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Greener Pastures? A Labor Market Theory of Climate Governance

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Climate governance requires access to climate experts: individuals with specialized knowledge of decarbonization and climate science. Here we model climate governance as the function of a competition between the state and private sector for a scarce pool of climate experts. Governments seek experts to develop and implement climate policies. Firms seek experts to affect policy choice, skirt enforcement, and measure climate risks to commercial interests. As firm interest in climate grows, the government's ability to attract experts declines, making it more reliant on the private sector for climate governance. To support this argument, we measure private sector demand for experts with unique data on U.S. job postings, paired with administrative data on government bureaucrats and procurement. Our findings offer a novel labor-based account of climate politics, contributing to the study of labor markets in political science, the sources of bureaucratic expertise, and the net effects of corporate social responsibility.

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Climate governance is marked by deep complexities and uncertainties. While the causes of climate change are well known, designing and projecting the effects of policies meant to mitigate warming are technically intensive tasks, shrouded in "fogs" of ambiguity (Stokes 2020, 36; Hai 2024). Models of local climate impacts, which guide public and private investments in adaptation and resilience, are difficult to develop and often opaque to lay audiences (Sobel 2021; Lehner et al. 2023; Boomhower et al. 2024). Climate action accordingly demands a high level of expert knowledge. Yet both governments and firms often lack the personnel able to supply this (Condon 2023). Recruitment of climate specialists has been complicated by the "limited number" of available experts and mounting demand across employers (Committeri et al. 2022, 10).[1]

Scholarship often takes government expertise in climate, its ability to implement effective climate policies if the political will is there, as a given.[2] We problematize this assumption. We instead understand climate governance to be the product of a competition between governments and firms for scarce climate experts. Policymakers and regulators seek experts to design, interpret, and enforce climate policies. Firms demand those same experts to strengthen their lobbying capacity and to meet legal and fiduciary obligations, such as to measure carbon emissions or physical climate risks to commercial interests. We characterize this competition in three steps. First, we argue that as firm demand for climate experts increases, the quality of expertise in government declines. Public bureaucracies struggle to counter the remunerative advantages of for-profit employers, impeding their ability to recruit and retain in-demand talent. Second, we theorize an ideological selection mechanism: firms should primarily pull extrinsically motivated experts away from public service, increasing the share of pro-social, intrinsically motivated workers in government.

[1] IMF 2023 [perma.cc/SPD7-ZZ7E], *Business Insider* 2022 [perma.cc/56PE-Y4Z4], *Financial Times* 2022 [on.ft.com/4cuIqwR].

[2] Some important literature analyzes state capacity vis-à-vis climate (e.g., Meckling and Nahm 2022), but less so the process by which expertise is developed and lost.

Third, despite this selection, we argue that the reallocation of expertise to firms prompts a *de facto* privatization of climate governance, with public agencies increasingly reliant on the private sector for the administration of climate policy.

To test this argument, we use new measures of private sector demand for expertise and granular data on U.S. federal bureaucrats. For the former, we leverage unique microdata on the near universe of jobs advertised by firms in the United States over the last decade. These data reveal an ongoing rush of firm demand for climate experts: the rate of job postings in the 2020s is nearly triple that of the 2010s, and the private sector wage premium for experts has likewise surged. Pairing this with individual-level data on government civil servants, we find that growth in private sector demand meaningfully erodes bureaucratic expertise. It reduces the average quality of bureaucrats, impedes bureaucratic recruitment, and skews the profiles of those successfully hired by government towards less educated and more junior workers. Notably, the primary mechanism appears to be out-recruitment of experts by firms; there is less evidence of firms poaching senior bureaucrats. We additionally find evidence of ideological selection: those who enter into and remain in government despite private sector demand express stronger pro-social sentiments, suggesting firms may largely hire experts with weaker intrinsic motivations for doing climate work. We lastly find, as theorized, that this loss of expertise has augmented environmental bureaucracies' reliance on third-party consultants, indicating mounting privatization of governance authority.

Our paper contributes a new understanding of how bureaucracies develop expertise in novel policy domains. Prominent theories emphasize determinants of expertise acquisition and recruitment that are internal to government, such as delegation of discretion by political principals or changes in messaging strategies (Gilligan and Krehbiel 1987; Gailmard and Patty 2007; Ashraf et al. 2020). We instead contend that consumption of expertise by firms impedes its acquisition by bureaucracies and other government offices. By arguing that public institutions and firms draw from the same pool of high-skilled workers — conceiving

of bureaucracies in terms of their place in broader labor markets — we effectively reframe expertise as a rivalrous good.

This conceptualization builds our understanding of bureaucratic performance generally and climate politics specifically. For the former, it suggests that holding constant the parameters of bureaucratic jobs, emergence of lucrative outside employment options may still drain governments of expertise. Public-private employment flows have been explored in the revolving door literature, which highlights the value to firms of employing past and future government staff (McCrain 2018; Lee and You 2023). With high-frequency data on the availability of outside employment options, which are unique in this literature, we detail how these revolving doors accelerate and decelerate over time.

By illuminating the transitory nature of government expertise, the paper brings theories of bureaucracy into closer conversation with those of climate politics. Our labor market-based conception of climate politics diverges from the growing literature that emphasizes electoral and lobbying (dis)incentives for climate action (e.g., Mildenberger 2020; Gaikwad, Genovese, and Tingley 2022; Colantone et al. 2024). While we agree with the importance of these factors, the labor market phenomena we identify may bind governments even in otherwise favorable political settings. Our findings connect well with work instead approaching climate as a complex issue marked by public-private expertise gaps (Green 2013; Stokes 2020). Building on literature that analyzes the behavior of bureaucratic principals and regulatory outcomes under these conditions (McCarty 2017; Perlman 2020), we offer a new dynamic understanding of how such informational asymmetries emerge and evolve over time.

Finally, this paper speaks to the consequences of private climate governance through corporate social responsibility (CSR) and environmental, social, and governance (ESG) initiatives. Scholars have been wary of CSR's ability to mitigate climate change primarily due to the concern that firms employ these initiatives in bad faith: rather than truly

attempting to fight climate change, private governance can be used to preempt public regulation (Malhotra, Monin, and Tomz 2019) or mask the lack of substantive mitigation efforts (Berliner and Prakash 2015; Green et al. 2022). This paper suggests that such initiatives, even when adopted in good faith, can compromise public regulatory capacity. Every climate expert that firms hire to carry out their private governance efforts reduces the pool of expertise available to the state. Sprawling growth in the "institutional patchwork" of climate governance may thus produce welfare-suboptimal outcomes on net (Falkner 2014, 195), particularly as wage differentials expand.

ALLOCATION OF EXPERTISE

Our theory understands climate to be a novel political issue, one in which most public and private institutions initially lack expertise. Political institutions dedicated to climate governance began to emerge in the 1980s and 1990s, often closely tied to communities of scientific experts (Haas 1992; Aklin and Urpelainen 2014). Attention to climate at generalist institutions, however — those without mandates specific to climate — took longer to emerge. Interest in climate governance at international financial institutions, for instance, did not seriously mount until the mid-2010s (Clark and Zucker 2024*a*). Central banks and financial regulators were further delayed in embracing the issue and remain lacking in expert knowledge (Condon 2022; Quorning 2023). Industry interest in climate is likewise recently ascendant (Sobel and Bieli 2024).[3]

Climate is moreover distinct in its technical complexity. Take one task of rapidly growing interest to both government and firms: modeling of future climate-induced physical risks to economic assets. Both firms, notably in the insurance industry, and public agencies use increasingly intricate catastrophe models to measure climate risks to commercial

[3]Firms have been attentive to climate since the 1990s (Green 2013), but this interest has recently deepened and broadened (Green et al. 2022; Lerner and Osgood 2023).

interests and government budgets, as well as to plan climate adaptation programs. The development of such models can require "a team of 10–20 leading experts from a variety of disciplines (specialists with PhD degrees) . . . work[ing] together for over two to three years" (Golnaraghi et al. 2018, 25). As another example, both firms and regulators have increasingly sought to evaluate financial institutions' resilience to future climate-related stressors. Efforts to conduct such tests have been plagued by a broad "lack of technical expertise on climate science and environmental economics" (NGFS 2020, 7). Measurement of greenhouse gas emissions, development of net-zero pathways, and identification of low-carbon investment opportunities likewise require expert involvement (Leffel 2022; Carnegie, Clark, and Zucker 2024).[4]

Demand for Climate Expertise

The novelty and complexity of climate change create incentives to acquire climate expertise. A large literature recognizes the importance of bureaucratic expertise to effective lawmaking (e.g., Weber 1948; Lewis 2007; Gailmard and Patty 2013; Blom-Hansen, Baekgaard, and Serritzlew 2021). In environmental and scientific contexts, academic expertise has long factored prominently into the development of international agreements (Haas 1992; Hai 2024), domestic policy (Greenstone, Kopits, and Wolverton 2013), and regulatory action (Perlman 2023). We accordingly assume that governments seek expertise to make and enforce climate-related policies and regulations. This expertise may be sought via agency bureaucracies, subnational governments, and other arms of the state, such as government-sponsored laboratories and legislative offices.

Public institutions' push for expertise is likely most intense when political leaders want to design and enact ambitious climate policies. But it should endure after those leaders are replaced by figures with weaker climate preferences or explicitly anti-climate platforms.

[4]Also see *Financial Times* 2022 [on.ft.com/4cuIqwR].

To the extent that civil servants remain motivated by policy outcomes despite changes in political leadership, they may still seek expertise to implement and enforce existing statutes when they retain that delegated authority across leadership transitions.[5] The ascension of an anti-climate leader may dampen demand in bureaucracies under their control (Bellodi, Morelli, and Vannoni 2024; Carnegie, Clark, and Zucker 2024), but not necessarily at the subnational level or in offices associated with opposition politicians.[6] It is also important to distinguish between expertise and political preferences; individuals with deep technical knowledge may be ideologically flexible and willing to carry out anti-climate agendas (see Gailmard and Patty 2007).

Profit-motivated firms in the private sector likewise benefit from acquiring expertise. Firms seek expertise in large part to identify and manage risks to commercial interests posed by decarbonization and physical climate impacts (Gazmararian and Milner 2024). Credit rating agencies are offering more climate risk services to customers.[7] Insurers and banks invest in modeling how future natural disasters will stress their portfolios (Golnaraghi et al. 2018). Agricultural firms have been pressed to assess how climate change will affect production.[8] All such projects demand extensive technical expertise, fueling growth in a nascent "climate services" industry (Condon 2023). Likewise, growing attention to net-zero transition plans, carbon emissions accounting, and ESG values has increased demand for expertise in corporate sustainability across the private sector (Thrall 2021; Lerner and Osgood 2023).[9]

Expertise also serves as a source of policy influence. In complex issue areas like cli-

[5]Recent work indicates, for instance, that "the core of the U.S. federal government resembles a Weberian bureaucracy ... largely protected from political interference" (Spenkuch, Teso, and Xu 2023, 1173).

[6]Under the Trump administration, for example, the offices of state attorneys general brought repeated pro-climate suits against the Environmental Protection Administration; *New York Times* 2019 [nyti.ms/4eS1YgK]; *Washington Post* 2019 [wapo.st/3VSNWm4].

[7]*Barron's* 2021 [bit.ly/3W8CeoG]; *Deutsche Bank Research* 2023 [perma.cc/282F-UPKW]

[8]*Agri-Pulse* 2020 [bit.ly/4bybcvo].

[9]*GreenBiz* 2022 [bit.ly/3xMMdXA].

mate, private sector command of issue-specific expertise confers sway over less-informed policymakers and regulators (Culpepper 2011; McCarty 2017; Brutger 2023). Perlman (2023), for example, illustrates how firms strategically withhold private information about their operations to manipulate rulemaking. This is a salient concern; information about the physical vulnerability and carbon intensity of assets and supply chains is often held privately by firms, especially in the absence of binding disclosure requirements (Carattini et al. 2022).

Expertise can further protect against unfavorable government actions. For example, to the extent that expertise supports technological innovation and corporate flexibility (Ding et al. 2022), carbon-intensive firms with more in-house expertise should be better positioned to adapt to strict climate regulations (Kennard 2020).[10] More sophisticated firms should more capably avert regulatory scrutiny (Hall and Miler 2008) and quell litigation risks (de Figueiredo and de Figueiredo 2002). Hedging of this sort may be especially appealing given the existential stakes of the issue and the uncertainty that marks climate policy trajectories (Colgan, Green, and Hale 2021; Green et al. 2022). As Green (2013) highlights, firm command of expertise may in fact prompt states to delegate rule-making authority to private actors, a possibility we return to below.

Balance of Climate Expertise

Demand across public institutions and firms generates a market for *climate experts*: individuals with advanced technical knowledge of climate change and decarbonization. Here we group together individuals who acquire climate-related knowledge via formal schooling and via professional experiences. The former category encompasses researchers with advanced technical training related to climate across engineering, law, and the natural and

[10] Green et al. 2022 find that R&D-intensive firms are typically more supportive of decarbonization, "reflecting the idea that more 'innovative' firms are more able to shift strategies" (2057).

social sciences. The latter camp includes government bureaucrats who learn about climate while on the job, as they have been found to do (Clark and Zucker 2024*a*,*b*),[11] and private sector employees who do the same.

The novelty of climate as a hiring priority explains the scarcity of climate experts available to public and private employers. For employees of public institutions or firms, there is less incentive and opportunity to invest in acquiring expertise when climate is not a focus of political principals, firm executives, or prospective employers. There should also be less production of academic expertise; the logic of Mincer (1974) implies that individuals will invest less in learning climate-related skills when expected labor market demand and earnings are lower. Even when hiring and wage offers increase, individuals generally lag in updating their education decisions (Deming and Noray 2020). There is some empirical support for these intuitions. Efforts to hire new climate specialists at the IMF have been complicated by a "limited number" of experts available worldwide (Committeri et al. 2022, 10). In a recent survey, a third of British sustainability executives listed "difficulty in hiring talent with climate change skills" as a primary impediment to decarbonization.[12] While supply of climate expertise may eventually equalize with demand — a possibility we return to in the conclusion — short-term shortages following demand shocks are theoretically plausible and empirically apparent.

Here we theorize how private sector demand affects bureaucratic composition and quality. To do so, we develop a simple formal model of a labor market with two employers, a *F*irm and a *G*overnment, and several climate experts indexed by i. Each expert is endowed with some level of quality, $q_i > 0$, observable to both employers. Both employers share the goal of hiring the highest-quality experts possible subject to their budget constraints

[11] Several scholars have made the argument, generalized beyond climate, that civil servants have incentives to develop expertise over the course of their time in government (Gailmard and Patty 2007, 2013; Lewis 2007).

[12] *Ernst & Young* 2022 [go.ey.com/4eVt7iM].

($b^j > 0,\ j \in \{F, G\}$), which determine the maximum compensation that can be offered to any given expert. Both employers have some demand for climate expertise, $0 < d^j \leq 1$, that scales their respective valuations on hiring climate experts.

Wage offers increase in expert quality and employer demand with a hard cap at each employer's budget constraint, such that all experts exceeding the quality threshold $q_i \geq b^j$ receive the same offer. Formally, each expert receives offers ω^j from both F and G at the following wage level:

$$\omega_i^j = \begin{cases} q_i d^j & \text{if} \quad q_i < b^j \\ b^j d^j & \text{if} \quad q_i \geq b^j \end{cases} \tag{1}$$

The wages offered to any given expert by F and G differ if at least one of two conditions is met: (1) the public and private sectors have different levels of demand for expertise, such that $d^F \neq d^G$; (2) the employers' budget constraints differ ($b^j > b^{\neg j}$) *and* expert i's quality exceeds the lower of the two constraints ($q_i > b^{\neg j}$).

When deliberating between their offers from F and G, experts weigh two factors. First, experts consider the wage offered by each employer, which we call *extrinsic* compensation. All else equal, we assume that all experts prefer higher wages. However, each expert is also endowed with some level of pro-sociality $0 \leq \gamma_i < 1$;[13] this can be understood as the non-wage, intrinsic premium placed on doing meaningful, welfare-enhancing work on climate (Ashraf et al. 2020), or the strength of their public service motivation.[14] We assume that highly pro-social individuals are willing to trade off higher pay for the opportunity to work at G, where they would serve the public interest rather than the interests of F's shareholders.[15] Experts accept the offer that maximizes their utility; an expert's utility

[13] While there may be fully pro-social experts who would never entertain any offer from the private sector, we focus on experts that could potentially be swayed one way or another.

[14] Our conceptualization is consistent with the notion of norm-based and affective public service motivation: "desire to serve the public interest" and "commitment to a program from a genuine conviction about its social importance" (Perry and Wise 1990, 370).

[15] We do not claim that private sector climate efforts do not serve the public interest in any way. We merely note that, as organizations, firms' primary responsibility is to serve shareholders rather than the general

from accepting each employer's offer is as follows:

$$U(\omega_i^F) = \omega_i^F(1-\gamma_i) \tag{2}$$

$$U(\omega_i^G) = \omega_i^G \tag{3}$$

We are interested in evaluating how an increase in F's demand for climate expertise affects experts' likelihood of accepting F's offer, as well as the average quality and pro-sociality of those who accept G's offer. To do so, we make one final assumption: the government is more constrained than the private sector in the maximum wage that it can offer to any particular expert, such that $b^F > b^G$. There is empirical support for this assumption; research points to a consistent private sector wage premium for the most educated workers, with government employers reacting sluggishly to private sector wage growth (Katz and Krueger 1991; Borjas 2002; CBO 2024).

We highlight three primary implications of this model for experts' preference for private sector versus government work ($U(\omega_i^F) - U(\omega_i^G)$). First, we show that for all climate experts, the appeal of private sector employment increases with F's demand for experts:[16]

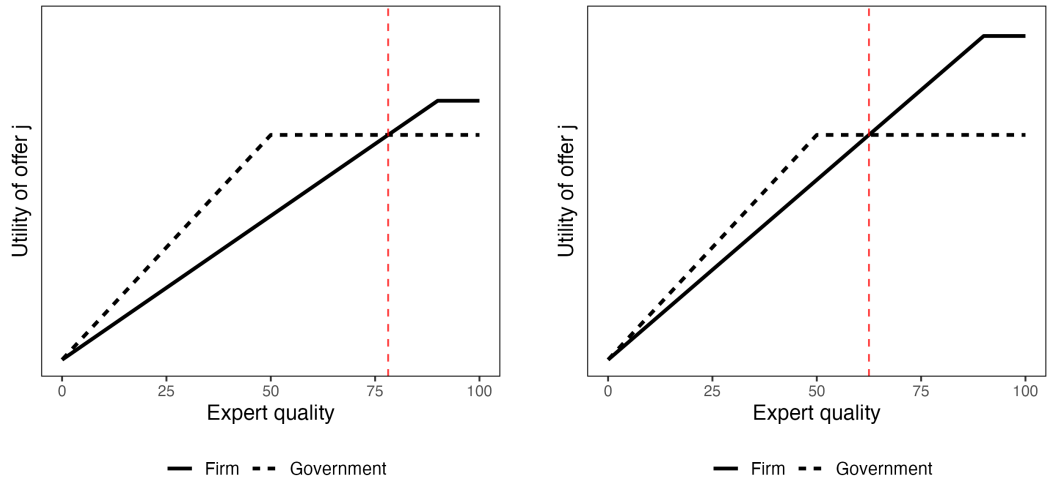
$$\frac{\partial U(\omega_i^F) - U(\omega_i^G)}{\partial d^F} > 0 \tag{4}$$

Intuitively, experts receive better employment offers from the private sector, relative to the government, as firm demand for climate expertise increases.

Next, we consider what mounting private sector demand implies for the quality of gov-

public. An interesting extension of the model could treat γ as a function of both individual expert preferences as well as the pro-sociality of particular governments and firms, to allow for the fact that some governments and firms are more pro-social than others. We leave this for future work.

[16] Proofs available in Appendix A.



(*a*) $d^F = 0.8$, $d^G = 1.0$, $\gamma = 0.2$ (*b*) $d^F = 1.0$, $d^G = 1.0$, $\gamma = 0.2$

Figure 1: As private sector demand for climate expertise (d^F) increases relative to public sector demand (d^G), higher-quality experts become relatively more likely to accept F's offer. Dashed red lines indicate the level of quality at which experts begin to prefer F's offer.

ernment experts. We show that for all experts with $q_i < b^F$:

$$\frac{\partial U(\omega_i^F) - U(\omega_i^G)}{\partial q_i \partial d^F} > 0 \tag{5}$$

That is, as firm demand for climate expertise increases, higher quality experts become relatively more likely to accept F's offer over G's. This implies that all else equal, as private sector demand for climate experts rises, the most skilled experts are particularly likely to pursue private sector employment. The relative quality of the government's climate bureaucracy should in turn decline.

Figure 1 illustrates this dynamic. The scenarios depicted in the two panels hold constant government demand d^G and expert pro-sociality γ, varying only firm demand d^F. Growth in firm demand increases the appeal of private sector wage offers, particularly for higher quality experts for whom government offers are already at the budget constraint. This consequently allows firms to recruit the high-quality experts that governments were once

able to attract. Articulated as a testable hypothesis:

Hypothesis 1. *Growth in firm demand for climate expertise impedes the recruitment and retention of high-quality climate experts by public institutions.*

Next, we consider the effect of increasing private sector demand for climate expertise on the pro-sociality of government experts. For all experts, we show that:

$$\frac{\partial U(\omega_i^F) - U(\omega_i^G)}{\partial \gamma_i \partial d^F} < 0 \tag{6}$$

As private sector demand for climate experts grows, pro-sociality has an *increasingly negative* effect on experts' likelihood of accepting private sector employment. The intuition behind this result is that, since pro-social experts receive only some proportion $1-\gamma$ of the utility from private sector offers, the absolute size of the private sector penalty $\gamma\omega_i^F$ is increasing in pro-sociality. Highly pro-social climate experts will be thus be difficult for firms to recruit away from government, even when the private sector wage premium is high. Less pro-social experts will remain relatively more attracted to private sector employment. In the aggregate, this leads to our second hypothesis:

Hypothesis 2. *Firm demand for climate expertise increases the average pro-sociality of government experts.*

De Facto Privatization?

Our model predicts that, as private sector demand for climate expertise increases relative to public sector demand, the highest quality climate experts will increasingly choose to work for firms rather than the government. Government interest in accessing top talent should persist, however. Here we discuss one means by which public agencies may compensate for challenges in hiring in-house experts: contracting environmental governance tasks out

to the private sector. Pay offers to temporary contractors are not bound by standard government payscales in countries such as the U.S., granting government agencies greater flexibility in sweetening compensation offers for contractors than for in-house experts.[17]

Government agencies will plausibly seek to contract out more technically intensive aspects of climate governance, where expert input is vital. One such domain is climate modeling, a task that requires sophisticated programming skills as well as knowledge of environmental science and econometrics. The U.S. Environmental Protection Administration (EPA) recently commissioned Eastern Research Group, a private consulting firm, to help it design an environmental input-output model to understand the emissions impact of industry-specific shocks.[18] As another example, the Pennsylvania Department of Environmental Protection relied on contractor ICF to develop a predictive model of extreme temperature within the state.[19] While Eastern Research Group and ICF are private firms, and their employees not government workers, they nonetheless supply expertise for the administration of public climate policy.

We argue that private sector demand for climate expertise, by diminishing government agencies' ability to bring experts in house, pushes the public sector to engage in more arm's length contracting with private sector environmental consultants. This implies, in turn, a shift in the conduct of climate governance from the public to private sector. Because this shift emerges from labor market pressures, rather than intentional acts by government, we argue that this amounts to a *de facto*, not *de jure*, privatization of governance authority.

Hypothesis 3. *Firm demand for climate expertise increases the government's procurement of environmental consulting services from the private sector.*

[17] See 5 U.S. Code § 3109—Employment of experts and consultants; temporary or intermittent.
[18] See Eastern Research Group [perma.cc/8RWC-9RY4].
[19] See ICF [https://perma.cc/YGQ3-PLHF].

DATA AND MEASUREMENT

We focus empirically on the United States. The U.S. is notable for the size of its "administrative state" (Dudley 2021), as well as for the level of private sector climate hiring in recent years. We test our theory with fine-grained data on firm demand for climate experts, the composition of the U.S. federal bureaucracy, bureaucrat pro-sociality, and government contracting.

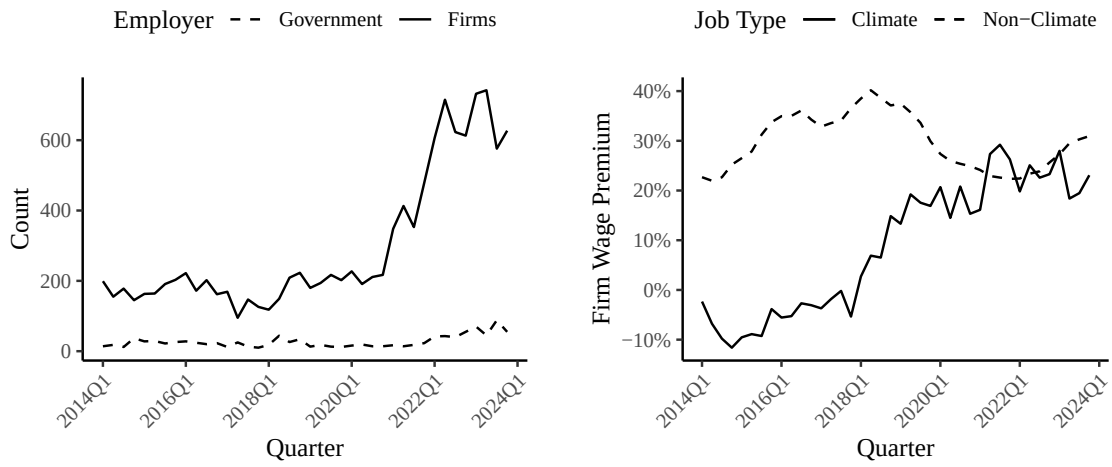
Demand for Experts

We measure firm demand for climate experts using data on 397 million job postings in the U.S. between 2010–2023, covering the private and public sectors. We draw these data from Lightcast, a labor market analytics company that collects large amounts of information on individual job openings, including job descriptions, education requirements, requested skills, and salary ranges. Despite its unique breadth and detail, Lightcast data have not been widely used in political science nor in any studies of climate change to our knowledge.[20]

As our theory concerns high-skilled workers, we focus on full-time, non-internship positions that require applicants to hold a postgraduate degree. We then identify job postings targeted at climate experts based on the skills required. To measure such skills, we rely on the Lightcast Open Skills Taxonomy, which uses a mix of human coders and machine-learning algorithms to match jobs with granular, specialized skills; prior users of the taxonomy include the U.S. Bureau of Labor Statistics and UK Office for National Statistics.[21] We define climate jobs as those involving at least one of 43 climate-related skills; as representative examples, these skills include expertise in climate modeling, climate policy, and emissions calculations (full list in Appendix B).

Figure 2 summarizes changes in demand for climate experts using this skill-based mea-

[20]Data from Lightcast, formerly known as Burning Glass Technologies, have been recently used in labor economics (e.g., Deming and Noray 2020). For one political science application, see Berliner, Kalyanpur,



(*a*) Climate Job Postings by Employer

(*b*) Firm vs. Government Wage Premia

Figure 2: Panel (a) displays the count of climate jobs by quarter and employer type. Panel (b) plots the percentage difference between the eight-quarter rolling means of private sector and public sector wages for climate vs. non-climate jobs. Sample limited to full-time jobs in the U.S. requiring a postgraduate degree.

sure. Affirming our theoretical intuitions, two trends are immediately apparent. First, panel 2(a) illustrates a surge in private sector demand for climate expertise in recent years that far surpasses public sector demand in magnitude. Firms advertised 6,827 climate jobs between 2021 and 2023, nearly three times as many as were posted in the preceding three years. Second, panel 2(b) shows that this proliferation of climate jobs mirrors growth in the wages on offer. Over the last decade, high-skilled non-climate wages in the private have exceeded those in government by 30% on average.[22] Wage premia for climate experts have rapidly converged to and occasionally risen above this level in recent years. This supports our claim that climate experts face mounting wage incentives to take private sector jobs. While government agencies' demand for climate experts has also grown, they have struggled to narrow wage differentials.

and Thrall 2024.

[21] See Lightcast [perma.cc/4HYD-ZB5E].

[22] Limited to jobs requiring a postgraduate degree.

Bureaucratic Composition

We use two sources of data to measure the composition and characteristics of climate expertise in the public sector. First, we draw on U.S. Office of Personnel Management (OPM) FedScope data, which provide detailed individual-level employment information on 96% of federal employees at the quarterly level.[23] This comprehensive administrative dataset, compiled automatically from files that executive agencies submit to OPM, has been used in recent micro-level studies of the federal bureaucracy (Ban, Park, and You 2024; Decarolis et al. 2020; Spenkuch, Teso, and Xu 2023). FedScope data provide rich detail on the salary, class and grade, age, education, length of service, and — importantly for our purposes — *occupation* of federal workers, which allows us to identify which workers hold climate-relevant positions across all agencies. FedScope provides similar datasets on newly acquired and separated workers; we use these to identify the extent to which workforce changes owe to shifts in hires versus exits.

To test for changes in pro-sociality, we require a measure of bureaucrat preferences. For this we draw on thirteen waves of the OPM Federal Employee Viewpoint Survey (FEVS), a workplace climate survey administered annually to most of the federal workforce. The FEVS carries a relatively high average response rate of approximately 33%.[24] It contains a variety of items regarding individuals' experiences in the workplace, job satisfaction, and opinions regarding the success of their respective agencies. Usefully, each FEVS wave from 2010–2022 asked respondents about the extent to which they receive a feeling of *personal accomplishment* from their work; we use this to measure bureaucrats' pro-sociality.

[23]The data exclude postal workers and politically sensitive employees, such as intelligence and foreign service officers (Jennings and Nagel 2020). The data are anonymized. While de-anonymized data procured via Freedom of Information requests are available through 2018, we use FedScope since much of the growth in private sector demand occurs after this point.

[24]The response rate among EPA employees is 55%. See OPM 2022 [perma.cc/66VS-KFM9].

Federal Agencies' Procurement of Consulting Services

To test Hypothesis 3, we use rich data from the U.S. General Services Administration on the near universe of procurement contracts signed by all non-military U.S. executive agencies from 2014–2023. The data, which come from the Federal Procurement Data System and were accessed via SAM.gov, contain detailed metadata on approximately nine million federal contracts.[25] Contract-level variables include the name of the contracting firm, the primary location where the contract will be carried out, the value of the contract, and — importantly for our purposes — the firm's six-digit NAICS industry classification. We use industry classifications to identify contracts in which a federal agency purchased consulting services from the private sector.

BUREAUCRATIC QUALITY

How does private sector demand for climate expertise affect the composition of the federal climate bureaucracy? We draw on FedScope data to answer this. We first use the provided occupation codes to identify federal employees in climate-relevant positions. We define climate-relevant occupations as "environmental protection specialist," "environmental protection assistant," "general natural resources management and biological sciences," "ecology," and "environmental engineering." We filter to the nineteen federal agencies with at least 1,000 climate-relevant employee-quarter-year observations. We then aggregate to the agency-quarter-year-job type (climate relevant or not) level. For example, we have separate observations for Department of Agriculture, 2018Q2, climate-relevant, and Department of Agriculture, 2018Q2, other (non-climate relevant).

This data structure allows us to use each agency's non-climate relevant staff as a com-

[25]Federal agencies must report all contracts that are estimated to be worth $10,000 or more to the Federal Procurement Data System. See FPDS [perma.cc/3TSX-X645].

parison group for its climate experts; non-climate employees should be unaffected by private sector climate demand, while accounting for agency-specific hiring practices. Importantly, we do *not* include the EPA in this analysis. While the EPA is the primary federal agency tasked with climate change mitigation, it is not feasible to identify non-climate relevant workers within the agency. Lawyers, accountants, and others at the EPA plausibly work on or have an interest in climate-related issues, and thus may also be affected by private sector demand for climate expertise.

Our identification strategy approximates a difference-in-differences design with continuous treatment. The treatment variable, plotted in Figure 2(a), is the logged number of climate-relevant private sector job postings in a given quarter. The treated group is the population of climate-relevant employees within each of the nineteen federal agencies in our sample; the comparison group is the population of all other non-climate-relevant employees within those agencies. We estimate the following equation by ordinary least squares:

$$Y_{atc} = \alpha \mathbb{I}(c = \text{climate}) + \beta \text{demand}_t + \delta[\text{demand}_t \times \mathbb{I}(c = \text{climate})] + \phi_a + \gamma_t + \varepsilon_{atc}$$

where a indexes agencies, t quarter-years, and c the climate-relevance of the job type.

Our coefficient of interest is δ, the interaction between private sector climate demand and a binary indicator for climate-relevant employees. All models include agency and quarter-year fixed effects. We estimate the above equation for several different outcomes related to experts' skill or quality: their salary, education (graduate degree or PhD), general schedule (GS) grade — the classification system used by the federal government to measure rank and decide pay[26] — and length of federal service. It is important to note that we are using the salary outcome as a proxy for skill, under the assumption that higher-skilled experts receive larger salaries, rather than using it to draw conclusions about the competi-

[26]Per OPM, "agencies establish (classify) the grade of each job based on the level of difficulty, responsibility, and qualifications required" [perma.cc/YG7N-BKY9]. GS grades range from 1 (lowest) to 15 (highest).

DV:	Salary (log)	Prop. MA+	Prop. PhD	Avg. GS	Avg. LOS	Workers (#)
Demand × Climate-relevant	−0.027** (0.009)	−0.021* (0.008)	0.001 (0.011)	−0.200*** (0.044)	−0.051 (0.181)	−3810.757 (4346.638)
N	2,014	2,014	2,014	2,014	2,014	2,014
R^2	0.905	0.927	0.782	0.823	0.628	0.653
Quarter-year FE	✓	✓	✓	✓	✓	✓
Agency FE	✓	✓	✓	✓	✓	✓

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 1: Regressions of bureaucratic quality on private sector demand in same quarter, interacted with climate relevance of job type. Standard errors clustered by quarter-year and agency.

tiveness of the government's wage offers relative to the private sector. We also estimate the effect of private sector demand on the number of climate experts in government relative to other types of federal employees.

Table 1 presents the results of six models alongside robust standard errors clustered by federal agency and quarter-year. The results are broadly in line with Hypothesis 1. Greater private sector demand is associated with lower salaries, lower GS grades, and a lower proportion of graduate degrees among federal climate experts relative to non-experts. The effects are of non-trivial magnitude as well. The change in demand observed between 2017Q2 and 2022Q2 would be associated with a relative salary reduction of 5% for federal climate experts and a 3.9 percentage point reduction in the relative proportion of climate experts with graduate degrees. Results are consistent when re-estimating the model at the individual level (Appendix C), and across the Obama, Trump, and Biden administrations (Appendix D).

Recruitment vs. Retention

The results in Table 1 suggest that increased private sector demand for climate expertise produces a climate bureaucracy that is relatively less educated, lower on the government payscale, and less well compensated. There are two primary paths through which private

DV:	Salary (log)	Prop. MA+	Prop. PhD	Avg. GS	Avg. LOS	Hires (#)
Demand × Climate-relevant	−0.069** (0.019)	−0.020 (0.016)	−0.013* (0.006)	−0.628** (0.165)	−1.060*** (0.170)	−425.546* (151.033)
N	1,958	1,957	1,957	1,846	1,958	1,958
R^2	0.735	0.615	0.573	0.692	0.269	0.532
Quarter-year FE	✓	✓	✓	✓	✓	✓
Agency FE	✓	✓	✓	✓	✓	✓

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2: Regressions of new *hire* characteristics on private sector demand in same quarter, interacted with climate relevance of job type. Standard errors clustered by quarter-year and agency.

sector demand could impact the federal workforce. First, it could be that more abundant and more lucrative private sector opportunities make it more difficult for the government to hire top climate talent (*recruitment*). Second, private sector demand may lead high-quality experts to exit government in pursuit of greater private sector pay (*retention*).

To determine how much of the aggregate effect of private sector demand is driven by challenges in recruitment versus retention, we make use of additional FedScope datasets on the characteristics of (*a*) newly hired federal workers, and (*b*) federal workers that are resigning their positions. Both datasets contain nearly identical sets of variables to the aggregate FedScope data, differing primarily in that they are reported at the monthly rather than quarterly level; we aggregate up to the agency-quarter year-job type level for consistency. We estimate the same models as Table 1 for both hires and quits.

Table 2 presents the estimates for new federal hires. As in the aggregate data, increased private sector demand for climate expertise significantly reduces the average salary and GS grade of newly hired government climate experts relative to other new hires in their agencies. The magnitude of the salary effect is particularly notable: the change in private sector demand from 2017Q2 to 2022Q2 would be associated with a relative salary reduction of 13% for newly hired experts. Further, private sector demand reduces the relative proportion of climate experts that are hired with PhDs, the average length of service for climate experts

DV:	Salary (log)	Prop. MA+	Prop. PhD	Avg. GS	Avg. LOS	Quits (#)
Demand × Climate-relevant	−0.043* (0.017)	−0.034 (0.020)	−0.024 (0.020)	−0.539*** (0.110)	−0.437 (0.324)	−225.093*** (56.556)
N	1,767	1,769	1,769	1,634	1,769	1,769
R^2	0.697	0.532	0.465	0.768	0.287	0.648
Quarter-year FE	✓	✓	✓	✓	✓	✓
Agency FE	✓	✓	✓	✓	✓	✓

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: Regressions of new *quit* characteristics on private sector demand in same quarter, interacted with climate relevance of job type. Standard errors clustered by quarter-year and agency.

hired from other federal government positions, as well as the overall number of new hires of climate experts relative to other hires within their agencies. The effect of increased private sector competition on the government's ability to recruit high-quality climate experts — those with greater experience and education — appears to be substantial.

Table 3 presents the estimates for new resignations, an approximate measure of failed retention by government agencies. These results are more mixed. Among bureaucrats who do quit, increased demand is associated with lower average salary and GS grade. This suggests that the experts who leave government amid increased private sector demand are more junior. This may reflect the generally higher levels of labor mobility among younger workers (Mincer and Jovanovic 1979); many junior federal employees have not yet had their pensions vest.[27] It may also reflect greater possession of agency-specific knowledge by more senior bureaucrats, which suppresses pursuit of outside employment options (Bertelli and Lewis 2013). Overall, increased private sector demand for climate expertise results in relatively fewer quits among those in climate-relevant positions. It accordingly does not appear that private sector demand primarily reduces bureaucratic expertise via failures of retention (i.e., poaching by firms).

[27] Pensions under the Federal Employees Retirement System take five years of service to vest; see *FEDweek* 2023 [perma.cc/BL33-Z86X]. Notably, over half of all quits in the FedScope data are accounted for by federal employees with 1–5 years of service.

In sum, aggregate findings on the effect of private sector demand appear to be driven by challenges in recruitment more so than in retention. Private sector competition does not appear to inhibit government retention of high-quality experts, but it does make it more difficult to hire new ones. This comports with the descriptive finding that it is fairly uncommon for federal employees to quit their jobs; among climate experts, there are five times as many new hires as there are quits.[28] The strength of the recruitment results suggests that the long-term impact of private sector competition on bureaucratic quality may be greater than the short-term effects reported in Table 1, as bureaucrats gradually retire from government service and cannot be replaced by experts of equal quality.

IDEOLOGICAL SELECTION

Our model of labor market competition suggests that increased private sector demand for climate expertise should affect not only the quality but also the *pro-sociality* of the government climate workforce. Higher private wages attract less intrinsically motivated climate experts, screening these individuals out of (potential) government employment.

To test this, we use data from thirteen annual FEVS surveys of the federal workforce. We measure pro-sociality using workers' level of agreement with the following statement, which is worded identically in all survey waves: "My work gives me a feeling of personal accomplishment." Responses take the form of a five-point Likert scale, ascending in level of agreement. We believe that this survey item maps well to the concept of pro-sociality or intrinsic motivation: it captures the extent to which federal workers derive satisfaction from their work, excluding factors like compensation that may be factored into a more encompassing measure such as general job satisfaction.

It is possible that responses to this item are correlated with the *outcomes* of respondents' efforts. A bureaucrat may feel greater personal accomplishment from her work, indepen-

[28]This figure is similar for all other federal employees, among whom there are 23% as many quits as hires.

dent of the nature of that work, if she believes that it is delivering results. To account for this, we measure workers' perceived efficacy via stated agreement with the following item: "My agency is successful at accomplishing its mission." An increase in feelings of personal accomplishment without a concurrent increase in perceived efficacy suggests greater prosociality, as it suggests that federal employees derive greater satisfaction from their work independent of its results.

We use the same measure of private sector demand for climate expertise as in previous models. FEVS data do not record employee occupations; accordingly, we use employment in the EPA as a proxy for whether an employee holds a climate-relevant position. In these tests, we compare responses from federal workers employed by the EPA to those employed at all other federal agencies. The estimation strategy is otherwise similar to that employed in the above analyses of bureaucratic quality. We estimate the following by OLS:

$$Y_{ait} = \alpha \mathbb{I}(a = \text{EPA}) + \beta \text{demand}_t + \delta[\text{demand}_t \times \mathbb{I}(a = \text{EPA})] + \theta X_{it} + \phi_a + \gamma_t + \varepsilon_{ait}$$

where a indexes agency, i individuals, and t year.

Our data is at the employee-year level, although there are no unique identifiers that permit tracking of individuals across surveys. Our coefficient of interest is δ, the interaction of private sector demand and a binary indicator of whether a respondent works at the EPA. All models contain year fixed effects; some contain agency fixed effects. We include respondent-year controls for gender and length of federal tenure,[29] the only consistently measured demographics in the FEVS. To account for the possibility that Donald Trump's election in 2016 disproportionately affected the attitudes of EPA workers, we control for the interaction of Trump's term (an indicator variable equal to 1 for the years 2017–2020) and the EPA indicator.

[29]Measured as a categorical variable: (1) less than 10 years, (2) 11–20 years, (3) more than 20 years.

DV:	Personal accomplishment (1–5)			Org. accomplishing mission (1–5)		
	(1)	(2)	(3)	(4)	(5)	(6)
Demand × EPA	0.098***	0.110***	0.099***	0.137***	0.016	0.024
	(0.004)	(0.003)	(0.015)	(0.001)	(0.010)	(0.021)
N	5,948,131	4,926,710	4,926,710	5,772,065	4,858,654	4,858,654
R^2	0.002	0.004	0.013	0.008	0.012	0.031
Controls		✓	✓		✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Agency FE			✓			✓

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Regressions of agreement with the statements "my work gives me a feeling of personal accomplishment" and "my agency is successful at accomplishing its mission" on private sector demand, interacted with whether respondent works at the EPA. Standard errors clustered by year and agency.

Table 4 presents the results of six models alongside robust standard errors clustered by agency and year. Models 1–3 demonstrate that private sector demand for climate expertise has a positive and significant effect on feelings of personal accomplishment among EPA workers relative to those at other agencies. This effect is robust in both magnitude and statistical significance to the inclusion of controls and agency fixed effects. On the contrary, Models 4–6 demonstrate that — while there is a positive and significant effect on perceived efficacy in Model 4 — the estimates shrink dramatically in magnitude and lose significance when controls and agency fixed effects are added. The impact of private sector demand on pro-sociality within the EPA cannot be explained simply by a concurrent increase in perceptions of institutional efficacy.

These results are consistent with Hypothesis 2. As private sector demand for climate expertise grows, and along with it the private sector wage premium, climate experts who are primarily motivated by extrinsic compensation will be particularly inclined to seek greener pastures in the corporate world. The promise of more lucrative firm employment will also be enticing to pro-social climate experts, though less so. As a result, private sector

competition leads to greater average pro-sociality in the climate bureaucracy.

What do these results imply for climate governance? On one hand, they may indicate that private sector competition supports efficient ideological sorting; the pro-social, "mission-driven" bureaucrats who remain attracted to government work may be particularly innovative and effective in designing and implementing climate policies (Honig 2024). But it may be reputationally damaging for the EPA to be staffed primarily by experts with strong ideological convictions; the EPA is already perceived by those within the senior executive service to be one of the most left-wing agencies in the federal government (Richardson, Clinton, and Lewis 2018) and has experienced reputational decline in recent years (Bellodi 2023).

Selection for pro-social experts may also amplify the bureaucratic turnover that occurs with changes of political principals. The ascension of anti-climate principals plausibly reduces the discretion granted to bureaucrats. Per Gailmard and Patty (2007), this tightened constraint should be most troubling for policy motivated, pro-social staff. As the share of pro-social bureaucrats increases, so should overall rates of exit under an administration that is more hostile to climate policy.

DE FACTO PRIVATIZATION

We have thus far demonstrated that increased private sector demand for climate expertise limits the government's recruitment of high-quality experts; growing private sector wage premia have made federal employment relatively unfavorable for these experts, unless they are pro-social types who receive large non-wage benefits from government work. Hypothesis 3 posits that one consequence of this shift is increased reliance on private sector contractors for the administration of climate policy. In this way, greater private sector demand for climate expertise may lead to *de facto* privatization by expanding the role of private

industry in climate governance.

To test this hypothesis, we use the aforementioned data on procurement contracts signed by U.S. executive agencies from 2014 through 2023. These data constitute all significant ($> \$10,000$) purchases of goods and services made by government buyers from private contractors. Crucially for our purposes, these data contain granular industry codes for each individual contract. This allows us to identify all contracts in which an agency purchased private consulting services.[30] Consulting, more so than other services, captures a relationship in which the agency is paying to access private sector expertise. Such relationships are common: 70 of the 75 agencies in our data purchased some form of consulting services during the sample period and consulting services constitute 6% of all contracts signed.

Figure 3 shows the EPA's use of private consultants has increased rapidly over the last five years relative to the federal government average. While consulting accounted for less than one-quarter of the agency's purchases in 2014–2017, it accounted for well over one-third by 2023. Further, unlike other agencies, the vast majority of the EPA's consulting purchases concern *environmental* consulting (77% vs. 15% for other agencies). We argue that, rather than constituting part of a general secular increase in federal agencies' use of consultants, the disproportionate increase in the EPA's purchase of consulting services reflected in Figure 3 is a result of the concurrent rise in private sector demand for (and acquisition of) top climate experts.

To test this claim, we run several regressions using the procurement contract data. We use the same measure of private sector demand for climate expertise as in previous analyses, interacted with an indicator variable equal to 1 when the contracting agency is the EPA. To test Hypothesis 3, we take as our outcome an indicator variable equal to 1 if a given contract relates to the purchase of consulting services. We predict a positive sign on this interaction term: as private sector demand for climate experts goes up, we expect the EPA to increase

[30]NAICS codes `541611, 541614, 541690, 541612, 541618, 541620, 541613`.

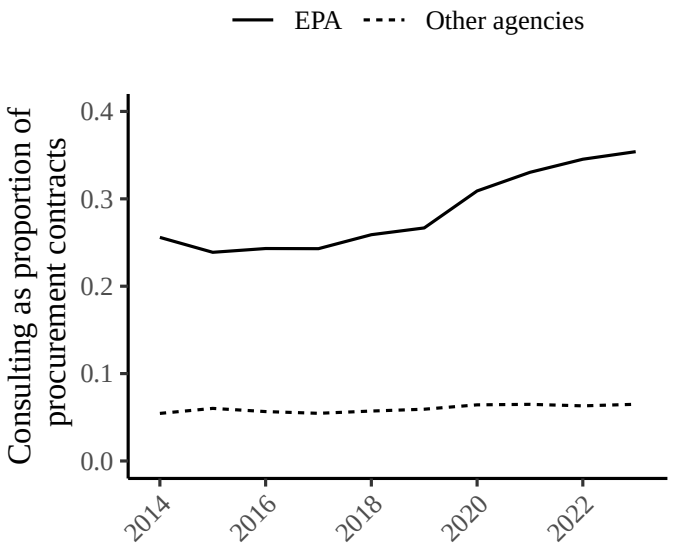


Figure 3: Proportion of procurement contracts going to consultants, by year and agency. The Environmental Protection Agency has increased its use of private sector consulting services to a greater extent than other executive agencies in recent years.

its reliance on private sector consultants relative to other agencies. We also use a number of placebo outcomes — contracts for construction, logistics, and manufacturing — for which our theory predicts no similar effect. For all outcomes, we estimate the following model:

$$Y_{aits} = \alpha \mathbb{I}(a = \text{EPA}) + \beta \text{demand}_t + \delta[\text{demand}_t \times \mathbb{I}(a = \text{EPA})] + \phi_a + \gamma_t + \iota_s + \varepsilon_{aits}$$

where a indexes agency, i contract, t quarter-year, and s the U.S. state in which the contract is carried out.[31]

Table 5 presents the results of five OLS regressions alongside robust standard errors clustered at the state level. Models 1 and 2 provide support for Hypothesis 3: with or without a demanding set of fixed effects, increased private sector demand for climate experts is strongly associated with increased use of consulting services by the EPA relative to other

[31] We include state fixed effects to ensure that results are not driven by, for example, the opening or closing of new regional offices that may have systematically different procurement needs.

DV: contract is for...	Consulting		Construction	Logistics	Manufacturing
	(1)	(2)	(3)	(4)	(5)
Demand × EPA	0.068***	0.059***	−0.001	−0.001*	−0.001
	(0.015)	(0.011)	(0.001)	(0.001)	(0.002)
N	7,547,738	7,547,738	7,547,738	7,547,738	7,547,738
R^2	0.017	0.201	0.583	0.020	0.909
Quarter-Year FE		✓	✓	✓	✓
Agency FE		✓	✓	✓	✓
Sector FE		✓	✓	✓	✓
State FE		✓	✓	✓	✓

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table 5: Regressions of indicator variables for various contract industries on private sector demand, interacted with an indicator variable equal to 1 when the contracting agency is the EPA.

agencies. This effect size is substantively meaningful: a one standard deviation increase in private sector demand would be associated with a 3.3 percentage point increase in the EPA's use of consultants relative to the rest of the federal bureaucracy. Further, we see no similar effects for any of the placebo outcomes, all of which are near zero in magnitude. This should ameliorate the concern that our results are merely picking up some broader, unrelated shift in the EPA's procurement strategy.

As private sector demand for climate expertise increases, the EPA becomes relatively more reliant on private consultants than other federal agencies. Unsurprisingly, we find even stronger results when we limit our focus to *environmental* consulting (see Appendix Table E1). We also aggregate the contracts data up to the agency-quarter-year level to look at additional outcomes; as Appendix Table E2 shows, private sector demand is associated with growth in the EPA's proportion, number, and (for environmental consulting) total value of consulting contracts relative to the rest of the federal government.

The evidence provided in this section suggests that, despite the lack of formal legislation or salient announcements to this effect, U.S. climate governance is undergoing *de*

facto privatization. What are the likely consequences of this phenomenon for the quality of climate policy? We offer two conjectures.

First, we point to Hart's (2003) observation that the government's decision to contract for a service at arm's length rather than providing it internally mirrors the dilemma explored by economic theories of the firm. When an upstream firm supplies a downstream firm, it faces a hold-up problem: specializing in the production sought by the downstream firm makes it vulnerable to extortion. Likewise, for a private sector consultant, specialization in government services could increase the government's ability to extract a lower price for its services. To avoid this problem, contractors may refrain from making investments sought by the government, limiting the quality of their government services. In this sense, contracting could imply some loss in the government's control over the making and administration of climate policy.

Second, we note that a large body of work has analyzed the trade-offs inherent in privatization and how these trade-offs may vary by policy area. Hart, Shleifer, and Vishny (1997) model privatization as a choice that delivers cost savings at the risk of diminished service quality, as private contractors are typically more efficient but may not share the government's objective for maximizing social welfare. In this model, privatization is more favorable when the government wants to encourage innovation in the policy area and when the deleterious side effects of cost cutting are obvious enough *ex ante* that they can be prevented through contracting. Hart, Shleifer, and Vishny (1997) argue, for example, that arms procurement is a clear case where privatization works well (innovation is important due to geopolitical competition; weapons quality is easy to contract on), whereas policing is an area where public provision is best (innovation is less important; it is difficult to specify complete contracts to prevent low-quality policing).

The implications of climate contracting are ambiguous. On one hand, policy innovation is critical to effective climate change mitigation and adaptation, and much policy experi-

mentation occurs outside of national governments (Sabel and Victor 2022). However, the complexities of climate change, including difficulties in projecting policy impacts (Stokes 2020), make it difficult to fully specify a contract that prevents a consultant from delivering a cost-efficient but welfare-suboptimal policy solution. This challenge is exemplified by growth in the "climate risk services" industry, where firms offer climate models of variable rigor and difficult-to-verify quality (Condon 2023). Contracting where firm performance is more easily assessed — e.g., infrastructure projects meant to build climate resiliency — may better enhance social welfare. Given the market-driven, *de facto* form of privatization that we document, it is unlikely that the government has increased consultant procurement based on a strategic consideration of these trade-offs.

CONCLUSION

Both governments and firms have incentives to acquire climate expertise. But the supply of that expertise is limited. This paper reframes climate governance as the product of a labor market competition between governments and firms for climate experts. We argue that as firm demand increases and private sector wage premia mount, governments struggle in the short term to recruit and retain climate experts, particularly those with weaker pro-social motivations. This, in turn, prompts some *de facto* privatization of climate governance as governments compensate for relative losses of expertise via private sector contracting.

To test this argument, we analyze unique data on firm hiring priorities and the composition and attitudes of the U.S. federal bureaucracy. We find, in line with our theory, that growth in firm demand lowers the share of high-skilled climate-relevant staff on government payrolls. This loss of expertise appears to primarily owe to challenges in government recruitment, and less so due to failures of retention. We moreover find evidence of ideological selection: those remaining in government as private sector hiring grows espouse

stronger pro-social views. Lastly, we link growth in private sector demand to increased government use of consultants, a means of compensating for difficulty in recruiting experts.

This paper points towards three paths for future work. First, for tractability, our theory treats changes in firm demand for expertise as exogenous. Future work should problematize this. One compelling possibility is that firm demand is endogenous to real or perceived climate policy trajectories. When firms experience or anticipate strengthened climate regulations, the returns to acquiring expertise plausibly grow, increasing wage offers and accelerating the flow of experts away from government. Greater policy ambition and regulatory stringency may, as a result, paradoxically complicate the implementation and enforcement of those laws. Forward-looking policymakers may anticipate this and proactively dampen their climate ambition. Narrowing wage differentials between the public and private sectors could guard against this possibility.

Second, for both academics and practitioners, a key question is what allows governments to retain an adequate supply of expertise under tight budget constraints. One option is to invest in converting bureaucrats already on staff into climate experts, but this may be unattractive if those bureaucrats cannot credibly commit to then forgo high-paying private sector jobs. Another option is to more aggressively select for pro-social experts or induce greater pro-sociality among jobseeking experts. Recruitment and messaging strategies that accomplish this may insulate public institutions from growth in private sector demand and support effective climate governance.

Third, we theorize about and measure short-term changes in bureaucratic expertise, arising from an initial shortage of climate experts. Over time, mounting demand for expertise should also increase the supply of that expertise. As supply and demand equalize, labor market power plausibly will shift from expert workers to employers. This, in turn, will incentivize experts to further distinguish themselves to employers in some way. For those

interested in private sector work, one means of doing so may be to undertake government work — acquiring political connections and bureaucratic knowledge that subsequently appeal to private employers. While climate labor markets have not yet reached that stage in practice, scholars should remain attentive to the evolution of climate as a profession and its implications for climate governance.

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APPENDICES

A. Proofs for Comparative Statics
B. List of Climate Skills
C. Individual-Level Models
D. Results by Administration
E. *De Facto* Privatization: Additional Results

A. PROOFS FOR COMPARATIVE STATICS

A.1. Relative favorability of F's offer is increasing in d^F

$$\frac{\partial U(\omega_i^F) - U(\omega_i^G)}{\partial d^F} > 0 \tag{7}$$

We've assumed that W_i will accept whichever offer is more favorable. The firm's offer will be more favorable, and thus accepted, when $[U(\omega_i^F) - U(\omega_i^G)] > 0$. To determine how the relative favorability of F's offer changes with d^F, we need to differentiate:

$$\frac{\partial U(\omega_i^F) - U(\omega_i^G)}{\partial d^F}$$

There are three distinct cases that could be examined:

1. When expert quality is less than G's budget constraint ($q_i < b^G$);
2. When expert quality is greater than or equal to G's budget constraint but less than F's ($b^G \leq q_i < b^F$);
3. When expert quality is greater than or equal to F's budget constraint ($q_i \geq b^F$).

It is sufficient to prove Eq. 1 for Cases (2) and (3) only, as F makes the same offer in both (1) and (2) and d^F does not influence G's offer.

Beginning with Case 2:

$$\begin{aligned} &\frac{\partial U(\omega_i^F) - U(\omega_i^G)}{\partial d^F} \\ &= \frac{\partial [q_i d^F (1-\gamma_i) - b^G d^G]}{\partial d^F} \\ &= q_i(1-\gamma_i) \end{aligned}$$

Given that $q_i > 0$ and $\gamma_i < 1$ by definition, the partial derivative of $U(\omega_i^F) - U(\omega_i^G)$ with respect to d^F is always positive in this condition.

In Case 3:

$$\begin{aligned} &\frac{\partial U(\omega_i^F) - U(\omega_i^G)}{\partial d^F} \\ &= \frac{\partial [b^F d^F (1-\gamma_i) - b^G d^G]}{\partial d^F} \\ &= b^F(1-\gamma_i) \end{aligned}$$

Given that $b^F > 0$ and $\gamma_i < 1$ by definition, the partial derivative of $U(\omega_i^F) - U(\omega_i^G)$ with respect to d^F is always positive in this condition. ■

A.2. Effect of expert quality on relative favorability of F's offer is increasing in d^F

This proof proceeds in two steps. First, for two separate conditions, we calculate the partial derivative of $U(\omega_i^F) - U(\omega_i^G)$ with respect to expert quality (q_i):

$$F_q = \frac{\partial U(\omega_i^F) - U(\omega_i^G)}{\partial q_i}$$

However, what we are really interested in proving is that the effect of q_i on the relative favorability of F's offer is increasing in F's demand for climate expertise. To do this, we calculate the cross-partial and show that it is strictly positive in both cases:

$$\frac{\partial F_q}{\partial d^F} > 0 \tag{8}$$

As in the previous proof, there are three distinct cases that could be examined:

1. When expert quality is less than G's budget constraint ($q_i < b^G$);
2. When expert quality is greater than or equal to G's budget constraint but less than F's ($b^G \leq q_i < b^F$);
3. When expert quality is greater than or equal to F's budget constraint ($q_i \geq b^F$).

We focus here on Cases 1 and 2; in Case 3, since q_i no longer shapes either employer's offer, both F_q and $\frac{\partial F_q}{\partial d^F}$ will be trivially equal to zero.

Beginning with Case 1:

$$\begin{aligned} F_q &= \frac{\partial U(\omega_i^F) - U(\omega_i^G)}{\partial q_i} \\ &= \frac{\partial [q_i d^F (1-\gamma_i) - q_i d^G]}{\partial q_i} \\ &= d^F(1-\gamma_i) - d^G \\ &= d^F - \gamma_i d^F - d^G \end{aligned}$$

Intuitively, for all experts with quality lower than b^G, both F and G offer the same base wage of q_i. Thus, unless an expert places no value on pro-sociality ($\gamma_i = 0$) or private firms have substantially *greater* demand for climate expertise than the government such that $d^F - \gamma_i d^F > d^G$, higher-quality experts in the range of $[0, b^G]$ receive relatively more favorable offers from G.

Next we calculate the cross-partial with respect to d^F:

$$\begin{aligned}&\frac{\partial F_q}{\partial d^F}\\ &= \frac{\partial d^F - \gamma_i d^F - d^G}{\partial d^F}\\ &= 1-\gamma\end{aligned}$$

Since $\gamma < 1$ by definition, $\frac{\partial F_q}{\partial d^F}$ is strictly positive in Case 1.

Moving to Case 2:

$$\begin{aligned}F_q &= \frac{\partial U(\omega_i^F) - U(\omega_i^G)}{\partial q_i}\\ &= \frac{\partial [q_i d^F (1-\gamma_i) - b^G d^G]}{\partial q_i}\\ &= d^F(1-\gamma)\end{aligned}$$

Because $\gamma < 1$ by definition, F_q is strictly positive in Case 2. The intuition is that, when $b^G \leq q_i < b^F$, F can continue to scale its offer to q_i but G cannot; naturally, this makes F's offer relatively more attractive to higher-quality experts.

Next we calculate the cross-partial with respect to d^F:

$$\begin{aligned}&\frac{\partial F_q}{\partial d^F}\\ &= \frac{\partial d^F (1-\gamma)}{\partial d^F}\\ &= 1-\gamma\end{aligned}$$

Again, since $\gamma < 1$ by definition, $\frac{\partial F_q}{\partial d^F}$ is strictly positive for all $q_i < b^F$. ■

A.3. Effect of expert pro-sociality on relative favorability of F's offer is decreasing in d^F

This proof proceeds, again, in two steps. First, for two separate conditions, we calculate the partial derivative of $U(\omega_i^F) - U(\omega_i^G)$ with respect to expert pro-sociality (γ_i):

$$F_\gamma = \frac{\partial U(\omega_i^F) - U(\omega_i^G)}{\partial \gamma_i}$$

However, what we are really interested in proving is that the effect of γ_i on the relative favorability of F's offer is decreasing in F's demand for climate expertise. To do this, we

calculate the cross-partial and show that it is strictly negative in both cases:

$$\frac{\partial F_\gamma}{\partial d^F} < 0 \tag{9}$$

As in both previous proofs, there are three distinct cases that could be examined:

1. When expert quality is less than G's budget constraint ($q_i < b^G$);
2. When expert quality is greater than or equal to G's budget constraint but less than F's ($b^G \leq q_i < b^F$);
3. When expert quality is greater than or equal to F's budget constraint ($q_i \geq b^F$).

Here it is again sufficient to prove Eq. 3 for Cases 2 and 3, as F offers $q_i d^F$ in both Cases 1 and 2 and γ_i does not affect G's offer.

Beginning with Case 2:

$$\begin{aligned} F_\gamma &= \frac{\partial U(\omega_i^F) - U(\omega_i^G)}{\partial \gamma_i} \\ &= \frac{\partial [q_i d^F (1-\gamma_i) - b^G d^G]}{\partial \gamma_i} \\ &= \frac{\partial [q_i d^F - \gamma_i q_i d^F - b^G d^G]}{\partial \gamma_i} \\ &= -q_i d^F \end{aligned}$$

Since $q_i > 0$ and $d^F > 0$, the favorability of F's offer is (unsurprisingly) strictly decreasing in γ_i.

Next we calculate the cross-partial with respect to d^F:

$$\begin{aligned} &\frac{\partial F_\gamma}{\partial d^F} \\ &= \frac{\partial - q_i d^F}{\partial d^F} \\ &= -q_i \end{aligned}$$

Since $q_i > 0$, the effect of pro-sociality on the relative favorability of F's offer is decreasing in F's demand for climate expertise in Case 2.

Moving to Case 3:

$$\begin{aligned} F_\gamma &= \frac{\partial U(\omega_i^F) - U(\omega_i^G)}{\partial \gamma_i} \\ &= \frac{\partial [b^F d^F (1-\gamma_i) - b^G d^G]}{\partial \gamma_i} \\ &= \frac{\partial [b^F d^F - \gamma_i b^F d^F - b^G d^G]}{\partial \gamma_i} \\ &= -b^F d^F \end{aligned}$$

Since $q_i > 0$ and $b^F > 0$, the favorability of F's offer is (again, unsurprisingly) strictly decreasing in γ_i.

Next we calculate the cross-partial with respect to d^F:

$$\begin{aligned} &\frac{\partial F_\gamma}{\partial d^F} \\ &= \frac{\partial - b^F d^F}{\partial d^F} \\ &= -b^F \end{aligned}$$

Again, since $b^F > 0$ by definition, $\frac{\partial F_\gamma}{\partial d^F}$ is strictly negative for all experts. ■

B. LIST OF CLIMATE SKILLS

To identify climate-related skills, we conducted keyword searches of the Lightcast Open Skills Taxonomy in July 2024. This yielded the following skills by keyword:

- Carbon: carbon footprint reduction, carbon accounting, carbon management, carbon markets, carbon offsets, carbon capture and storage, low carbon solutions, low carbon development
- Climate: climatology, climate policy, climate variability and change, climate resilience, climate modeling, climate change mitigation, climate change adaptation, climate prediction, climate engineering, climate change programs, climate information, climate analysis, Community Climate System Model, Climate Data Exchange (CDX), Action for Climate Empowerment (ACE), Climate Data Analysis Tool (CDAT)
- Emissions: vehicle emissions controls, emissions inventory, emissions calculations, emission testing, emission standards, Continuous Emissions Monitoring Systems, fugitive emissions, emissions analyzers, emissions controls, National Emissions Standards for Hazardous Air Pollutants, stack emission measurements, emissions trading, emission reduction projects, AVoided Emissions And GeneRation Tool, Michigan Air Emissions Reporting Systems, UN Race-to-Zero Emissions Breakthroughs
- Greenhouse: greenhouse gas, Regional Greenhouse Gas Initiative
- Net zero: net zero

C. INDIVIDUAL-LEVEL MODELS

DV:	Salary (log)	Pr(MA+ = 1)	GS	LOS
Climate-relevant job	0.361***	0.162***	1.878***	4.132***
	(0.031)	(0.005)	(0.122)	(0.346)
Climate-relevant job × Demand	−0.047***	−0.013***	−0.208***	−0.288***
	(0.005)	(0.001)	(0.021)	(0.060)
N	53,259,438	60,272,100	42,898,322	60,271,571
Adj. R^2	0.124	0.032	0.161	0.038
Quarter-year FE	✓	✓	✓	✓
Agency FE	✓	✓	✓	✓

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table C1: Regressions of the characteristics of bureaucrats on private sector demand for climate experts in the preceding quarter (count of job postings; natural log), interacted with the climate relevance of the government job. Standard errors clustered by quarter-year. Sample limited to federal agencies with at least 1,000 climate job-quarter observations between 2014–2023.

D. RESULTS BY ADMINISTRATION

Bureaucrat behavior varies with the policies of political principals (Gailmard and Patty 2007). These supplementary tests account for differences in presidential administrations. While the Obama and Biden administrations were friendly to pro-climate bureaucrats, the Trump administration imposed strict constraints on environmental bureaucrats.[1] In Table D1, we replace quarter-year fixed effects with administration fixed effects. In Tables D2–D5, we split the sample by administration. Results indicate that the erosion of bureaucratic quality we identify is not specific to any one administration.

DV:	Salary (log)	Pr(MA+ = 1)	GS	LOS
Climate-relevant job	0.360***	0.161***	1.878***	4.163***
	(0.031)	(0.005)	(0.122)	(0.346)
Demand	0.068***	0.009***	0.088***	−0.348***
	(0.011)	(0.002)	(0.010)	(0.077)
Climate-relevant job × Demand	−0.046***	−0.013***	−0.208***	−0.293***
	(0.005)	(0.001)	(0.021)	(0.060)
N	53,259,438	60,272,100	42,898,322	60,271,571
Adj. R^2	0.122	0.032	0.161	0.038
Administration FE	✓	✓	✓	✓
Agency FE	✓	✓	✓	✓

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table D1: Regressions of the characteristics of bureaucrats on private sector demand for climate experts in the preceding quarter (count of job postings; natural log), interacted with the climate relevance of the government job. Standard errors clustered by quarter-year. Sample limited to federal agencies with at least 1,000 climate job-quarter observations between 2014–2023.

[1] *The New York Times* 2017 [nyti.ms/3AxoLP2].

DV: Salary (log). Subsample:	Obama	Trump	Biden
Climate-relevant job	0.288***	0.211***	0.263***
	(0.063)	(0.029)	(0.032)
Climate-relevant job × Demand	−0.032*	−0.028**	−0.029***
	(0.012)	(0.006)	(0.005)
N	17,971,479	22,208,516	13,079,443
Adj. R^2	0.102	0.113	0.110
Quarter-year FE	✓	✓	✓
Agency FE	✓	✓	✓

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table D2: Regressions of bureaucrat salaries on private sector demand for climate experts in the preceding quarter (count of job postings; natural log), interacted with the climate relevance of the government job. Sample split by presidential administration. Standard errors clustered by quarter-year. Sample limited to federal agencies with at least 1,000 climate job-quarter observations between 2014–2023.

DV: Pr(MA+ = 1). Subsample:	Obama	Trump	Biden
Climate-relevant job	0.142***	0.149***	0.115***
	(0.017)	(0.010)	(0.009)
Climate-relevant job × Demand	−0.009*	−0.011***	−0.007**
	(0.003)	(0.002)	(0.001)
N	18,875,975	26,142,369	15,253,756
Adj. R^2	0.030	0.032	0.034
Quarter-year FE	✓	✓	✓
Agency FE	✓	✓	✓

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table D3: Regressions of bureaucrat educational attainment on private sector demand for climate experts in the preceding quarter (count of job postings; natural log), interacted with the climate relevance of the government job. Sample split by presidential administration. Standard errors clustered by quarter-year. Sample limited to federal agencies with at least 1,000 climate job-quarter observations between 2014–2023.

DV: GS. Subsample:	Obama	Trump	Biden
Climate-relevant job	1.818***	1.165***	1.410***
	(0.366)	(0.140)	(0.131)
Climate-relevant job × Demand	−0.189*	−0.080*	−0.127***
	(0.071)	(0.027)	(0.022)
N	13,661,534	18,488,394	10,748,394
Adj. R^2	0.155	0.164	0.162
Quarter-year FE	✓	✓	✓
Agency FE	✓	✓	✓

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table D4: Regressions of bureaucrat GS grades on private sector demand for climate experts in the preceding quarter (count of job postings; natural log), interacted with the climate relevance of the government job. Sample split by presidential administration. Standard errors clustered by quarter-year. Sample limited to federal agencies with at least 1,000 climate job-quarter observations between 2014–2023.

DV: LOS. Subsample:	Obama	Trump	Biden
Climate-relevant job	1.760+	1.111*	5.350***
	(0.953)	(0.483)	(0.710)
Climate-relevant job × Demand	0.128	0.293**	−0.436**
	(0.184)	(0.092)	(0.113)
N	18,875,971	26,142,347	15,253,253
Adj. R^2	0.036	0.040	0.038
Quarter-year FE	✓	✓	✓
Agency FE	✓	✓	✓

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table D5: Regressions of bureaucrat length of service on private sector demand for climate experts in the preceding quarter (count of job postings; natural log), interacted with the climate relevance of the government job. Sample split by presidential administration. Standard errors clustered by quarter-year. Sample limited to federal agencies with at least 1,000 climate job-quarter observations between 2014–2023.

E. *DE FACTO* PRIVATIZATION: ADDITIONAL RESULTS

DV: Contract is for Environmental Consulting		
	(1)	(2)
Demand x EPA	0.065***	0.064***
	(0.012)	(0.012)
N	7547738	7547738
R^2	0.065	0.105
Quarter-Year FE		✓
Agency FE		✓
Sector FE		✓
State FE		✓

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table E1: Regressions of indicator variable equal to 1 when contract concerns environmental consulting on private sector demand, interacted with an indicator variable equal to 1 when the contracting agency is the EPA.

DV:	Prop. of contracts		Count of contracts		Value of contracts	
	All	Env.	All	Env.	All	Env.
Demand x EPA	0.051***	0.063***	0.116**	0.217***	-0.389	0.412**
	(0.006)	(0.004)	(0.043)	(0.042)	(0.257)	(0.123)
N	2581	2581	2581	2581	2581	2581
R^2	0.655	0.850	0.958	0.963	0.753	0.859
Quarter-Year FE	✓	✓	✓	✓	✓	✓
Agency FE	✓	✓	✓	✓	✓	✓

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table E2: Regressions of three different variables—the proportion of agency-quarter-year contracts allocated to [environmental] consulting, the (logged) number of agency-quarter-year contracts allocated to [environmental] consulting, and the (logged) total dollar value of agency-quarter-year contracts allocated to [environmental] consulting—on private sector demand, interacted with an indicator variable equal to 1 when the contracting agency is the EPA.