accommodation on Freight Carrier
- 411 Expanded, Threaded, Driven, Headed, Tool-Deformed, or Lock-Threaded Fastener
- 413 Sheet Metal Container Making
- 414 Material or Article Handling
- 415 Rotary Kinetic Fluid Motors or Pumps
- 418 Rotary Expansible Chamber Devices
- 419 Powder Metallurgy Processes
- 420 Alloys or Metallic Compositions
- 425 Plastic Article or Earthenware Shaping or Treating: Apparatus
- 428 Stock Material or Miscellaneous Articles
- 432 Heating
- 453 Coin Handling
- 464 Rotary Shafts, Gudgeons, Housings, and Flexible Couplings for Rotary Shafts
- 474 Endless Belt Power Transmission Systems or Components
- 475 Planetary Gear Transmission Systems or Components
- 477 Interrelated Power Delivery Controls Including Engine Control
- 493 Manufacturing Container or Tube from Paper; or Other Manufacturing From a Sheet or
- 585 Chemistry of Hydrocarbon Compounds

Field 5: All Other Technologies

- 002 Apparel
- 004 Baths, Closets, Sinks, and Spittoons
- 005 Beds
- 012 Boot and Shoe Making
- 014 Bridges
- 017

Field 5 (continued)

- 024 Buckles, Buttons, Clasps, Etc.
- 027 Undertaking
- 030 Cutlery
- 036 Boot, Shoes, and Leggings
- 037 Excavating
- 040 Card, Picture, or Sign Exhibiting
- 042 Firearms
- 043 Fishing, Trapping, and Vermin Destroying
- 047 Plant Husbandry
- 052 Static Structures (e.g., Buildings)
- 054 Harness
- 063 Jewelry
- 070 Locks
- 084 Music
- 086 Ammunition and Explosive-Charge Making
- 089 Ordnance
- 099 Foods and Beverages: Apparatus
- 101 Printing
- 102 Ammunition and Explosives
- 108 Horizontally Supported Planar Surfaces
- 109 Safes, Bank Protection, or a Related Device
- 111 Planting
- 112 Sewing
- 114 Ships
- 119 Animal Husbandry
- 124 Mechanical Guns and Projectors
- 127 Sugar, Starch, and Carbohydrates
- 131 Tobacco
- 132 Toilet
- 135 Tent, Canopy, Umbrella, or Cane
- 149 Explosive and Thermic Compositions or Charges
- 163 Needle and Pin Making
- 166 Wells
- 171 Unearthing Plants or Buried Objects
- 172 Earth Working
- 175 Boring or Penetrating the Earth
- 181 Acoustics
- 182 Fire Escape, Ladder, or Scaffold
- 186 Merchandising
- 211 Supports: Racks
- 223 Apparel Apparatus
- 231 Whips and Whip Apparatus
- 248 Supports
- 256 Fences
- 269 Work Holders
- 272
- 273 Amusement Devices: Games
- 283 Printed Matter
- 297 Chairs and Seats
- 299 Mining or In Situ Disintegration of Hard Material
- 300 Brush, Broom, and Mop Making
- 312 Supports: Cabinet Structure
- 400 Typewriting Machines
- 404 Road Structure, Process, or Apparatus
- 405 Hydraulic and Earth Engineering
- 412 Bookbinding: Process and Apparatus
- 426 Food or Edible Material: Processes, Compositions, and Products
- 434 Education and Demonstration
- 440 Marine Propulsion
- 441 Buoys, Rafts, and Aquatic Devices
- 446 Amusement Devices: Toys
- 449 Bee Culture
- 450 Foundation Garments
- 452 Butchering
- 460 Crop Threshing or Separating
- 503 Record Receiver Having Plural Leaves or a Colorless Color Former, Method of Use, or

Regression Results for Importance Over Time

| Year | <i>Other Federal</i> | | <i>NASA</i> | |
|------|----------------------|----------------|-------------|----------------|
| | Coefficient | Standard Error | Coefficient | Standard Error |
| 1963 | -0.41 | 0.255 | n/a | n/a |
| 1964 | -0.53 | 0.246 | n/a | n/a |
| 1965 | -0.59 | 0.216 | n/a | n/a |
| 1966 | -0.70 | 0.208 | n/a | n/a |
| 1967 | -0.79 | 0.211 | n/a | n/a |
| 1968 | -1.08 | 0.224 | n/a | n/a |
| 1969 | -0.79 | 0.219 | -0.64 | 0.316 |
| 1970 | -0.93 | 0.221 | -0.12 | 0.305 |
| 1971 | -0.61 | 0.204 | -0.31 | 0.286 |
| 1972 | -0.49 | 0.212 | -0.13 | 0.330 |
| 1973 | -0.48 | 0.208 | 0.79 | 0.329 |
| 1974 | -1.27 | 0.211 | -1.04 | 0.346 |
| 1975 | -1.39 | 0.216 | 1.04 | 0.376 |
| 1976 | -0.96 | 0.221 | 0.03 | 0.463 |
| 1977 | -1.29 | 0.232 | 1.39 | 0.453 |
| 1978 | -0.87 | 0.244 | 1.64 | 0.456 |
| 1979 | -1.03 | 0.279 | 0.18 | 0.550 |
| 1980 | -1.18 | 0.243 | -0.65 | 0.537 |
| 1981 | -1.62 | 0.248 | -0.16 | 0.514 |
| 1982 | -0.95 | 0.270 | -0.35 | 0.550 |
| 1983 | -0.76 | 0.267 | -0.88 | 0.423 |
| 1984 | -0.78 | 0.247 | -0.04 | 0.418 |
| 1985 | -0.64 | 0.250 | 0.38 | 0.412 |
| 1986 | -0.90 | 0.257 | -1.58 | 0.487 |
| 1987 | -0.94 | 0.249 | -0.92 | 0.439 |
| 1988 | -0.84 | 0.268 | -0.70 | 0.483 |
| 1989 | -0.74 | 0.239 | -0.55 | 0.416 |
| 1990 | -0.62 | 0.237 | -0.35 | 0.418 |
| 1991 | -0.26 | 0.227 | 0.03 | 0.387 |
| 1992 | -0.17 | 0.230 | -0.10 | 0.389 |
| 1993 | 0.03 | 0.224 | -0.14 | 0.374 |

Patent class dummies 386

Year dummies 30

R-squared 0.146

Dependent Mean 3.18

Root M.S.E. 4.15

Number of observations 55710

Regression Results for Generality Over Time

| Year | <i>Other Federal</i> | | <i>NASA</i> | |
|------|----------------------|----------------|-------------|----------------|
| | Coefficient | Standard Error | Coefficient | Standard Error |
| 1963 | -0.03 | 0.021 | n/a | n/a |
| 1964 | -0.01 | 0.020 | n/a | n/a |
| 1965 | -0.03 | 0.017 | n/a | n/a |
| 1966 | -0.05 | 0.016 | n/a | n/a |
| 1967 | -0.03 | 0.016 | n/a | n/a |
| 1968 | -0.03 | 0.017 | n/a | n/a |
| 1969 | 0.00 | 0.017 | 0.00 | 0.024 |
| 1970 | -0.05 | 0.017 | -0.03 | 0.023 |
| 1971 | -0.02 | 0.015 | 0.03 | 0.021 |
| 1972 | 0.01 | 0.016 | 0.05 | 0.024 |
| 1973 | 0.00 | 0.015 | 0.03 | 0.024 |
| 1974 | -0.03 | 0.015 | -0.04 | 0.025 |
| 1975 | -0.05 | 0.015 | 0.02 | 0.026 |
| 1976 | 0.02 | 0.016 | 0.05 | 0.032 |
| 1977 | 0.02 | 0.016 | 0.04 | 0.031 |
| 1978 | 0.01 | 0.017 | 0.08 | 0.031 |
| 1979 | 0.01 | 0.019 | 0.08 | 0.037 |
| 1980 | 0.01 | 0.017 | 0.06 | 0.037 |
| 1981 | 0.00 | 0.017 | 0.03 | 0.035 |
| 1982 | 0.00 | 0.019 | 0.05 | 0.038 |
| 1983 | 0.00 | 0.019 | 0.05 | 0.030 |
| 1984 | 0.02 | 0.017 | 0.02 | 0.029 |
| 1985 | 0.03 | 0.018 | 0.07 | 0.028 |
| 1986 | 0.01 | 0.018 | 0.01 | 0.035 |
| 1987 | 0.00 | 0.018 | 0.01 | 0.032 |
| 1988 | 0.00 | 0.020 | 0.03 | 0.035 |
| 1989 | 0.04 | 0.018 | -0.02 | 0.031 |
| 1990 | -0.03 | 0.019 | -0.01 | 0.032 |
| 1991 | 0.00 | 0.019 | 0.02 | 0.031 |
| 1992 | 0.01 | 0.022 | 0.00 | 0.036 |
| 1993 | 0.00 | 0.032 | -0.03 | 0.057 |

Patent class dummies 381
 Year dummies 30

R-squared 0.102
 Dependent Mean 0.282
 Root M.S.E. 0.270
 Number of observations 40865