

# **SURVIVE, BUT NOT THRIVE? THE CONSTRAINING INFLUENCE OF GOVERNMENT CUSTOMERS ON TECHNOLOGY START-UPS**

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May 8, 2019



# Government + Start-Ups



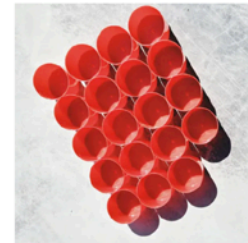
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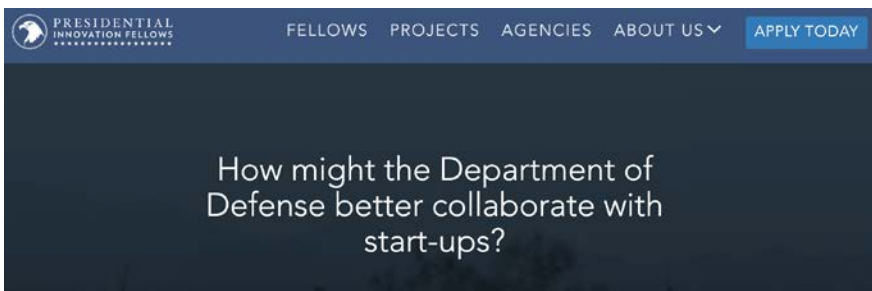


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## Why Startups Don't Bid on Government Contracts

AUGUST 22, 2017

By Geoff Orazem, [Greg Mallory](#), Matthew Schlueter, and [Danny Werfel](#)



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## THE STARTUP SHAKE UP

Tech firms are adopting a new language to win a shot at innovation contracts.

# Government Consumers + Start-Ups = ?

## Start-ups often partner with governments through dedicated small-business innovation programs

- Governments subsidize innovation in to counter-act small business underinvestment (Anton & Yao, 1994; Gans & Stern, 2000)
  - Significant funding available (DoD Small Business funding ~\$58B in 2016)
- Start-ups are “**resource lite**”, making subsidies attractive (Kropp & Zolin, 2005)
- **Non-dilutive funding** a particularly attractive incentive for growth-oriented technology start-ups
  - Comparable to equity investment (Angel ~\$285K, SBIR Phase I ~\$225K)
  - 60% of SBIR companies are start-ups

## Yet, we don't really know how government consumers are associated with start-up performance

- Entrepreneurship research on government funding partnerships focus on “**new technology ventures**” not the performance of “**new technology firms**” (Elston & Audretsch, 2011; Lerner, 1999; Toole & Czarnitzki, 2007; Wallsten, 2000)
- Empirical evidence focuses on **project performance**, not **firm performance** (i.e., survival, growth)
  - + Papers (Toole & Czarnitzki, 2009), Patents (Howell, 2017), Products (Link and Scott, 2010), Product Sales (Gans & Stern, 2000), Knowledge Spill-overs (Audretsch et al., 2002; Feldman, 2000), etc.
- Prior research does not disentangle **government-as-a-consumer** versus **government-as-an-investor** (Link & Scott, 2012; Hiatt et al., 2017; Howell, 2017)



# Preview

## Investigate the impact of government consumers on dual-use start-ups

- Government Consumers = “Mission Agencies” - e.g., DoD, NASA, DHS
- Dual-use industries = B2B/C and/or B2G (e.g., cyber security, aerospace)
- Technology start-ups require STEM SMEs and are < 5 yrs of age



## Uncover the connection between government consumers and growth

- Prior research has focused on innovation outcomes (e.g., patents, products)
- Largely ignored survival and growth outcomes

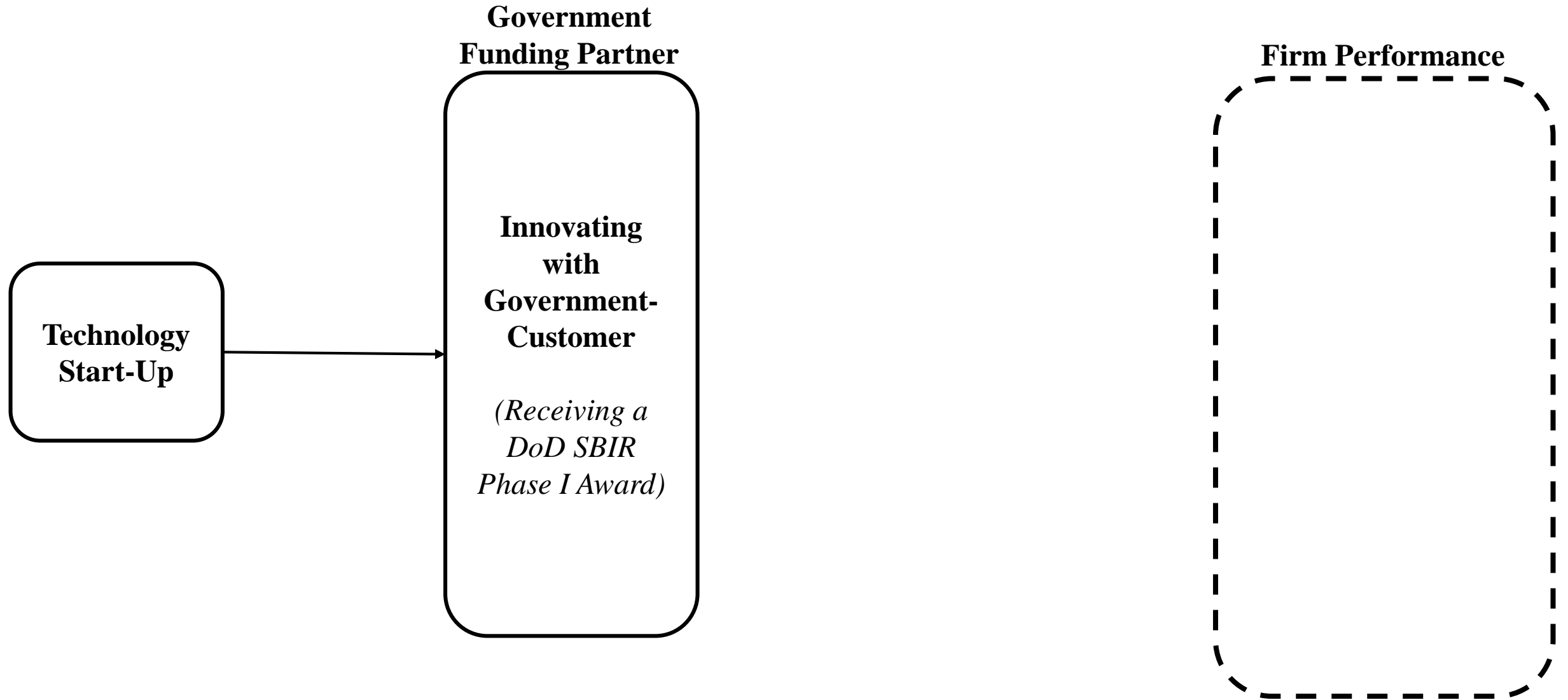


*Find that government consumers are positively associated with technical innovation and survival, but slower growth*

## Research Question

How do *government consumers* influence *start-up performance*?

# Hypotheses Overview



# Start-Up Performance via Opportunity Recognition

## Opportunity Recognition (Kirzner, 1973)

- “Situations in which **new goods**, services, raw materials, markets and organizing methods **can be introduced** through the **formation of new means, ends, or means–ends relationships**” (Eckhardt and Shane, 2003)
- Opportunity recognition defined as “the process through which ideas for potentially **profitable new business opportunities** are **identified**” (Baron & Ensley, 2006; Kirzner 1979, Shane 2003)
- **Opportunity sources** include universities, investor networks, potential consumers, etc.

## Those who are “good” at opportunity recognition perform better

- Combination of **perception** and **action** (Ardichvili et al., 2003; Bremner & Eisenhart, 2019; MacMullen & Shepherd, 2006)
  - Alert to new opportunities as they emerge (Ardichvili et al., 2003)
  - Able to exploit opportunities (Wang & Decastro, 2017)
- **+ Innovation, Survival, Growth** (Gruber et al., 2008; Dencker & Gruber, 2015; Eshima & Anderson, 2017)

# Government Consumers as an Unique Opportunity Source

## Government consumers provide technical resources

- Fund R&D (Auzolay et al, 2011; Branscomb, 1993; Sauermann & Stephan, 2012)
- Government consumers are often technical experts (Pahnke et al., 2015)
- Access to capital-intensive resources, such as national user facilities (Rathje & Katila, 2019)

**H1: Start-ups who partner with government consumers are associated with a higher technological innovation rates than those who do not**



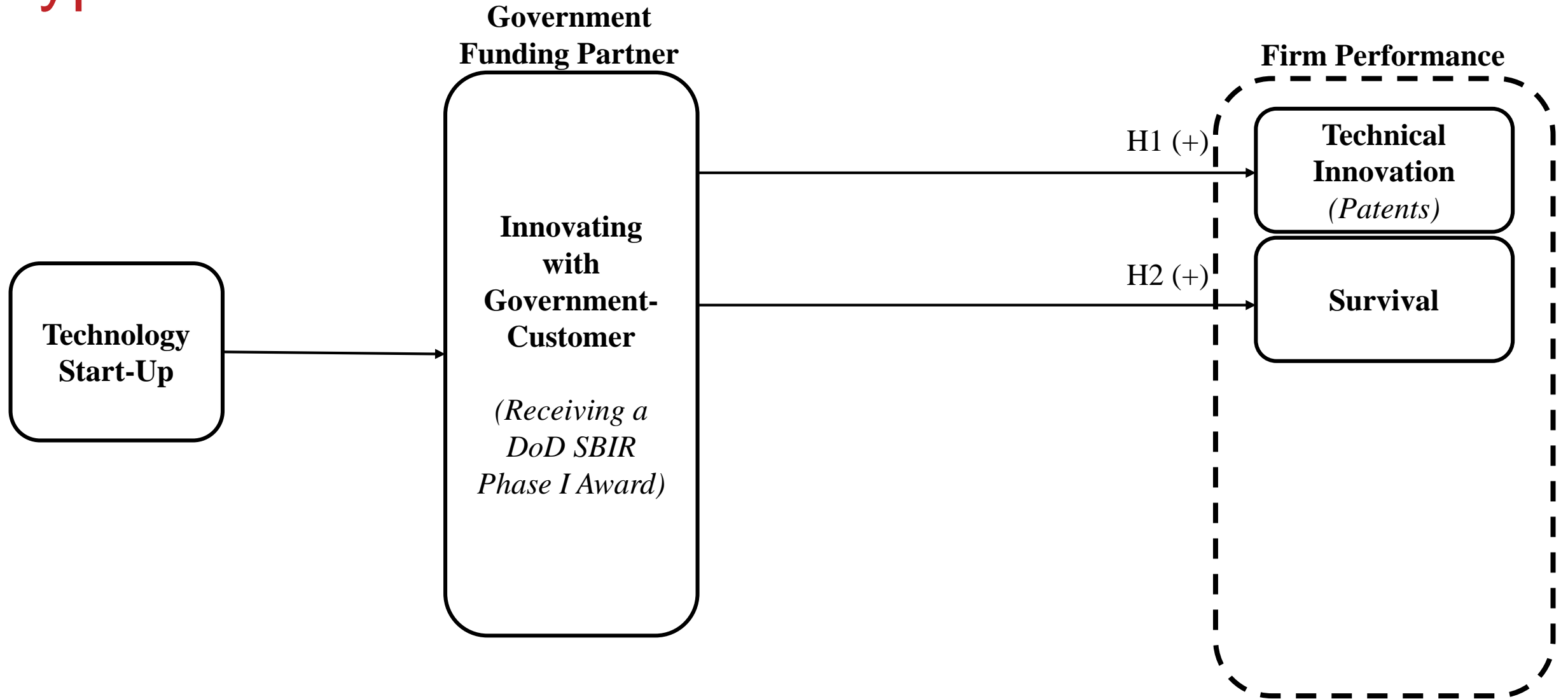
# Government Consumers as an Unique Opportunity Source

## Government consumers provide stability

- Legitimacy via certification & expanded political and social networks (Autio and Rannikko, 2016; Eesley et al., 2016; Hillman et al., 1990; Wang and Qian, 2011)
  - Certification of technical expertise is signaled by government partnerships (Armanios et al., 2017)
  - Government partners particularly useful in times of uncertainty (Hiatt et al., 2017)

**H2: Start-ups who partner with government consumers are associated with higher survival rates than similar firms who do not**

# Hypotheses Overview



# Iterative Opportunity Recognition

## *Iterative opportunity recognition is critical for growth*

- Growth is contingent on recognizing multiple opportunities for exploitation (Cohen et al., 2018; Penrose, 1953; Gans & Stern, 2019)
- Research on “learn” prioritizes experimentation through iterative hypotheses testing, flexibility, and making low-commitment investments – i.e., “**pivots**” (Blank, 2013; Contigiani & Levinthal, 2019; Leatherbee & Katila, 2019; Reis, 2011)
  - Pivoting can be viewed as strategic action for opportunity recognition

## *Iterative opportunity recognition is difficult*

- Pivoting **slows or stops once demand is found** (Contigiani & Levinthal, 2019)
  - Satisficing behavior could limit firms from finding optimum opportunities (Cohen et al., 2018; Stern & Gans, 2019)
- Structural constraints of present business models often limit flexibility to adapt to new business models (Vindova & Kotha, 2000; Eesley and Wu, 2017)

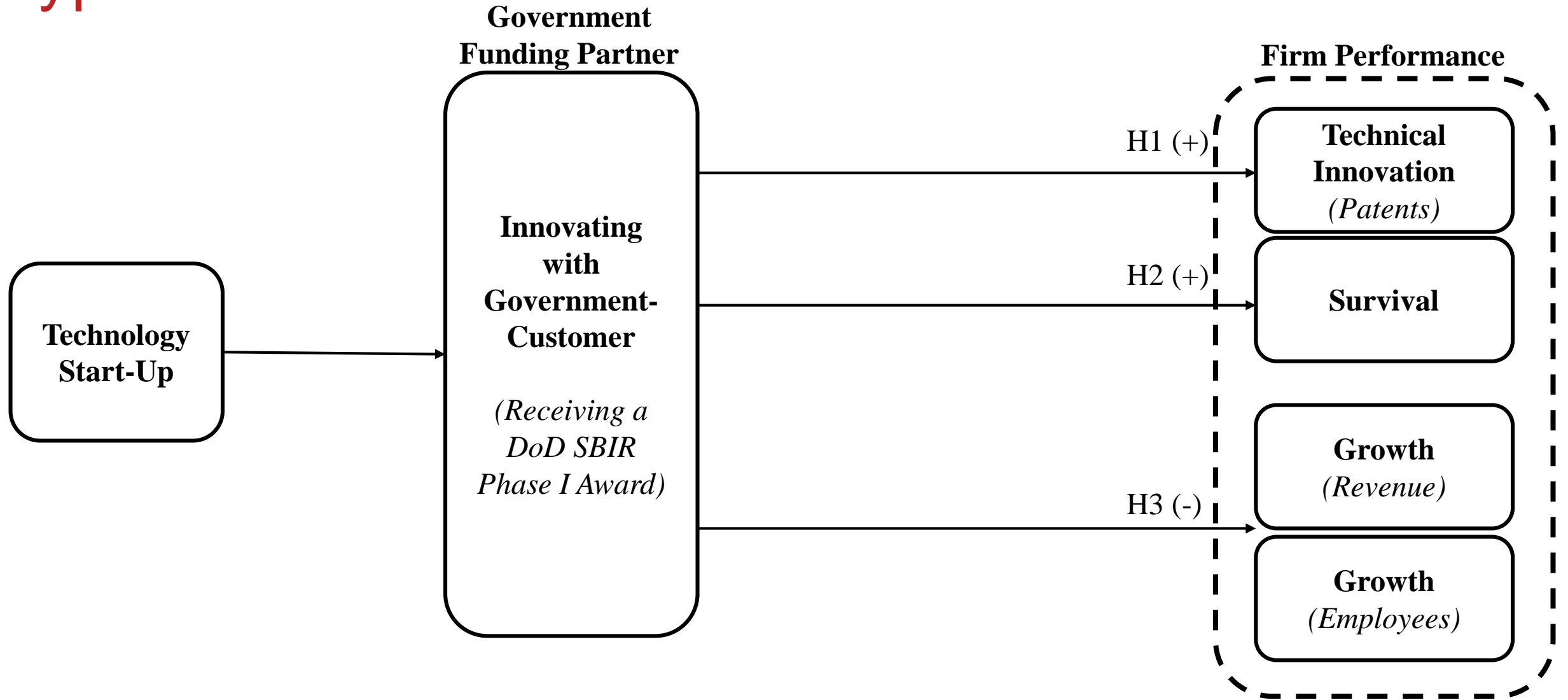
# Government Consumers & Iterative Opportunity Recognition

## Contracts focus work and restrict flexibility

- Encourage organizational structure to meet “B2G” business model (Lichtenberg, 1988; Flammer, 2018; 13 C.F.R. §§ 701-705.)
- Pivots require contract modifications (Branscomb, 1993; Ham and Mowery, 1998)
- Often lead to relational and cognitive lock-in with government partners (Mauer & Ebers, 2006)
- Opportunity closure: “limited ability to recognize future opportunities once an initial opportunity is exploited”

**H3: Start-ups who partner with government consumers grow slower as compared to similar firms who do not**

# Hypotheses Overview



# Opportunity Closure, Moderated

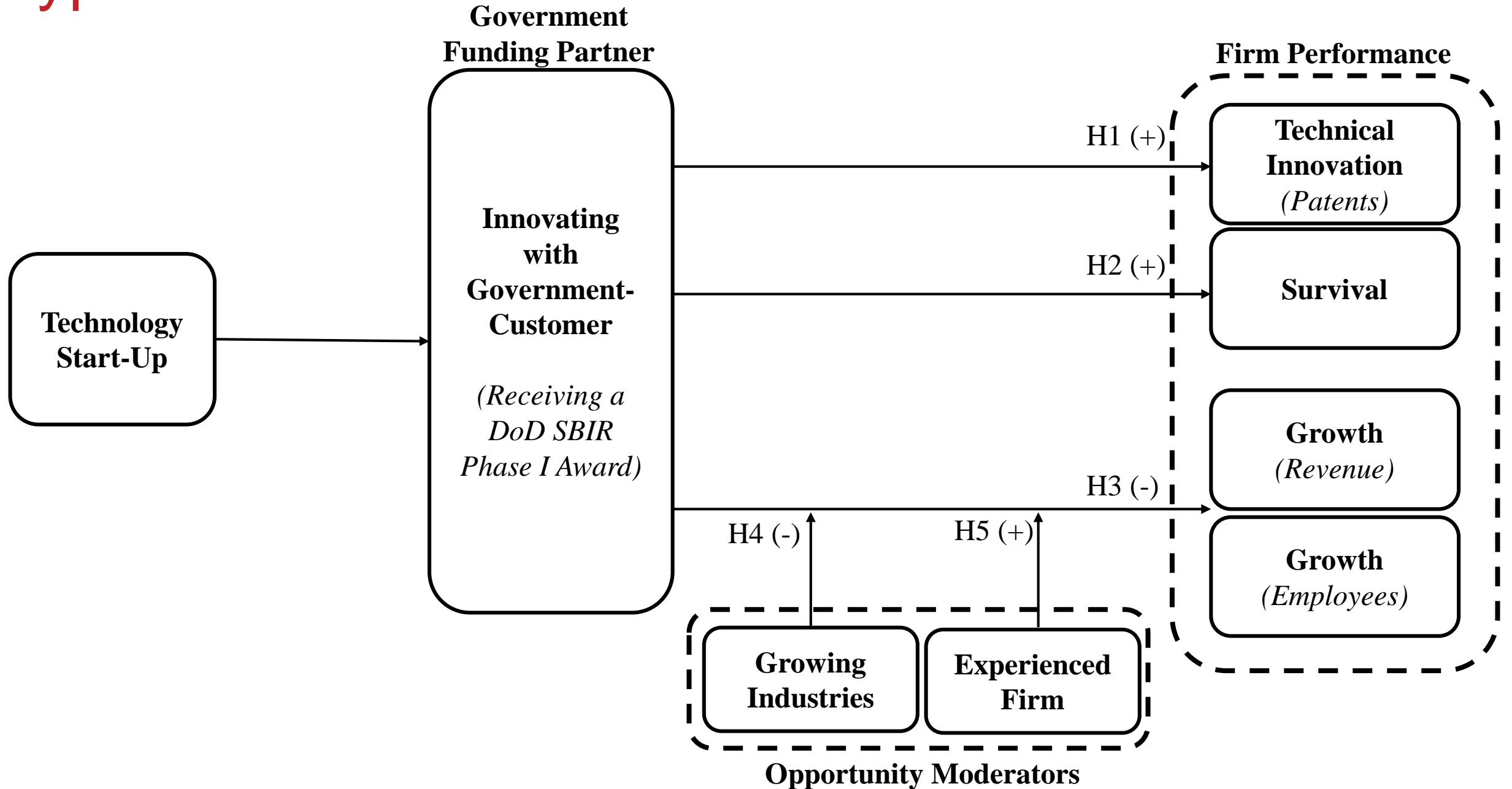
## Industry Growth

- In growing industries (i.e., greater opportunities), iterative opportunity recognition is extremely important
  - Performant firms dynamically shift organizational forms, functions, and competitive advantages (Rindova & Kotha, 2001; Teece, 1986)
- **H4: The negative association between start-up growth and government consumers is strengthened in growing industries**

## Firm Experience

- More likely to have already explored opportunities and selected a commercialization strategy (Rivkin & Siggelkow, 2003; Trigeorgis & Reuer, 2017)
- **H5: The negative association between start-up growth and government consumers is weakened by increasing firm experience**

# Hypotheses Overview



# Data

## DoD SBIR Program

- Multi-phased innovation funding program dedicated to “product transition”
  - Phase I – up to \$250K
  - Phase II – up to \$3M
- SBIR makes up the predominance of government funding for early stage ventures (Audretsch, 2003; SBA, 2014)
  - 60% of DoD SBIR firms are “start-ups”
- DoD uses contracts (other agencies use grants)
- DoD prioritizes “mission needs” (i.e., consumer demands)



# Data

## Matched sets of dual-use ventures

- Full set of DoD SBIR-receiving, dual-use start-ups from 1997-2012 collected from SBIR.gov
  - 1,437 unique firms
- Match SBIR receiving firms to non-receiving SBIR counterparts
  - Matched on founding year, SIC, and location
  - 27,730 firms recovered (26,293 did not receive an award)
- Match firms to Dun and Bradstreet identifying information
  - Dun and Bradstreet reporting is required by all SBIR receiving companies
  - Useful in studying entrepreneurial growth (Eesley and Roberts, 2012)
- Correlated with the universe of companies in Thompson One & USPTO to indicate venture funding & patent data



# Measures

## *Dependent Measures*

- Patents, Firm Survival, Log Revenue, Log Employees (Bradley et al., 2011; Rao, 1994; Eesley and Roberts, 2012 )

## *Independent Measures*

- SBIR-awardee
- Industry Growth (Industry Entry Rate)
- Firm Experience (Age)

## *Controls*

- Firm age, Industry (SIC), State, Patents, Venture Funding, Team Diversity, Temporal Effects (Beckman and Burton, 2008; Eisenhardt and Schoonhoven, 1990; Evans and Leighton, 1989; Zajac, 1988)

# Methods

## Cox Proportional Hazard

- Hazard function of dependent variable occurrence (Audretsch and Mahmood, 1995)
  - (+) Firms more likely to patent
  - (-) Firms more likely to survive

## Differences-in-Differences (Short and Toffel, 2011)

- Controls for selection longitudinally
- Robust approach in evaluating policy treatments
- Estimate longitudinal performance

# Results H1 & H2 (Innovation, Survival)



Table 2. Cox proportional hazard model

Variables	Patent		Survival	
	(1)	(2)	(3)	(4)
<b>Independent Variables:</b>				
<i>SBIR-awardee</i>		0.936 <sup>****</sup> (0.828, 1.044)		-0.816 <sup>****</sup> (-1.250, -0.381)
<b>Controls:</b>				
<i>Venture Raised</i>	2.074 <sup>****</sup> (1.986, 2.162)	2.057 <sup>****</sup> (1.968, 2.145)	0.181 (-0.119, 0.480)	0.155 (-0.146, 0.456)
<i>Firm Age</i>	0.015 <sup>***</sup> (0.005, 0.024)	0.009 <sup>*</sup> (-0.001, 0.018)	-0.053 <sup>****</sup> (-0.074, -0.032)	-0.051 <sup>****</sup> (-0.071, -0.030)
<i>Founding Team Size</i>	0.0001 (-0.001, 0.001)	0.0004 (-0.0004, 0.001)	-0.345 <sup>***</sup> (-0.596, -0.093)	-0.260 <sup>**</sup> (-0.514, -0.006)
<i>Woman</i>	0.252 <sup>****</sup> (0.104, 0.400)	0.216 <sup>***</sup> (0.068, 0.363)	-0.0001 (-0.002, 0.002)	-0.0005 (-0.003, 0.002)
<i>Minority</i>	-0.132 <sup>*</sup> (-0.267, 0.003)	-0.191 <sup>***</sup> (-0.326, -0.056)	-0.114 (-0.459, 0.231)	-0.1 (-0.445, 0.245)
<i>Patents</i>			-0.450 <sup>***</sup> (-0.738, -0.162)	-0.431 <sup>***</sup> (-0.719, -0.143)
<b>Dummies Included:</b>				
<i>SIC (4-digit)</i>	Yes	Yes	Yes	Yes
<i>State</i>	Yes	Yes	Yes	Yes
N	27,730	27,730	27,730	27,730

Note: \*p < 0.1; \*\*p < 0.05; \*\*\*p < 0.01; \*\*\*\*p < 0.001

# Results H3, H4, H5 (Revenue)



Table 4. Revenue: Diff-in-Diff

Revenue (Logged)			Growing Industries	Stagnant Industries	Younger Firm	Older Firm
	(1)	(2)	(3)	(4)	(5)	(6)
<b>Independent Variables:</b>						
<i>SBIR-awardee</i>		1.534**** (1.401, 1.668)	2.613**** (2.177, 3.050)	1.267**** (1.134, 1.401)	2.622**** (2.336, 2.908)	1.169**** (1.022, 1.316)
<i>After treatment</i>		1.009**** (0.861, 1.057)	1.261**** (1.113, 1.410)	1.282**** (1.218, 1.347)	1.558**** (1.471, 1.646)	1.232**** (1.166, 1.297)
<i>SBIR-awardee x After treatment</i>		-0.725**** (-0.870, -0.580)	-1.532**** (-2.057, -1.006)	-0.569**** (-0.718, -0.419)	-1.736**** (-2.033, -1.440)	-0.440**** (-0.608, -0.272)
<b>Controls:</b>						
<i>Intercept</i>	14.599**** (11.892, 17.306)	13.639**** (10.947, 16.331)	15.372**** (12.221, 18.523)	14.159**** (12.489, 15.830)	23.576**** (17.153, 30.000)	15.438**** (13.615, 17.260)
<i>Venture Raised</i>	0.685**** (0.615, 0.756)	0.668**** (0.598, 0.738)	-0.093 (-0.358, 0.172)	0.847**** (0.762, 0.932)	0.488**** (0.389, 0.586)	0.827**** (0.728, 0.925)
<i>Firm Age</i>	0.265**** (0.261, 0.270)	0.232**** (0.228, 0.237)	0.589**** (0.558, 0.621)	0.169**** (0.162, 0.177)	0.296**** (0.289, 0.303)	0.137**** (0.129, 0.146)
<i>Patents</i>	0.037**** (0.029, 0.046)	0.035**** (0.027, 0.044)	0.016** (0.001, 0.030)	0.047**** (0.035, 0.059)	0.025**** (0.016, 0.034)	0.077**** (0.059, 0.095)
<i>Founding Team Size</i>	0.009**** (0.008, 0.009)	0.009**** (0.009, 0.009)	0.042**** (0.038, 0.046)	0.008**** (0.008, 0.009)	0.009**** (0.008, 0.010)	0.009**** (0.008, 0.010)
<i>Woman</i>	0.594**** (0.530, 0.659)	0.578**** (0.514, 0.642)	0.590**** (0.498, 0.681)	0.489**** (0.401, 0.577)	0.590**** (0.498, 0.681)	0.489**** (0.401, 0.577)
<i>Minority</i>	0.318**** (0.269, 0.367)	0.290**** (0.242, 0.339)	0.489**** (0.331, 0.646)	0.226**** (0.167, 0.285)	0.299**** (0.228, 0.370)	0.259**** (0.194, 0.325)
<b>Dummies Included:</b>						
<i>SIC (4-digit)</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>State</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes	Yes
N	228,314	228,314	123,104	105,210	75,587	114,349
Adjusted R-squared	0.174	0.184	0.190	0.198	0.212	0.201

Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01; \*\*\*\*p<0.001

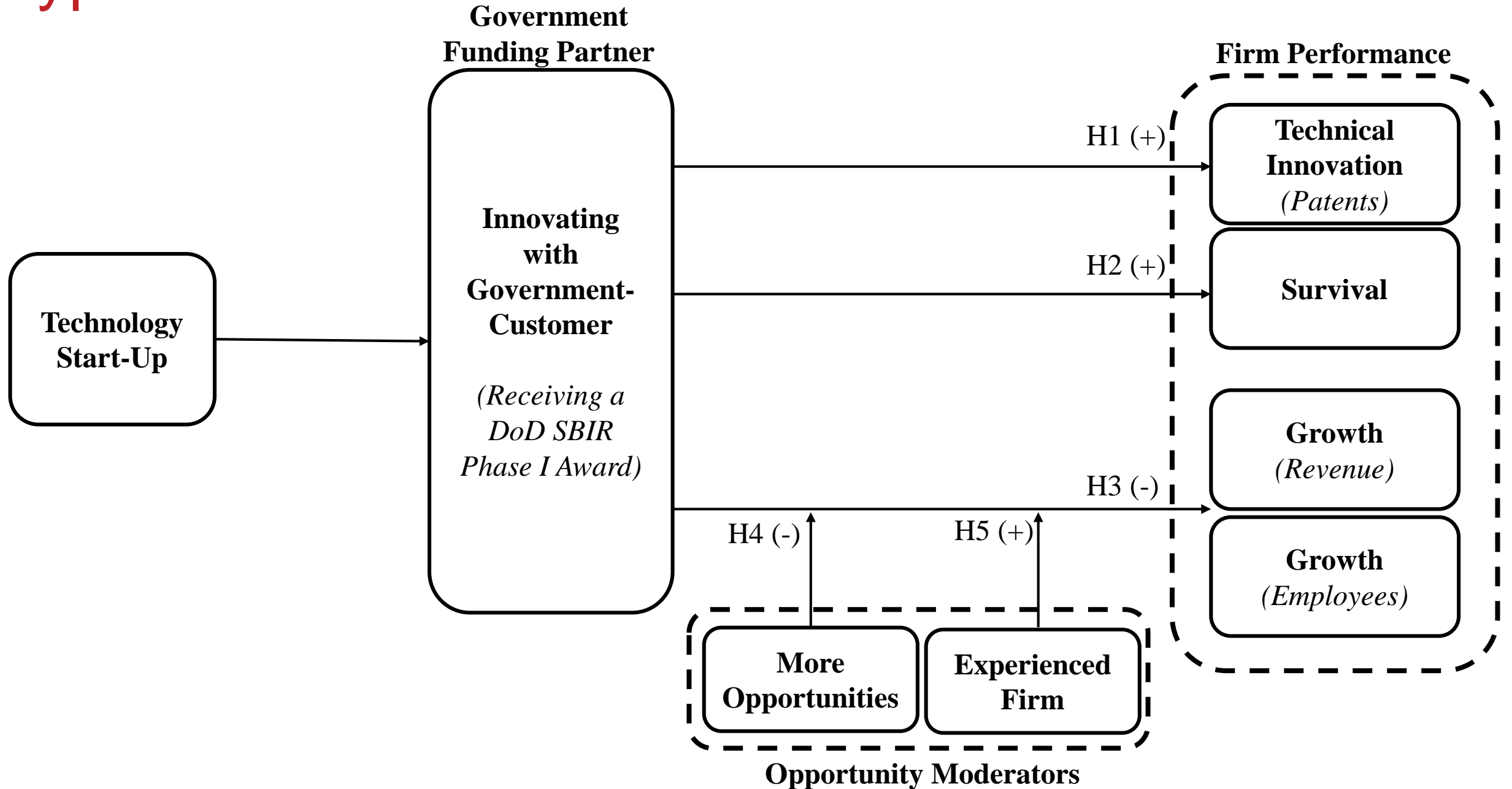
# Results H3, H4, H5 (Employees)

Table 3. *Employees* : Diff-in-Diff

Employees (Logged)			Growing Industries	Stagnant Industries	Younger Firm	Older Firm
	(1)	(2)	(3)	(4)	(5)	(6)
<b>Independent Variables:</b>						
<i>SBIR-awardee</i>		0.253**** (0.223, 0.283)	0.292**** (0.230, 0.354)	0.225**** (0.188, 0.261)	0.312**** (0.253, 0.370)	0.220**** (0.183, 0.256)
<i>After treatment</i>		0.128**** (0.117, 0.138)	0.154**** (0.133, 0.175)	0.148**** (0.138, 0.158)	0.194**** (0.176, 0.212)	0.156**** (0.148, 0.173)
<i>SBIR-awardee x After treatment</i>		0.107**** (0.074, 0.140)	-0.052 (-0.127, 0.022)	0.168**** (0.127, 0.209)	0.001 (-0.060, 0.062)	0.196**** (0.154, 0.238)
<b>Controls:</b>						
<i>Intercept</i>	2.647**** (2.035, 3.258)	2.377**** (1.770, 2.985)	2.887**** (1.976, 3.799)	3.678**** (3.175, 4.180)	2.447**** (1.799, 3.096)	2.926**** (2.508, 3.344)
<i>Venture Raised</i>	0.520*** (0.504, 0.536)	0.515**** (0.499, 0.531)	0.167**** (0.129, 0.204)	0.608**** (0.585, 0.632)	0.437**** (0.417, 0.458)	0.588**** (0.563, 0.612)
<i>Firm Age</i>	0.061**** (0.060, 0.062)	0.055**** (0.054, 0.056)	0.062**** (0.058, 0.067)	0.063**** (0.061, 0.065)	0.059**** (0.058, 0.061)	0.048**** (0.046, 0.050)
<i>Patents</i>	0.014**** (0.012, 0.016)	0.013**** (0.011, 0.015)	0.167**** (0.129, 0.204)	0.608**** (0.585, 0.632)	0.008**** (0.006, 0.010)	0.034**** (0.030, 0.039)
<i>Founding Team Size</i>	0.006**** (0.006, 0.006)	0.006**** (0.006, 0.006)	0.018**** (0.018, 0.019)	0.005**** (0.005, 0.006)	0.005**** (0.005, 0.006)	0.006**** (0.006, 0.007)
<i>Woman</i>	0.285**** (0.271, 0.300)	0.278**** (0.263, 0.292)	0.143**** (0.108, 0.178)	0.338**** (0.317, 0.359)	0.222**** (0.203, 0.241)	0.320**** (0.298, 0.342)
<i>Minority</i>	-0.015*** (-0.026, -0.004)	-0.026**** (-0.037, -0.015)	-0.01 (-0.033, 0.012)	-0.044**** (-0.061, -0.028)	-0.003 (-0.017, 0.012)	-0.046**** (-0.062, -0.030)
<b>Dummies Included:</b>						
<i>SIC (4-digit)</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>State</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes	Yes
N	228,314	228,314	75,587	114,349	123,104	105,210
Adjusted R-squared	0.269	0.278	0.342	0.27	0.248	0.301

Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01; \*\*\*\*p<0.001

# Hypotheses Overview



# Summary & Implications for Policy

## Summary

- Opportunity Recognition is critical for start-up performance
- Government as a consumer is an enticing resource for new firms
- Yet, the government can have long-term negative impacts on growth

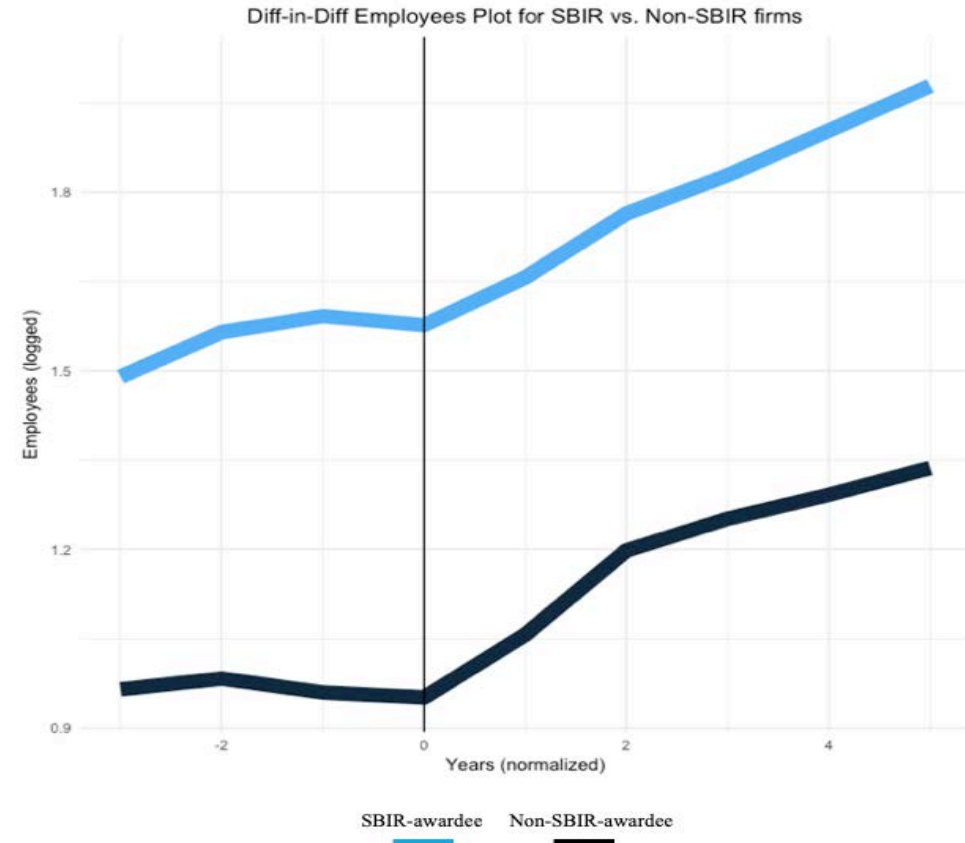
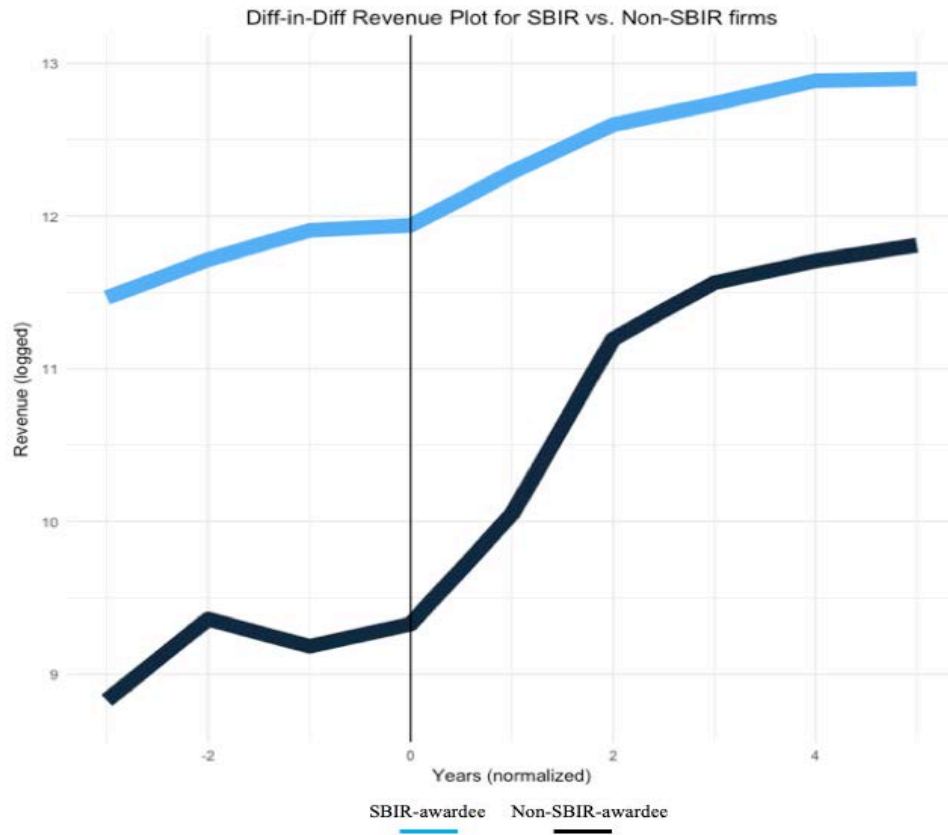
## Policy Implications

- Innovation and Survival...great!
- Negative growth effects can result in negative selection
  - Cultural divide driven by economic incentives?
- Must consider start-ups as a unique category within “small-business”
  - What makes a small-business successful (i.e., innovation) might not make a start-up successful (i.e., growth)

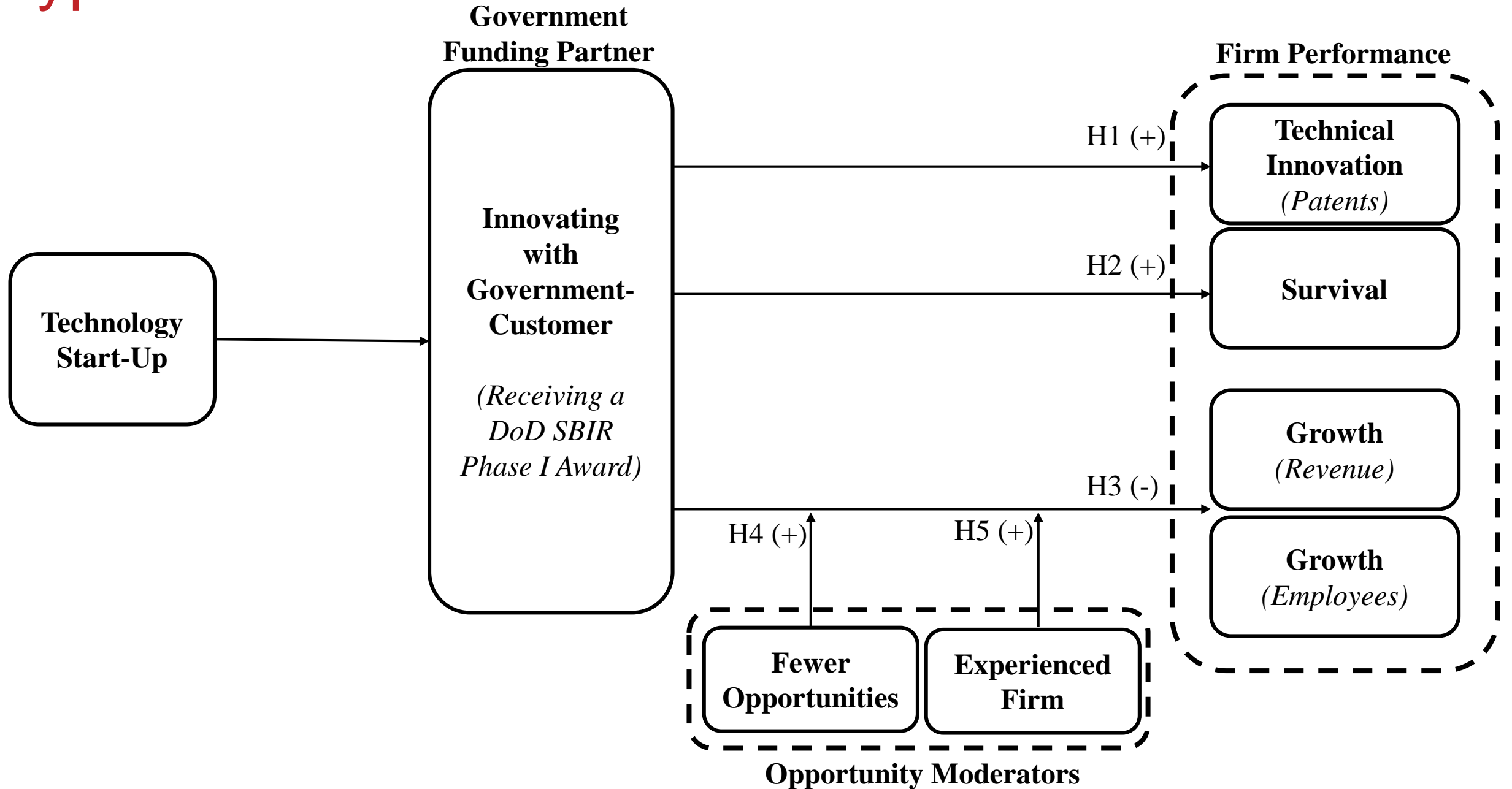


# Questions?

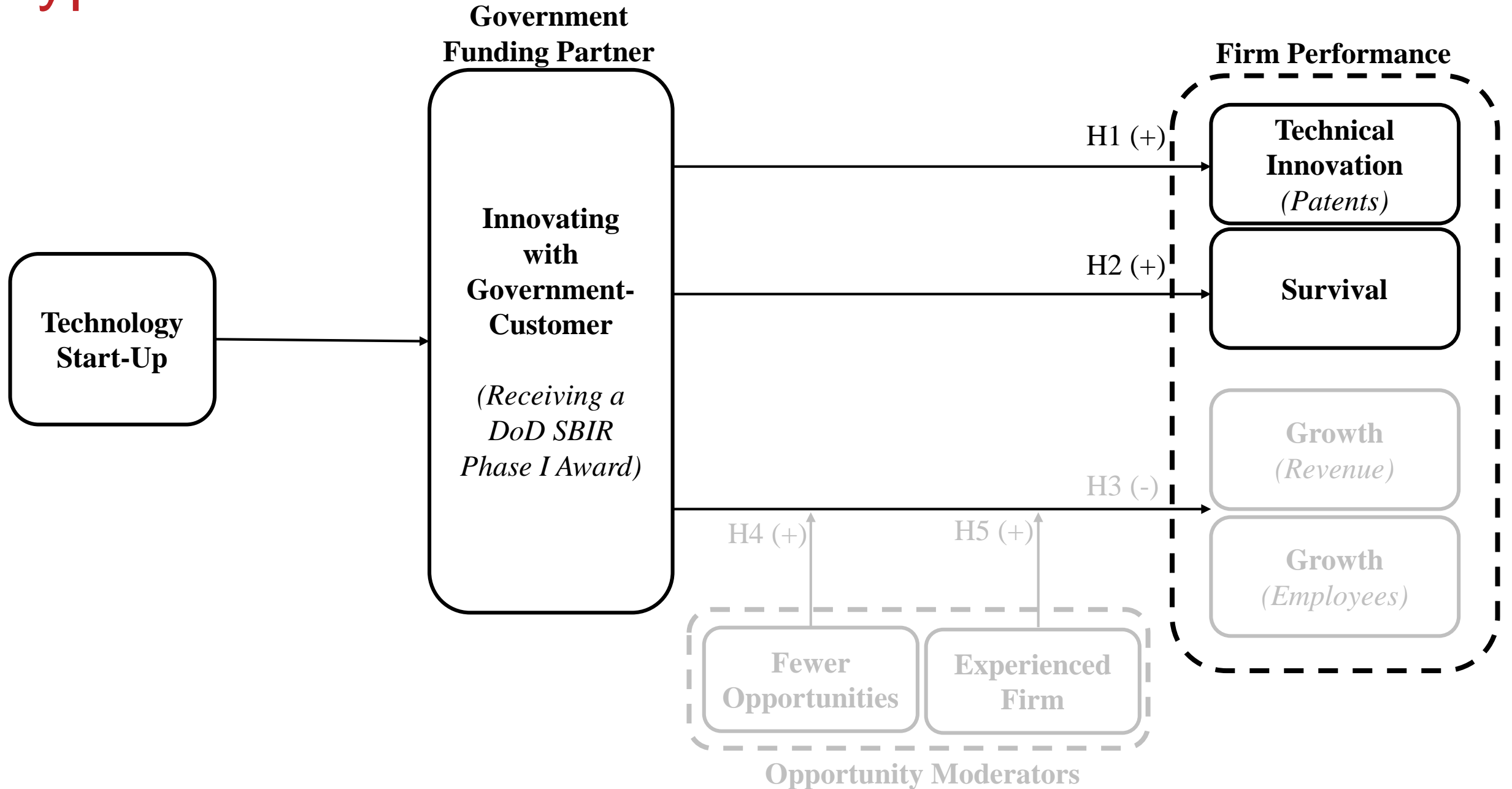
# Results H3 (Growth)



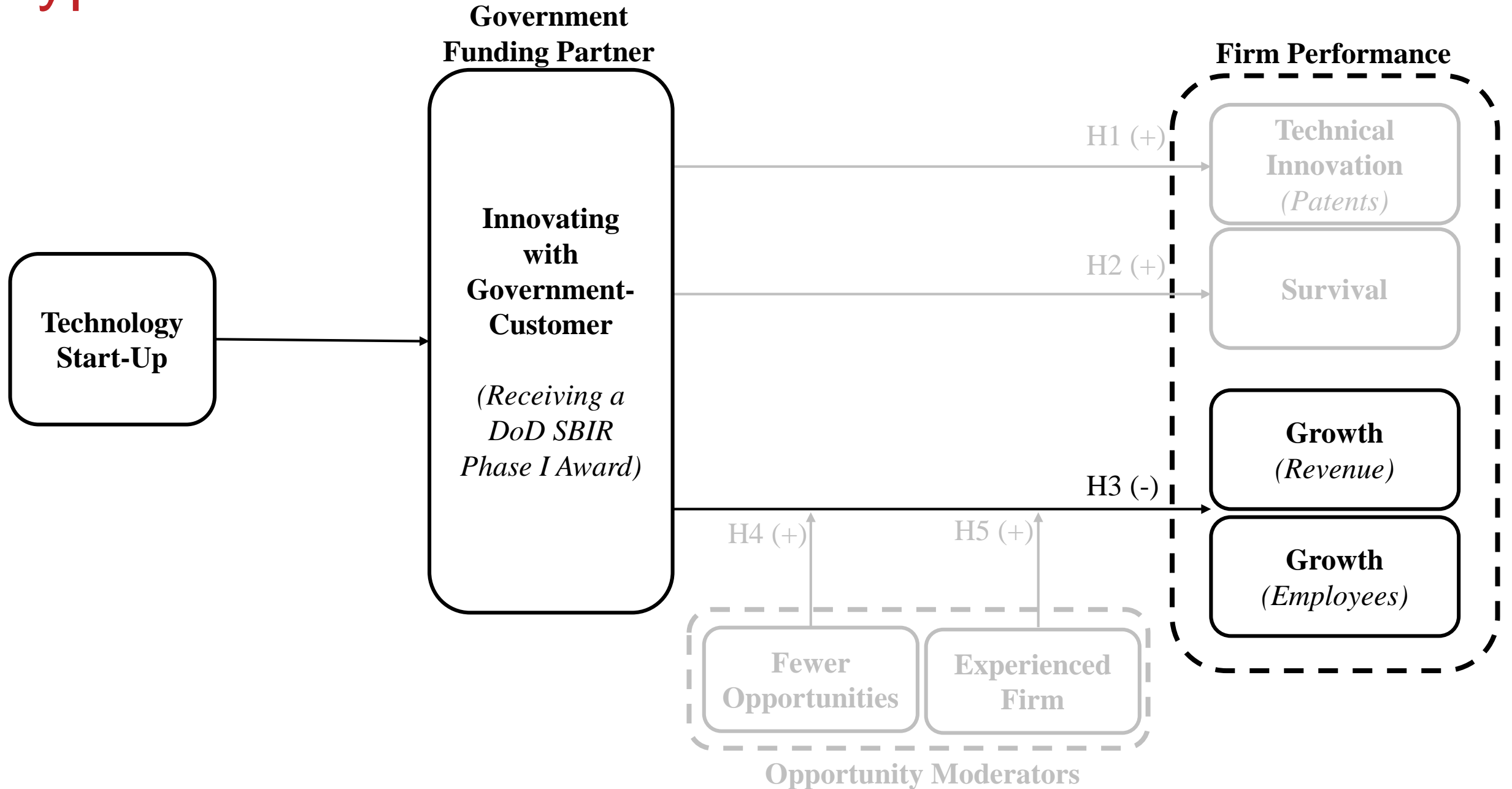
# Hypotheses Overview



# Hypotheses Overview



# Hypotheses Overview



# Government Customers + Small Business = Innovation

- Small-businesses are critically important to economic growth, yet tend to under-invest in innovation (Anton & Yao, 1994; Gans & Stern, 2000)
- A significant portion of government funding directed to small-businesses specifically for innovation
  - The U.S. Department of Defense (DoD) spending goal was 22% in 2016 (\$58B total)
  - U.S. SBIR (Howell, 2017; Link & Scott, 2010), Chinese Innofund (Guo, Guo, & Jiang, 2016; Wang, Li, & Furman, 2017) , Swedish VINN NU (Söderblom, Samuelsson, Wiklund, & Sandberg, 2015), etc.
- Research has predicted positive “innovation” returns (Arichbald & Finifter, 2003)
  - + Papers (Toole & Czarnitzki, 2009), Patents (Howell, 2017), Products (Link and Scott, 2010), Product Sales (Gans & Stern, 2000), Knowledge Spill-overs (Audretsch et al., 2002; Feldman, 2000), etc.



# Government as Customer-Driven Innovation

## Government organizations can be consumers

- Mission-focused government funding agencies serve as consumer-driven organizations (Dasgupta, 1994; Link & Scott, 2012; Mowery, 2009)
  - Ex. While DoD and NSF both have R&D budgets, DoD has a \$120B procurement budget
  - CVCs are perhaps the closest comparison (Smith and Shah, 2013)
- Government consumer organizations often prioritize procurement over basic research
  - Ex: DoD uses “contracts” for innovation, while NSF uses “grants”
  - Theoretically provide access to lucrative follow-on contracts

# Consumers as an Opportunity Source

## The role of consumers

- Serve as a source of experimentation for novel ideas (Dahldaner et al., 2008; Franke & Shah, 2003)
- Provide contextualized knowledge of current market demands (Lüthje et al., 2005; Katila et al., 2017)
- Are particularly useful when “consumer-inventors” (Ogawa, 1998; Sanchez-Gonzalez et al., 2009; von Hippel, 1994)
  - Provide “cosmopolitan” expertise via consumer-inventor personal networks (Dahlander & Fredreiksen, 2012; Smith & Shah, 2013)

## Performance Related Outcomes

- + Technical Innovation
  - Patenting (Adams et al., 2013; Dushintsky and Lenox, 2006), Patent Citations (Smith & Shah, 2013), Technical Prototypes (Dahlander & Fredreiksen, 2012)
- + Commercial Innovation
  - Product Introductions (von Hippel, 1976; Katila et al., 2017), Product Satisfaction (Urban & von Hippel, 1988; Franke & von Hippel, 2003), Service Introductions (Oliveria & von Hippel, 2009)



# Opportunity Moderators: Opportunity Availability

## Industry Growth & Opportunity Availability

- Growing industries are strongly correlated to opportunity availability (Dencker & Gruber, 2015)
- In growing industries (i.e., greater opportunities), iterative opportunity recognition is extremely important
  - Performant firms dynamically shift organizational forms, functions, and competitive advantages (Rindova & Kotha, 2001; Teece, 1986)

**H4: The negative association between start-up growth and government consumers is strengthened in growing industries**

# Opportunity Moderators: Experienced Firms

## Firm Experience

- More experienced start-ups will be better able to recognize opportunities (Baron, 2006; Baron & Ensley, 2006)

**H5: The negative association between start-up growth and government consumers is weakened by increasing firm experience**