Public sector entrepreneurship, politics, and innovation

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Abstract:

We suggest that a political leader or a political administration can be described in terms of a public sector entrepreneurship framework. To illustrate, we define the actions of US President Donald Trump's Administration to refocus the emphasis of the Environmental Protection Agency (EPA) as an innovative public policy initiative. And, we explore empirically the social consequences of those actions in terms of changes in the number of STEM employees at the EPA and the number of attendant innovative scientific publications. We find that declining experienced STEM employees at the EPA during President Trump's Administration is associated with declining innovative environmental scientific publications.

Keywords: public sector entrepreneurship | Environmental Protection Agency | Trump Administration | STEM employees | scientific publications

Article:

Plain English Summary

Declining experienced STEM employees at the EPA during President Donald Trump's Administration is associated with declining innovative environmental scientific publications. A public sector entrepreneur is an individual who champions an innovative public policy. In this paper we propose that President Trump's Administration's policies toward the EPA during his administration were innovative, although different from that of previous administrations. These policies sought to reorient the EPA toward industrial and industry-friendly interests which was contrary to the agency's health and environmental missions. One response to the administration's new policies was that experienced STEM (science, technology, engineering, and mathematics) employees left the EPA. A social consequence of the departure of experienced STEM employees is that the number of environmentally related scientific publications—one indicator of an agency's innovative activity—from EPA scientists declined. An implication from our empirical findings is that not all public sector entrepreneurial actions are socially desirable; some have potentially detrimental short-run and possible long-run effects on society as a whole.

1. Introduction

As defined by Leyden & Link, (2015, p. 14)[1]:

> [P]ublic sector entrepreneurship refers to innovative public policy initiatives that generate greater economic prosperity by transforming a status quo economic environment into one that is more conducive to economic units engaging in creative activities in the face of uncertainty.

Leyden and Link employed this definition as a basis of their argument that there have been a number of US technology policies that fall under the rubric of public sector entrepreneurship because of their innovative design and transformative nature. In this paper, we suggest that individuals, including the actions of politicians and political administrations, can also fall under the umbrella of public sector entrepreneurship.

In Section 2, we propose a framework for evaluating the economic consequences of public sector entrepreneurship. In Section 3, we introduce the politics of this paper using as an example the public policy initiatives introduced by US President Donald Trump and his administration toward the Environmental Protection Agency (EPA). In Section 4, we present data that characterizes one aspect of the social consequences of the Trump Administration's EPA policy emphasis in terms of changes in the number of STEM employees. In Section 5, we introduce the innovation dimensions of this paper; we present data that characterizes another aspect of the social consequences of the EPA policy emphasis described in Section 4, namely changes in the number of attendant innovative scientific publications. Finally, in Section 6 we summarize our findings with reference to the public sector entrepreneurial framework presented in Section 2, and we offer suggestions for future research on other individuals who might be characterized as public sector entrepreneurs.

2. A framework for the consequences of public sector entrepreneurship

Assume that a public sector entrepreneur has a preconceived appropriable rate of return from his/her perceived-to-be innovative public policy initiative. And, assume there is in the mind of a public sector entrepreneur some minimum acceptable rate of return to enhancing his/her professional status that he/she expects before pursuing the initiative.

In Fig. 1, this minimum rate of return is labeled as the public sector entrepreneur's hurdle rate.[2] If the expected rate of return to his/her action is less than this hurdle rate, the public sector entrepreneur will not pursue the action.

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[1] See the literature review on public sector entrepreneurship in Hayter, Link, and Scott (2018). See also Leyden (2016) and the essays on public sector entrepreneurship in Audretsch and Link (2016).

[2] An earlier version of this framework was proposed by Link (forthcoming) with reference to the policy actions of Vannevar Bush.

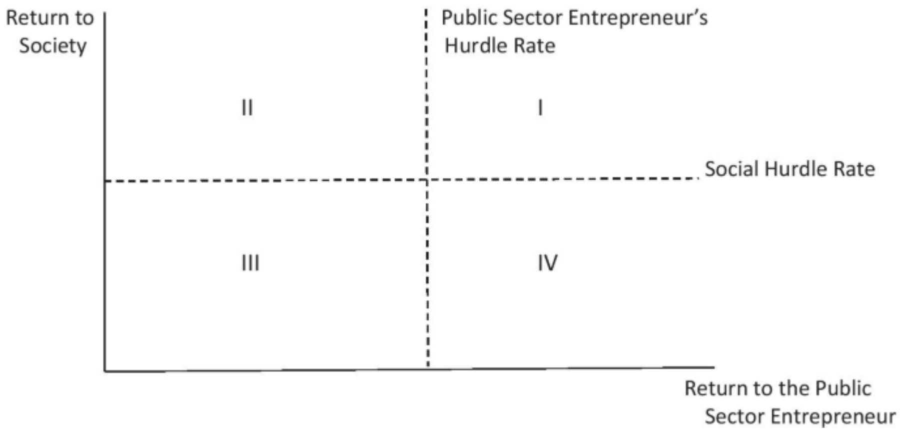

Fig. 1. The entrepreneur's and society's rate of return from an innovative public policy initiative

Society also has a hurdle rate, and it would like to see its resources used for innovative public policy initiatives that yield an expected rate of return above the social hurdle rate. If the expected rate of return to the use of society's resources to fulfill the public sector entrepreneur's policy initiative is less than this hurdle rate, society would prefer that such resources not be used. Ideally, both the public sector entrepreneur and society would like to see any public policy initiative result in a position that is characterized by quadrant I in Fig. 1, where the public sector entrepreneur is expecting or is realizing a rate of return from his/her actions that is greater than his/her hurdle rate and where society is expecting or is realizing a rate of return from his/her actions that is greater than its hurdle rate.

However, it is possible that a public policy initiative might at some point reside in quadrant IV where the public sector entrepreneur is expecting or is realizing a rate of return greater than his/her hurdle rate but where society is realizing a rate of return that is less than its hurdle rate. The latter might occur because of unintended consequences associated with the public policy initiative, in the sense of Bastiat (1995), or because society's long-run interests were not an anticipated element in the public sector entrepreneur's objective function.

3. Environmental public policy from the Trump Administration

According to Dillon et al., (2018, pp. S90–S92):

> The Trump administration has explicitly sought to reorient the EPA toward industrial and industry-friendly interests, often with little or no acknowledgment of the agency's health and environmental missions [through] political appointments … rhetoric … executive orders … restructured science advisory boards … [and Administrator Scott] Pruitt's own meetings and schedule, now posted online after many Freedom of Information Act requests, are almost exclusively with company and trade organizations and rarely with environmental, public health, or citizen groups … Significant policy changes at the EPA favor businesses and industry, while probably incurring considerable health and environmental consequences.[3]

[3] The reorientation of "the EPA toward industrial and industry-friendly interests" is the innovative public sector initiative referred to in Fig. 1.

Dillon et al., (2018, p. S93), through interviews with EPA employees, reached the conclusion that:

> The most common response [in the early period of the Trump Administration], at least among our interviewees still at the agency, has been a muted, steady determination to stay at their jobs and pursue an agency mission they quietly see as at odds with that of their new bosses. Indeed, our interviews suggest that the size of such agencies as the EPA may present challenges for regulatory capture,[4] especially when a new path set by leadership clashes so starkly with that long followed by its rank and file.

We propose, based on the assumption of rationality on the part of the Trump Administration,[5] that the administration viewed its public policy changes at the EPA to be in the spirit of an innovative public sector entrepreneurial response that reflected what Mokyr, (1992, p. 325) referred to as "social resistance to technological change." The "social resistance" perhaps is reflective of the administration's constituents' views toward a reduction in environmental regulations and constraints previously implemented through mandatory adoptions of new technology. Thus, in terms of the framework in Fig. 1, the Trump Administration's public policy initiatives toward the EPA will be in a position characterized by quadrants I or IV.

4. A response to the Trump Administration's EPA policy changes

In this section, we document that the response by EPA employees to EPA policy changes was not "a muted, steady determination to stay at their jobs and pursue an agency mission they quietly see as at odds with that of their new bosses." Rather, there was an exiting of scientists from the EPA during the Trump presidency. This exodus, according to the *Washington Post*, was "fueled broadly by administration policies that have diminished the role of science as well as more specific steps, such as the relocation of agencies away from the nation's capital."[6],[7]

The Office of Personnel Management (OPM) provides detailed STEM employment information, by government agency, for fiscal years (FYs) FY1998 through FY2020.[8] To quantify changes in scientists and staff employment at the EPA during the Trump Administration, we constructed a dataset consisting of 136,728 STEM EPA employees and 37,366 non-STEM EPA employees who have completed their college education, who are non-seasonal full-time permanent employees in professional occupations, and whose official duty station is in the USA.

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4 See Laffont and Tirole (1991) on regulatory capture.

5 See Zouboulakis (1997) on alterative review of rationality from both a classical and neoclassical perspective.

6 See https://www.washingtonpost.com/climate-environment/science-ranks-grow-thin-in-trump-administration/2020/01/23/5d22b522-3172-11ea-a053-dc6d944ba776_story.html.

7 Others in the popular presses signal out declines in the EPA's budgets as a cause for the exodus of scientists from the agency, although an inspection of inflation-adjusted federal R&D allocations to the EPA has been declining year-after-year since the early 2000s. See https://www.aaas.org/programs/r-d-budget-and-policy/historical-trends-federal-rd.

8 See https://www.fedscope.opm.gov/ and see employment information beginning in FY1998 at the end of each September quarter. The government's fiscal year is October 1 through September 30. Data are available through FY2020.

We grouped the states where employees are located into Census divisions, treating the District of Columbia, Maryland, and Virginia as a separate division due to the high number of federal employees located there, and we combined the East South Central and West South Central divisions because of small numbers of EPA employees located in the East South Central division.

OPM data contain information on the number of years of federal employment for each individual; our focus is on experienced employees in STEM occupations defined, for the purposes of this paper, to have 20 or more years of service.[9] See Table 1. For comparison, we also show results for non-STEM professional employees in Table 1. The table presents descriptive statistics for the total number of employees and the number of employees with 20 or more years of service for four administrations and STEM status. We also report the mean inflation-adjusted R&D budget in each administration (discussed below).

Table 1. Descriptive statistics, by administration

	STEM		Non-STEM		
Presidential administrations (years as President)	**Number of employees with 20 + years of service**	**Total number of employees**	**Number of employees with 20 + years of service**	**Total number of employees**	**R&D budget ($2020 M)**
Clinton (1998–2000)	1727.3	6101.0	427.3	1766.3	$930.7
	(89.6)	(111.2)	(50.5)	(44.2)	($97.5)
Bush (2001–2008)	2020.0	5973.3	553.3	1688.3	$792.1
	(227.6)	(60.8)	(58.9)	(29.8)	($78.2)
Obama (2009–2016)	2742.0	5945.6	763.0	1634.9	$629.1
	(128.0)	(276.3)	(40.0)	(112.7)	($57.6)
Trump (2017–2020)	2588.5	5767.5	652.8	1369.5	$508.8
	(78.5)	(169.7)	(32.6)	(49.7)	($16.2)

Mean values shown with standard deviation in parentheses.

To investigate empirically employment trends for our defined experienced EPA employees, we estimated changes in the share of long-term employees. We used worker-level data to estimate a linear probability model for the likelihood that an EPA employee has a length of service (*LOS*) of 20 or more years.[10]

$$LOS20_{it} = \beta_0 + \beta_1(BushxNonSTEM_i) + \beta_2(BushxSTEM_1) + \beta_3(Trump\ x\ NonSTEM_i) + \beta_4(TRUMP\ x\ STEM_i) + \beta_5\mathbf{STEMCategory_i} + \beta_6 GradDeg_i + \beta_7\boldsymbol{\gamma}_\mathbf{d} + \beta_8 t + \varepsilon_{it} \quad (1)$$

where *i* denotes worker; *t* indexes years; the *Bush* and *Trump* variables are indicators for the respective presidential administrations; *NonSTEM* and *STEM* denote the employee's occupation type; **STEMCategory** is a vector of STEM areas; *GradDeg* is an indicator for graduate degree; and $\boldsymbol{\gamma}_\mathbf{d}$ denotes a vector of Census division fixed effects. The model includes a linear time trend,

[9] The federal government's definition of STEM employment includes social science and health occupations. We use the complete definition in our analyses below, but we verify the robustness of the results by categorizing these two occupation groups as non-STEM. These results are available on request.

[10] A Probit model yielded similar marginal effects. These results are available from the authors on request.

but the results do not change substantially if the trend variable is excluded.[11] The regression results are in column (1) of Table 2.

Table 2. EPA employees with 20 or more years of service

	(1) **Probability that employee has 20 or more years of service**	**(2)** **Number of employees with 20 or more years of service**
Bush x Non-STEM	− 0.018	− 0.040
	(0.012)	(0.032)
		[− 1.4]
Bush x STEM	− 0.018**	− 0.046**
	(0.008)	(0.022)
		[− 5.9]
Trump x Non-STEM	− 0.064**	− 0.317***
	(0.023)	(0.029)
		[− 10.1]
Trump x STEM	− 0.088***	− 0.239***
	(0.017)	(0.042)
		[− 29.0]
n	174,094	828

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$
Coefficients from linear probability model (column (1)) or Poisson model (column (2)) with Census division fixed effects. Robust standard errors are shown in parentheses; marginal effects from an unconditional Poisson model are shown in brackets. The data for the model in column (2) are aggregated by year, Census division, education level, and STEM status. The models include a linear time trend and indicators for STEM occupation and graduate degree. Heteroscedasticity-robust standard errors reported in parentheses.

The share of experienced STEM employees is about 2 percentage points lower under the Bush Administration and about 9 percentage points lower under the Trump Administration relative to years with Democratic administrations. We see too a lower share of experienced professional employees in non-STEM occupations during the Trump presidency.

We also estimated changes in the overall number of experienced employees at the Census division level using Eq. (2). We aggregated the individual-level data at the division level, adding separately by STEM status the number of experienced employees with a college degree and the number with a graduate degree during a given year. This dataset has 828 observations since we have 23 years of data, 9 divisions, 2 education levels, and 2 occupation categories. We estimated a Poisson regression model (Wooldridge, 1999) with Census division fixed effects and robust error variance:

$$\begin{aligned} E\left(NUM20_{dsjt} \mid STEM_j, Bush, Trump, GradDeg_s, \boldsymbol{\gamma}_{\mathbf{d}}, t\right) &= \boldsymbol{\gamma}_{\mathbf{d}} exp\big(\delta_1\left(BushxNonSTEM_j\right) + \delta_2\left(Bush\ x\ STEM_j\right) \\ &+ \delta_3\left(Trump\ x\ NonSTEM_j\right) + \delta_4\left(Trump\ x\ STEM_j\right) + \delta_5 STEM_j \\ &+ \delta_6 GradDeg_s + \delta_7 t\big) \end{aligned} \quad (2)$$

[11] These results are available from the authors on request.

where *d* indexes division; *s* is an education category; *j* is occupation category (STEM vs. Non-STEM); and *t* is year.

Column (2) in Table 2 shows the coefficient estimates for the model in Eq. (2), and the results parallel the findings from the worker-level analysis in column (1). The results suggest that there was a slight decrease in the number of experienced STEM employees during the Bush presidency, and a more pronounced decrease in both STEM and non-STEM employees with 20 or more years of experience during the Trump presidency. To put the coefficient estimates in Table 2 in context, we show marginal effects from a Poisson model that does not condition on division. These estimates point to an average decrease of 29 STEM and 10 non-STEM employees per Census division, year, and education level during the years of the Trump administration. This may be viewed as a substantial decrease given that the average number of experienced STEM employees per division and education level is 130, and for non-STEM employees the corresponding number is 35.

5. A consequence of the Trump Administration's EPA policy changes

Having demonstrated empirically the declining trend in scientists and staff at the EPA during both the Bush and Trump administrations, we now illustrate a social consequence associated with the declining trend. An important technology transfer metric from research activity in a federal laboratory is the number of scientific publications (*Pubs*) per year (NIST, 2019).[12] And, it has been shown that scientific publication counts in an agency are positively related to innovation metrics in that agency (Link & Scott, 2021). Data on *Pubs*, defined as scholarly publications by calendar year with at least one author affiliated with the EPA, came from the Scopus Database.[13]

Figure 2 shows the number of publications per fiscal year by presidential administrations. We also show a piecewise linear time trend with breakpoints in 2001, 2009, and 2017. While the number of STEM employees did decrease during the Bush administration, apparently the decrease did not surpass the threshold level to be evidenced in a decline in publication counts. However, the decline in publication counts during the Trump administration is pronounced. The same implications can be inferred from Fig. 3 in which the performance metric is publication counts per million dollars of R&D.[14]

[12] As stated in NIST (2019, p. 14): "Although intellectual property has traditionally been tracked in terms of the number of patents, licenses, and collaborative efforts [CRADAs], most federal research results are transferred [into society] through publication of S&E [Science and Engineering] articles."
[13] See www.scopus.com.
[14] R&D data came from AAAS (2021), and the data are measured in millions of $2020. Details of the statistical analysis underlying Figs. 2 and 3 are available from the authors on request.

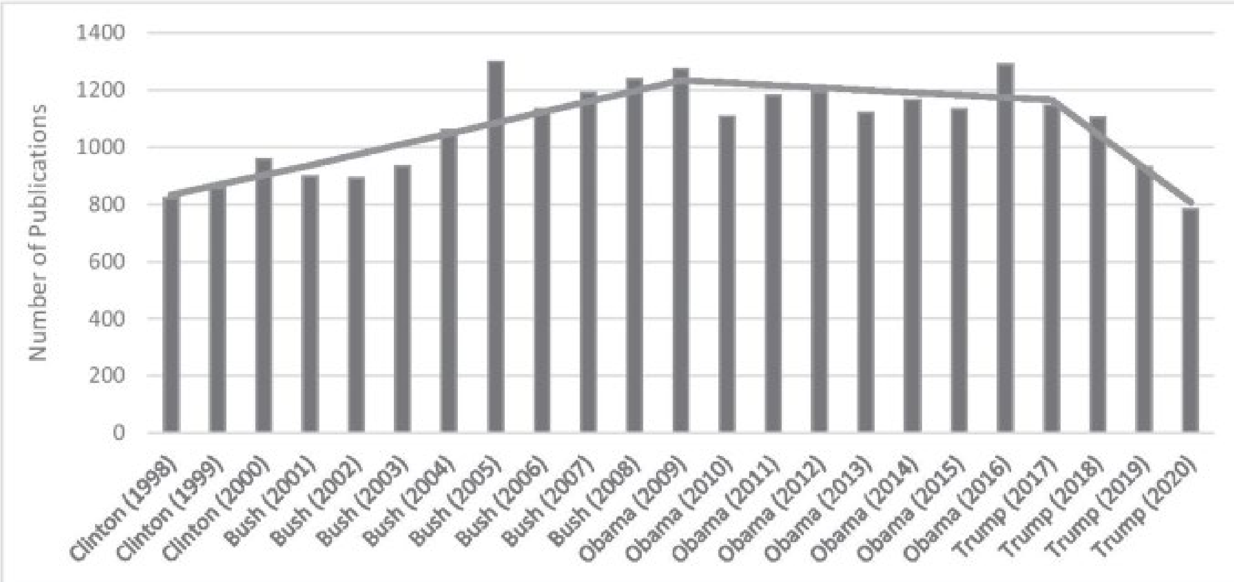

Fig. 2. Publication counts by presidential administration, by year. Note: The line shows a piecewise linear trend with breakpoints in 2001, 2009, and 2017. The corresponding slope estimates and their standard errors are: 34.3 (27.9) for 1998–2001; 37.2 (8.1) for 2001–2009; − 8.6 (8.1) for 2009–2017; and − 119.6 (27.9) for 2017–2020

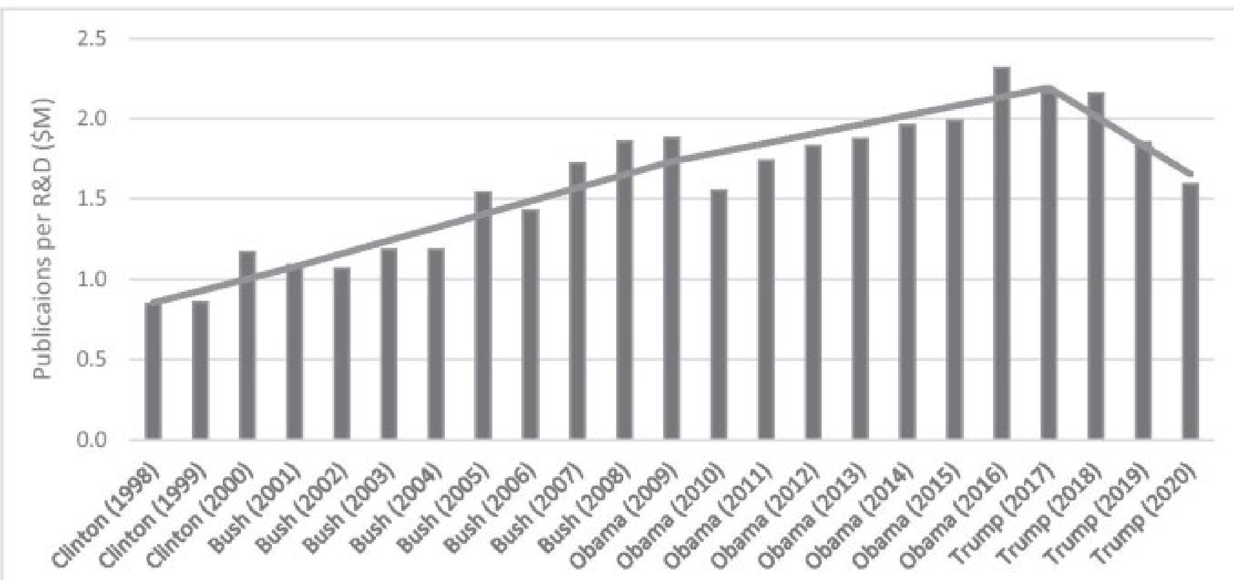

Fig. 3. Publication counts per R&D ($M) by presidential administration, by year. Note: The line shows a piecewise linear trend with breakpoints in 2001, 2009, and 2017. The corresponding slope estimates and their standard errors are: 0.074 (0.048) for 1998–2001; 0.082 (0.014) for 2001–2009; 0.057 (0.014) for 2009–2017; and − 0.180 (0.048) for 2017–2020

6. Concluding observations

Herein, we documented the number of scientists and staff leaving the EPA under the Trump Administration, and we associate that exodus with declines in the advancement of environmental innovation as measured by declines in scientific publications. While data are not available to quantify the short-run and long-run impacts from the attendant decline in environmental innovation, the known relationship between waning research activity and new environment EPA technology entering the economy (Link et al., 2019) suggests that our findings portend that technological advancement in the area of environmental science has suffered a setback.

Thus, in terms of the framework in Fig. 1, we suggest that the public policy changes at the EPA are perhaps in a position characterized by quadrant IV where the public sector's rate of return associated with these policy changes to the Trump Administration is greater than its hurdle rate, but the associated social rate of return is perhaps lower than society's hurdle rate. This suggestion is, of course, based only on a single social consequence to what we propose was conceived to be an innovative public policy initiative by the Trump Administration, and thus any generalization about the overall social benefits or consequences of the Trump Administration's actions related to the EPA are not possible.

We also suggest that more micro-oriented (in the management sense) research is needed to quantify examples of public sector entrepreneurship, and we propose that such research first demonstrate that the individual in question has characteristics of a public sector entrepreneur and that his/her actions have an innovative dimension.[15]

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[15] "… actions have an innovative dimension" refers to the Leyden and Link definition of public sector entrepreneurship as quoted above. See also Link (forthcoming) as an example of micro-oriented research.

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