Escaping Pay-for-Performance*

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Abstract

Should we pay regulators for performance? We address the question using a unique dataset that tracks the careers of 26,000 senior federal regulators. They are the highest-ranking bureaucrats in the federal government who collectively oversee all its regulatory activities. We exploit a major reform that switched most senior regulators to a pay-for-performance system. Using a difference-in-differences framework, we find that the reform accelerated the revolving door of affected regulators, who voluntarily left for the private sector. To understand this unexpected response, we build a structural model which highlights two crucial features: government pay is capped, and regulators can accept a private sector job with uncapped pay. Performance pay may induce more effort, but since regulators risk hitting the pay cap, they prefer to move to the private sector where effort is rewarded even more. Estimating our model, we find that 21% of executive pay in the federal government is performance-based. Moreover, performance pay has a large quantitative impact: a 1% increase in pay-for-performance will increase effort by 0.04% and exits by 7.2%. We design alternative executive pay packages, combining a stronger pay-for-performance component with a higher pay cap, to increase regulatory effort without accelerating the revolving door. Overall, our results shed light on the benefits and drawbacks of performance-based pay for regulators.

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1 Introduction

Following the banking crisis of 2023, a U.S. Senator famously quipped: "Our regulators appear to have been asleep at the wheel."[1] This potential failure of regulatory supervision has brought to the surface an important question: should we pay regulators for performance, to prevent them from "falling asleep" again? Even before the recent crisis, this question has often been at the center of public debate. For instance, financial regulators have attempted to implement performance-based pay systems, with limited success (Government Accountability Office, 2007; Henderson and Tung, 2011). To address this question, we assemble a new dataset that tracks the careers of senior federal regulators. First, we show that the adoption of a new pay-for-performance system in 2002 increased the "revolving door" of regulators who voluntarily moved to the private sector. To understand this unexpected response, we build a structural model which accounts for the broader context of performance pay: government pay is capped, and regulators can accept a private sector job with uncapped pay potential. While performance pay may induce more effort, regulators risk hitting the pay cap and may thus choose to resign. To quantify the role of those factors, we estimate the model and show how the pay cap and the outside option distort the impact of performance-based pay: regulators choose to exert slightly more effort, but they do so primarily to obtain a job in the private sector where effort is rewarded even more. Combined, our results highlight the unexpected impact of pay-for-performance on regulators.[2]

Our analysis is centered on the top executives of the federal government: a selective group of career bureaucrats, roughly 0.5% of the federal workforce, who hold the leadership positions in their respective agencies.[3] For instance, the Financial Crimes Enforcement Network is run by seven federal executives. Rising through the ranks of the Treasury Department over many decades, they now oversee the agency's activities to safeguard the financial system

[1] See here and here.

[2] A separate question is whether and how regulatory performance can be properly measured; we leave that for future work.

[3] In the government parlance they are referred to as Senior Executive Service, SES for short.

from illicit use, such as money laundering and terrorism. We choose the setting of federal executives to study pay-for-performance for two related reasons. First, they are at the helm of the federal bureaucracy and collectively oversee the plurality of regulatory activities in the United States. Second, unlike most regulators, their compensation is partially linked to performance, especially after a substantial reform which took place in 2002. Combined, this creates a unique opportunity to study the economic implications of paying regulators for performance.

We source a comprehensive data set with full payroll information on any federal employee who held an executive position at any point between 1996 and 2022. This includes 26,000 unique executives and 329,000 executive×year observations. Crucially, we observe the executive's pay, hiring date, and exit date, even before and after their elevation to the executive rank. We then exploit an overhaul of the compensation packages of federal executives, aimed to retain executive talent and to motivate greater effort. The reform was launched in 2002, covered most federal executives, and included two key aspects: it tied future pay raises to performance, and doubled the maximum allowable pay for executives. Our dataset spans the decade before and after the reform, and it includes agencies that were exempt from the reform because they use independent pay systems for their executives, such as the Office of the Comptroller of the Currency.[4] In a difference-in-differences specification, we find that the reform triggered a wave of exits among treated federal executives, increasing their turnover rates by 2.5-3.7 percentage points. Exit rates rose sharply within the first three years following the reform, and they were not driven by forced retirement, low-performing executives, or any particular agency.

Our initial results are surprising. The reform intended to retain talent within the public sector, but seems to have achieved the opposite. It suggests that pay-for-performance could involve an unexpected trade-off. While it may increase effort (which we cannot observe), it also increases the incentive to switch to the private sector. To investigate this trade-off, we

[4]For robustness, we restrict the control group to executives on managerial pay plans or executives whose salary is greater than or equal to the minimum salary of treated executives.

develop a structural model that links executive pay to exit and effort. In our model, a federal executive has an outside option in the private sector. The pay in both sectors increases with tenure and productivity. However, the public sector pay has a floor and a ceiling. The pay never decreases, even with dismal performance, and never exceeds a government-wide cap, even with excellent performance. This does not hold in the private sector, where poor performance yields deep pay cuts and good performance is rewarded with substantial pay raises. The federal executive chooses effort and exit policy to maximize lifetime earnings. Effort increases productivity and hence wages, but it is also costly. Exit to the private sector can offer higher pay, since there is no pay cap, but also greater exposure to productivity shocks, resulting in lower pay during periods of bad performance.

How will the executive respond to changes in their compensation package? We focus on the two key ingredients, the sensitivity of pay to performance and the pay cap. Our model predicts that both ingredients will have a positive impact on effort. Pay-for-performance increases the direct reward for productivity, and a higher pay cap increases the potential upside from higher productivity. Either way, effort increases. However, the two ingredients have contradicting effects on exits. A higher pay cap provides better growth opportunities in the government which reduces the incentive to switch careers. Pay-for-performance, on the other hand, increases the incentive to exit: with the same level of effort, the executive would prefer the private sector where pay is uncapped.

With the stylized predictions in hand, we turn to the quantitative analysis. We structurally estimate the parameters in our model using the rich executive-level dataset and the estimated treatment effect (the response to the 2002 reform). The estimation yields two important insights. *First*, 21% of federal executive pay is based on productivity and the remaining 79% is a deterministic function of tenure.[5] This is almost the exact opposite of CEO compensation, where bonus and incentive pay account for 75-80% of total CEO pay (Frydman and Jenter, 2010; Murphy, 2013; Edmans, Gosling, and Jenter, 2023). Thus,

[5]The reform increased pay for performance by 16.8%-20%, that is, from 20.7% to 24.2%-24.9%.

while performance incentives for federal executives are non-trivial, they are substantially lower than in the private sector. *Second*, despite the relatively small incentive, performance pay has large quantitative impact on federal executives. Concretely, we estimate that a 1% increase in pay-for-performance will, on average, increase effort by 0.04% and exits by 7.24% (relative to the sample mean). This illustrates the trade-offs associated with performance pay in the public sector. Any increase in performance pay will lead to a (small) bump in executive effort, but it will also trigger a wave of resignations, since executives will value the private sector even more.

Our final set of exercises evaluates alternative policies that regulatory agencies may adopt. First, we consider a "zero-exit" policy which aims to induce greater effort without accelerating turnover. Note that the key friction which generates exits from the public sector is the pay ceiling. Thus, to avoid excessive exits, one would need to increase both pay-for-performance (more exits) and the pay cap (less exits). Our estimation shows that a 1% increase in the pay cap lowers exits by 6.37% and increases effort by 0.02%. Relying on those elasticities we identify a range of "zero exit" policies, for instance, a combination of 10% increase in pay-for-performance and 9% increase in the pay cap. Separately, we evaluate a policy that reduces the cost of effort, for instance, allowing executives to work from home. Lowering the cost of effort will increase effort, as expected, but will also increase exits. Intuitively, as the executive exerts more effort, he receives more pay-for-performance compensation and gets closer to the pay cap. Therefore, from the executive's perspective, the upside from staying in the public sector is limited. As a result, the probability of exit increases. Quantitatively, we find that a 1% decrease in the cost of effort would translate to 0.1% increase in effort but 1.6% increase in exit rates. In other words, the elasticity of effort to cost is weaker than the elasticity of exits to cost.

Overall, our paper highlights the consequences of performance-based pay in the government, as well as the challenges of finding the right mix. Performance-based pay contributes to greater effort by regulators, but it also raises the value of their outside option and increases the prevalence of the revolving door. Raising the pay ceiling in the government can alleviate the trade-offs, but in turn will raise budgetary concerns and fears of potential self-dealing. The data we use, as well as the pay reform we exploit for the difference-in-difference estimation, are all centered on high-level federal executives. This might limit the extent to which our conclusions apply to the general population of federal regulators. However, we note that our model is quite general and is not restricted to high- or low-level public sector employees. Finally, we note that our model is centered on the optimization problem of the individual executive, and we do not take a stand on how effort and exit affect total welfare.[6] We leave those important questions for future follow-on studies.

Our work relates primarily to the literature on regulatory incentives and performance. Concretely, we make three contributions. *First*, studies in this area tend to focus on the level of pay and abstract from the determinants of pay.[7] Our paper directly examines the pay structure and, specifically, the role of pay ceiling and performance-based pay. The two factors have a similar effect on effort but the opposite effect on the incentive to exit. *Second*, we connect the pay structure to the revolving door. Existing studies typically focus on the prevalence of the revolving door and whether it induces regulatory leniency, without considering how regulatory agencies design pay packages for their employees.[8] Our work shows that the design of regulatory pay is directly related to the revolving door incentive: the incentive to accept a private sector job increases with pay-for-performance and decreases with the pay ceiling. *Third*, we assess the efficacy of policies related to regulatory pay and highlight several considerations. Any policy will have a joint impact on effort and exits, sometimes in the opposite direction. Moreover, the design of regulatory pay does not exist

[6] For instance, greater effort could be interpreted as greater regulatory burden which is potentially costly for firms (Kalmenovitz, 2023), but also as more leniency which is in fact beneficial for firms (Kalmenovitz, Vij, and Xiao, 2022).

[7] Such as Dal Bó, Finan, and Rossi (2013); Kalmenovitz (2021). A related literature studies organizational features such as fee schedules (Kisin and Manela, 2018), field offices (Gopalan, Kalda, and Manela, 2021), supervision (Hirtle, Kovner, and Plosser, 2020; Eisenbach, Lucca, and Townsend, 2016), and jurisdictional overlap (Kalmenovitz, Lowry, and Volkova, 2021).

[8] See for example deHaan et al. (2015); Lucca, Seru, and Trebbi (2014); Tabakovic and Wollmann (2018); Correia (2014); Lambert (2019); Heese (2022); Hendricks, Landsman, and Peña-Romera (2022); Kalmenovitz, Vij, and Xiao (2022).

in a vacuum, since regulators compare their expected cash flows in the public sector to those offered by private employers. Finally, raising the pay ceiling and emphasizing pay-for-performance can have contradicting effect on regulators. With those considerations in mind, we propose and evaluate alternative policies using a structural model and the granular executive-level dataset. We consider, for instance, "zero-quit" policies that aim to induce effort without increasing the turnover. Our results can inform the debate on how to improve the performance of regulatory agencies further.

Our work also adds to the robust literature on executive pay. Studies are exclusively focused on executives in the private sector,[9] and we extend it by looking into federal executives. We uncover the pay structure of those federal executives, which differs sharply from private sector executives: nearly 80% of executive pay in the federal government is independent of performance, while nearly 80% of executive pay in the private sector is linked to performance (Edmans, Gosling, and Jenter, 2023). We further utilize a rare reform in executive pay, and highlight how even small changes to incentive pay can induce significant responses in terms of effort and voluntary turnover. While our findings may not apply equally to private sector executives, at the minimum they contribute to our understanding of an understudied group of executives, who manage large organizations with significant economic impact.

2 Federal executives and pay-for-performance

2.1 Institutional setting

Our paper is focused on the executives of the federal government.[10] In the government parlance they are known as the Senior Executive Service, or SES for short, but we simply refer to them as federal executives. They play a crucial role in the federal bureaucracy: they hold key leadership positions just below the top Presidential appointees, manage the activities

[9] See Frydman and Jenter (2010) and Yermack (2004), among others.

[10] This section is based primarily on Government Accountability Office (1980); Congressional Research Service (2007); Congressional Research Service (2012); and Congressional Research Service (2021).

of the federal government, and serve as a link between the political appointees and the rest of the federal workforce. For instance, the Administrator and the Deputy Administrator of the Environmental Protection Agency are political appointees, picked by the President for a limited term. They oversee more than 200 federal executives who rose through the EPA ranks over many decades. Those federal executives manage the EPA's 15,000-strong workforce, and assist the political leadership in mobilizing the agency's resources to achieve the administration's priorities.[11]

The Senior Executive Service was established in 1979, following the Civil Service Reform Act of 1978.[12] The goal was to "attract and retain highly competent senior executives," by designing an executive pay package that would be contingent on "executive success." The newly-designed executive pay had a lower and upper bound, corresponding to 120% of GS-15 and 100% of EX-IV.[13] Executives also received a small cash bonus and a locality pay adjustment, based on their geographic location.[14] Importantly, executives received virtually automatic and identical annual pay raises. Thus, while executive pay was generally higher than non-executive pay, it followed the same principles: bound between a floor and a ceiling, with salary progression determined by tenure rather than by performance.

By the late 1990s, the executive pay system came under scrutiny for two related reasons. First, there was no meaningful pay-for-performance system. In other words, executives were not rewarded for good performance, nor were they penalized for inadequate performance. For instance, the Director of the Office of Personnel Management (OPM)[15] stated:

> "[...] agencies rated 85% of their executives at the highest level their system permits. I believe most executives provide quality service to our citizens. However, these statistics suggest that agencies are not making meaningful distinctions

[11]Note that some federal agencies are not part of the SES system and manage their executive talent independently. We rely on those cross-agency differences in Section 3.

[12]P.L. 95-454, Title IV, amending various sections of the U.S. Code, Title 5, Chapters 31, 33, and 35.

[13]GS is the General Schedule, the most common pay system in the federal government. EX is the Executive Schedule, reserved for political appointees and organized in reverse order, such that EX-IV is the lowest rank and EX-I is the highest. SES is reserved for career bureaucrats, who are the focus of this paper.

[14]Locality pay for federal employees was introduced in 1994.

[15]This federal agency acts as the chief human resources officer of the entire Federal government.

between those who merely do what's expected and those with a consistent track-record of outstanding performance" (Office of Personnel Management, 2001).

A related challenge was a severe compression of executive pay: the lower bound of the SES pay was climbing with GS-15 pay levels, but the upper bound did not increase at the same rate. Thus, even if a pay-for-performance system will be installed, agencies will not be able to reward executives properly for good performance.

To address those challenges, a comprehensive reform in executive pay was rolled out between 2002-2004. In the first wave, the goal was to keep the original SES system while solving its fundamental challenges. Concretely, agencies were required to establish new performance appraisal systems for their executives, and to make meaningful distinctions between executives based on their performance. Once the agency adopts a proper appraisal system, and the system is certified by OPM, the pay cap for its executives will be raised substantially.[16] In the second wave, the old SES system was replaced with an entirely new system. The new system replaced the automatic annual pay raises with performance-based pay raises. Moreover, the pay cap for executives has been raised from EX-IV to either EX-III or EX-II, with the higher cap reserved for agencies that have a robust performance appraisal system certified by OPM.[17]

2.2 Data

Our goal is to study how federal executives respond to pay-for-performance. To that end, we source a comprehensive data set covering all federal employees who held an executive position at any point between 1996 and 2022. The data set includes details on the employee's agency, occupation, original hiring date, location, and compensation. To the best of our knowledge, the data set is free from selection bias and includes the universe of executives from that period. For the main analysis, we focus on executives who can be unambiguously tracked over time. We therefore remove observations with incomplete names or names that

[16] §1322 of the Homeland Security Act of 2002 (P.L. 107-296).
[17] §1125 of the National Defense Authorization Act of 2004 (P.L. 108-136).

appear more than once in a given year. Our final sample includes 26,178 unique executives working in 330 agencies, total of 141,030 executive×year observations. Parts of the analysis require information on the executive's career before and after their elevation to the executive position. This broader sample includes 330,446 employee×year observations.

Table 1 reports descriptive statistics of federal executives. Compensation variables are adjusted for inflation and expressed in constant 2023 USD. In Panel A we focus on the executive stage, that is, when the employee held an executive position. The average executive has 22 years of experience in the government, and the unconditional turnover rate among executives is 13.2%.[18] They earn $218,600 in base pay, $4,400 in locality adjustment, and $1,200 cash bonus, for a total compensation of $224,200. This is about $15,500 or 7.5% below the government-wide executive pay cap. For comparison, other studies find 23%-33% promotion incentives among enforcement attorneys at the SEC and the EPA (Kalmenovitz, 2021; Chen and Kalmenovitz, 2021). Thus, it appears that federal executives face limited pay growth opportunities. Of course, those comparative promotion incentives were calculated among non-executives who can get promoted to the next rank. Executives, on the other hand, by definition have reached the top rank in the federal bureaucracy. Taking into account the executive's entire career (Panel B), the average executive earns $171,500 in base pay, $12,500 in locality adjustment, and $1,300 cash bonus, for a total compensation of $185,100. Finally, we note that nearly 70% of the executives are males.

2.3 Pay-for-performance and realized pay

In Figure 1, we plot the evolution of executive pay in the federal government from 1979 to 2022.[19] Each year, we compute the upper and lower bounds of executive pay (1^{st} and 99^{th} percentiles), and the mean and standard deviation of pay across all federal executives. We

[18] Note that we track executives before and after their ascension to the executive position, and we also observe their original hiring date, even if it preceded 1996.

[19] Information on the years 1996-2022 comes from the primary data set described in the text. Information on the years 1979-1995 comes from a separate data set, which is less suitable for executive-level analysis due to missing or misspelled names.

use data on adjusted pay, which is defined as base pay plus locality rate, and the numbers are not adjusted for inflation. The shaded area captures the years 2002-2004, during which the executive pay reform was gradually implemented.

Two important facts emerge. First, the reform significantly increased the range of executive pay. Before the reform (1979-2001), the upper bound of executive pay was $14,556 or 17.3% higher than the lower bound. After the reform (2005-2022), the upper bound was $46,850 or 34.9% higher than the lower bound. In other words, the reform relieved the pay compression for federal executives and more than doubled the pay growth potential. Second, the reform significantly increased the variation in pay across executives. The standard deviation of realized pay was $3,937 before the reform, and it almost tripled to $11,375 after the reform. The reform aimed to create meaningful distinctions between executives based on performance, and the substantially higher variation in pay is consistent with this goal.[20]

In sum, the reform led to substantial changes in executive pay. The pay ceiling has been raised and the variation in pay across executives has increased. Both outcomes are indicative of a pay-for-performance system, with opportunities for pay growth in accordance with performance. This is helpful, because it provides clear evidence that the new pay-for-performance system was not merely "cheap talk:" it was implemented on a large scale and had a demonstrable impact on executive compensation. This pivot toward pay-for-performance was intended to retain executive talent and to improve their productivity, and we now turn to investigate those goals. The analysis is conducted in three steps. In Section 3, we implement a difference-in-differences test to see how pay-for-performance affected exits from the public sector to the private sector. In Section 4, we develop a structural model that ties pay-for-performance to the executive's joint decision on effort and exit. Finally, in Section 5, we estimate the model based and study the quantitative implications of pay-for-performance.

[20] As we show in Section 4.3, when executives are paid for performance, the volatility of their productivity (σ) leads to higher variation in their wages.

3 Impact on exits

We estimate the following difference-in-differences specification:

$$Exit_{i,t+1} = \beta \cdot Post_t \cdot Treated_i + X'_{i,t} + \alpha_t + \epsilon_{i,t} \tag{1}$$

Where $Exit_{i,t+1} = 1$ if executive i left the government at time $t+1$, and $Post_t = 1$ if year t is greater than or equal to 2002. Note that the the new pay-for-performance scheme has been established in multiple waves between 2002 and 2004. Even if the executive's agency was not part of the first wave of implementation, at that point the expectations for pay-for-performance have been established, making 2002 a reasonable choice for the treatment year. We limit the analysis to the years 1997-2007, creating a symmetric window of ±5 years around the treatment year. $Treated = 1$ if the executive was on the SES pay scale before the reform.[21] Consequently, the control group includes agencies that are not part of the SES system and instead use independent pay systems for their executives.[22] $X'_{i,t}$ is a vector of characteristics that relate to turnover: tenure, base pay, bonus, and locality adjustment. Since compensation variables are themselves affected by the reform (as we explore below in Section 4), we use pre-treatment average values to avoid inclusion of "bad controls" in our specification. We add various combinations of year, occupation, state, and agency fixed effects, which absorb *Post* and *Treated*. The coefficient of interest is β, which captures the impact of the reform on turnover rates among treated executives. We cluster standard errors at the agency level.

Our findings are summarized in Table 2. We begin with a simple specification without fixed effect, controlling for *Post* and *Treated*. The significant positive coefficient indicates that, in the post-reform period, the probability of turnover among treated executives increased by 2.5 percentage point, which is 33% of the average turnover in the sample period.

[21] Executives who joined the government after the reform may have preference for pay-for-performance, and therefore have self-selected into the treatment group.

[22] For example, the Office of the Comptroller of the Currency, Office of Thrift Supervision, and the Farm Credit Administration.

In column 2 we add year and agency fixed effects, which subsumes $Post_t$ and $Treated$. The effect remains significant and large, 34% of the mean. In columns 3-4 we further control for executive-level characteristics that could affect the decision to exit: tenure, salary, bonus, and locality pay. We also add the interaction of $Post$ with $Transition$, recognizing that turnover rates could also be driven by the change in administration (note that $Transition$ alone is subsumed by time fixed effects).[23] We continue to find a significant change in the post-reform period, nearly 49% of the sample mean. In the last three columns we add year×state, year×occupation, and agency×state fixed effects. This removes confounding factors at the state, occupation, and agency level. For instance, we rule out the possibility that rising private sector opportunities for SEC attorneys in New York is driving exit rates. In the tightest specification, the reform increased turnover rate among treated executives by 3.3 percentage points, which are 44.2% of the sample mean.

We conduct several exercises to test the robustness of those results, summarized in Table A.1. First, we postpone the treatment year to 2004, rather than 2002, when the new pay-for-performance scheme was fully operational. Under this specification, we find an even greater increase in turnover rates for treated executives after the reform. In the tightest specification, turnover increased by 48% relative to the sample mean. In another set of tests we keep 2002 as the treatment year but restrict the control group. In one version, we keep only executives on managerial pay plans other than SES. This includes, for instance, the SW pay plan at Transportation Security Administration, CD at the Commodity Futures Trading Commission, and CM at the Federal Deposit Insurance Corporation. In another version, we keep only executives whose salary is greater than or equal to the minimum salary of treated executives.[24] Either way, we continue to find significantly higher turnover rates among treated executives after the implementation of the reform.

[23] As noted in Section 2.2, executives serve as a link between political appointees and the federal workforce, and are thus likely to exit when a new administration comes in. We demonstrate this cyclical rise in exit rates in Figure A.1.

[24] The first version leaves a sample of 59,521 observations, consisting of 46,025 observations in 282 treated agencies and 5,520 observations in 20 control agencies. The second leaves a sample of 59,521 observations, consisting of 40,505 observations in 282 treated agencies and 19,016 observations in 48 control agencies.

Next, we estimate a dynamic version of Equation 1:

$$Exit_{i,t+1} = \sum_{k=1997}^{2007} \eta_k \cdot Treated_i \cdot [\mathbb{1}(Year_t = k)] \\ + Treated \times Transition + \alpha_a + \alpha_t + \epsilon_{i,j,a,t}, \tag{2}$$

where $Exit_{i,t+1} = 1$ if executive i exits the public sector in year $t+1$, α_a is agency fixed effects, and α_t is year fixed effects. Here, $\mathbb{1}(Year_t = k)$ is an indicator variable that equals one when the year t equals k. We control for $Treated \times Transition$ to account for excessive managerial turnover during change in administration.[25] We plot the resulting coefficients in Figure 2. The figure reveals a sharp break after the reform, suggesting that they are not driven by any secular trends in turnover rates. It appears that exit rates started to rise already in 2002, when the reform started to be implemented, and continued to rise till the end of the analysis window (2007).

Finally, we collapse Equation 1 into a cross-sectional regression:

$$Exit_i = \beta \cdot Treated_i + X_i^{'} + \epsilon_{i,t}, \tag{3}$$

where the sample is restricted to the post-reform period. $Treated$ is defined in a similar manner, but $Exit = 1$ if the executive quit the government at any point after 2002. $X_i^{'}$ is a vector of pre-reform pay characteristics and tenure. The results are reported in Table A.2. Without controls, exit rates among treated executives increased by 14.6 percentage-point, which is 43% of the unconditional probability in this sample. With pre-reform controls, the exit rates increased by 11.1 p.p. which is 33% of the unconditional rate. All results are statistically significant and consistent with the panel regression findings reported above.

In sum, the pivot towards pay-for-performance triggered a wave of exits among government executives.[26] The accelerated turnover rate is somewhat surprising, given that the

[25] Consequently, the coefficient on the year 2000 ($Treated_i \cdot [\mathbb{1}(Year_t = 2000)]$) drops.

[26] We do not know if the executive resigned voluntarily or was forced out, but forced terminations of federal

reform's intention was to retain executive talent. To better understand this phenomenon, we now turn to a structural model of federal executives which links pay-for-performance to exit and effort decisions.

4 Structural model

The pay-for-performance reform was intended to retain executive talent and to induce more effort. While we do not observe effort, in Section 3 we found that the reform in fact increased turnover rates rather than retention rates. This suggests that pay-for-performance involves an unexpected trade-off: while it may increase effort, it also increases the incentive to switch to the private sector. Motivated by this finding, we now develop a structural model that links pay-for-performance to exit and effort.

4.1 Setup

A government executive earns a realized wage, which we model as:

$$\widetilde{w}_t^g = \min\{\overline{w}(t),\ w_t^g\} \tag{4}$$

The left-hand side term, $\overline{w}(t)$, is a government-wide pay cap which applies uniformly to all executives. The right-hand side term, w_t^g, is an executive-specific uncapped pay. This uncapped pay can exceed the pay cap, but the realized pay ($\widetilde{w}_t^g$) cannot. This fundamental tension has important implications in our model.

The executive's uncapped pay (w_t^g) is a function of tenure and performance:

$$\log(w_t^g) \equiv \log(w^g(t, z_t)) = \alpha_{base} f_w(t) + \max\{0,\ \alpha_{P4P}\log(z_t)\}. \tag{5}$$

executives are extremely rare. For example, an internal survey concluded that 98% of executive exits during 2015-2016 were voluntary (Office of Personnel Management, 2017).

In words, the uncapped pay consists of two factors: a deterministic component which depends on tenure, $f_w(t)$, and a stochastic pay-for-performance component which depends on productivity, z_t. The weights of the two parts are given by α_{base} and α_{P4P}, respectively.[27] The parameter α_{P4P} represents the exposure to pay-for-performance. If $\alpha_{P4P} = 0$, there is no pay-for-performance, meaning that wages are deterministic and based solely on tenure. As α_{P4P} increases, the executive is more exposed to pay-for-performance. Crucially, bad performance can never reduce the executive's pay, while good performance can increase his pay beyond the deterministic tenure-based component (up to the pay cap). This condition is captured by the right-hand side term in Equation 5.

The executive's productivity (z_t) evolves according to:

$$\log(z_{t+1}) = \log(f_t)(1-\rho) + \rho \log(z_t) + \sigma\varepsilon_{t+1}, \quad \varepsilon_{t+1} \sim \mathcal{N}(0,1), \tag{6}$$

such that the next period productivity z_{t+1} is a function of last period effort f_t, last period productivity z_t, and a productivity shock ε_{t+1}. The parameters ρ and σ represent the persistence and volatility of the productivity process. By exerting more effort today, the executive expects to increase productivity moving forward. However, the realization of productivity also depends on the shock ε. In other words, the executive can be rewarded for performance that's either due to effort f_t or the random noise ε.

The executive faces a mandatory retirement age at t_R. Retirement income is non-stochastic and and defined by the replacement rate λ of the final wage $\lambda\widetilde{w}^g_{t_R}$. The executive collects the retirement income for t_N more years upon retirement. Therefore, $\lambda\widetilde{w}_{t_R}$ determines the terminal value at the retirement age, V^R.

The executive has an option to accept a job in the private sector. We denote the per-

[27] In the baseline case the sum of the two weights is one, and thus the wage is a weighted average of the two components. We do not impose this requirement when we examine counterfactual policies (Section 5.4). Otherwise, changing the pay-for-performance exposure would lower the base salary, which is at odds with the reform's goals.

period value of the outside option as o_t, and define it as:

$$o_t \equiv o(\phi_t, w_t^o) = \frac{1}{\theta} \cdot \phi_t \cdot w_t^o. \tag{7}$$

The outside option value is based primarily on the private sector wage, denoted with w_t^o. We model this wage as a function of tenure and productivity:

$$\begin{aligned} \log(w_t^o) \equiv \log(w^o(t, z_t)) &= \alpha_{base} f_w(t) + \alpha_{P4P} \log(z_t) \\ &= \log(w_t^g) + \min\{0, \alpha_{P4P} \log(z_t)\} \end{aligned} \tag{8}$$

It is helpful to compare the private sector wage w_t^o (Equation 8) to the uncapped public sector wage w_t^g (Equation 5). Both are determined by tenure and by the executive's per-period productivity. However, the public sector salary never decreases, even with dismal performance. Private sector executives, on the other hand, could experience cuts in the variable component of their salary due to poor performance, which is captured by the right-hand side term in Equation 8. Moreover, the realized public sector wage (Equation 4) is capped from above, meaning that the upside of good performance is limited. The realized private sector wage, on the other hand, has no such cap. Thus, unlike in the government pay, pay-for-performance in the private sector has no floor or ceiling.

To derive the value of the outside option in Equation 7, we consider two additional adjustments. First, the parameter $\theta \in [1, \infty)$ is a discount rate of a private sector job, for example, because of losing perceived prestige.[28] If $\theta = 1$, the executive does not discount the private sector wage. As θ increases, the executive discounts the private sector wage even more. Additionally, we include a private sector multiplier, denoted with ϕ_t, to account for the substantial wage differential between the public and private sector (Federal Salary Council, 2023). We model ϕ_t as a function of the executive's experience t, rewarding more seasoned executives with a greater wage differential. For example, an executive with 20 years

[28] We elaborate on the reasons for the discount in Section 5.1.

of tenure can expect the public-private multiplier to be greater than that of an executive with only 2 years of experience.

At time t, after observing the pay for this period, the executive decides whether to continue working in the public sector for one more period ($q_t = 0$), or exercise their outside option and quit ($q_t = 1$).[29] Let t_Q denote the time at which the executive voluntarily quits to join the private sector, such that $t_Q < t_R$. Let $t_E \in \{t_Q, t_R\}$ indicate the time at which the executive exits the public sector, either by choice (t_Q) or due to mandatory retirement age (t_R).

We assume that the executive is risk- *and* effort averse with a constant relative risk aversion over their period t wage (similar to Hirshleifer and Suh, 1992; Page, 2018):

$$u(w_t, f_{t+1}) = \frac{(w_t - 1)^{1-\gamma}}{1-\gamma} - \xi(\overline{f} - f_{t+1})^{-1}, \tag{9}$$

where $\gamma > 0$ and $\xi > 0$ represent risk aversion and cost of effort, respectively, and $\overline{f}$ is the maximum possible effort. This specification implies that the executive prefers receiving a certain wage w_t over a risky wage with the same expected value. Moreover, high levels of effort induce strong disutility for the executive. Note that today's effort f_t was chosen at time $t-1$ and affects wages today. However, today's decision about next period's effort f_{t+1} affects the executive's utility today.

The executive's salary is set at the beginning of period t and consumed during the period. The executive's expected utility at time t is then:

$$U_t = \mathbb{E}_t \sum_{s=t}^{t_E} \beta^{s-t} u(\widetilde{w}^g_s, f_{s+1}) + \beta^{t_E+1-t} q_{t_E} U^E, \tag{10}$$

where β is the discount factor. The left-hand side term in Equation 10 captures the expected utility from government pay, received until the exit point t_E (whether by choice

[29]For simplicity, we assume that the executive cannot go back to working in the public sector (as in Kalmenovitz, Vij, and Xiao, 2022). In the data, the unconditional probability of returning is 1.8%.

or due to retirement). The last term, U^E, captures the (next period) expected utility from receiving non-government pay. This includes the executive's retirement benefits or the private sector income, if the executive quits before the retirement age. We assume that, upon exiting the public sector, the effort is expected to remain at the same level (f_{t_E}).

In particular, we consider two cases of Equation 10. In the first scenario, the executive retires from the public sector at the mandatory age. In other words, $t_E = t_R$ and $q_{t_R} = 1$. In this case, the term U^E is:

$$U^E = U^R = \sum_{s=t_R}^{t_N} \beta^{s-t_R} u(\lambda \widetilde{w}^g_{t_R}, f_{t_R}).$$

which is the present value of retirement paychecks, based on the executive's terminal wage in the public sector $\widetilde{w}_{t_R}$ and the replacement factor λ. In the alternative scenario, the executive chooses to quit at time $t_Q = t_E < t_R$ and $q_{t_Q} = 1$. In other words, their government career is followed by a private sector career and then retirement. In this case, U^E is:

$$U^E = U^Q = \sum_{s=t_Q}^{t_R} \beta^{s-t_Q} \mathbb{E}_{t_Q}[u(o_s, f_{t_Q})] + \sum_{s=t_R}^{t_N} \beta^{s-(t_R-t_Q)} \mathbb{E}_{t_Q}[u(\lambda o_{t_R}, f_{t_Q})],$$

where $\mathbb{E}_{t_Q}[u(o_s, f_{t_Q})]$ captures the expected utility of the private sector wage at time s, if the executive quits the government job at time t_Q, and $\mathbb{E}_{t_Q}[u(\lambda o_{t_R}, f_{t_Q})]$ is the expected utility of the retirement benefits when quitting the government job at time t_Q.

4.2 Model solution

Every period, the executive chooses effort f and quitting time q, to maximize the present value of discounted future income. This is summarized in the following Bellman equation:

$$\begin{aligned} U(f_t, z_t) = \max_{f_{t+1}, q_{t+1}} \Big\{ & u(\widetilde{w}^g_t, f_{t+1}) + (1 - q_{t+1})\beta \mathbb{E}\left[U(f_{t+1}, z_{t+1})\right] \\ & + q_{t+1}\beta \mathbb{E}\left[U^E(f_{t+1}, z_{t+1})\right] \Big\}. \end{aligned} \tag{11}$$

The problem in Equation 11 is solved by discretizing the state variables f and z and then applying backward induction, starting at $t = T$. The solution consists of two decision rules: whether to quit the public sector job and how much effort to exert, with respect to the next period. Each decision rule is a function of the three state variables: productivity z, effort f, and tenure t. We illustrate the optimal effort and quitting choices in Figure 3.[30]

Starting with effort, note that greater effort yields a short-term disutility due to cost of effort ξ. On the other hand, greater effort will increase productivity and hence the expected wages in the next period. This dynamic is captured in Panel A. First, effort decreases with tenure, because the upside of effort becomes more limited. The deterministic component of pay pushes the realized pay closer to the cap, which reduces the incentive to exert additional (and costly) effort. Second, there is a non-linear relation between effort and productivity. For low-productivity employees, the deterministic component and the pay floor ensures that they get sufficient compensation, resulting in no incentive to exert effort. For high-productivity employees, the pay-for-performance component pushes the realized pay closer to the cap. The executive will continue to be close to the cap in the future, due to the persistence of the productivity process. Therefore, they have a weak incentive to exert effort.

Exit policy involves a different trade-off. The private sector can offer higher pay, due to the multiplier ϕ and the lack of pay cap. On the other hand, the private sector pay is more exposed to performance shocks, resulting in lower pay during periods of bad performance. Panel B illustrates this dynamic. First, exit probability increases with productivity. Productive executives prefer the uncapped pay of the private sector, since the upside from being a top performer in the public sector is capped. As the executive is close to retirement age, two opposing factors emerge. On the one hand, the executive is more likely to reach the maximum allowable pay in the public sector. Thus, the upside from staying in the government is even lower. On the other hand, adverse productivity shocks can lower his last wage, which would be the benchmark for his entire retirement income stream. On balance, as the

[30] For illustration purposes, we use the parameters from Table 3 and Table 4, which are discussed in the next section.

executive gets especially close to retirement, quitting rates decrease. Finally, effort increases the incentive to quit. As we gradually shift from black to gray shades, the quitting region expands to include younger and less productive employees. This is because the private sector rewards effort more extensively, without imposing an upper bound on salaries, as opposed to the strict pay cap in the public sector.

4.3 Estimation

Having established the model, we turn to the the structural estimation. We first estimate outside of the model several parameters, such as the deterministic components of wages. Those are reported in Table 3. We then estimate the remaining parameters of interest: pay-for-performance (α_{P4P}), private sector discount rate (θ), cost of effort (ξ), and the persistence (ρ) and volatility (σ) of productivity. We start by selecting the functional forms of f_w, the deterministic component in both public and private sector wages (Equation 5 and Equation 8). We assume that it is a linear function of tenure:

$$f_w(t) = l_0 + l_t \times t \tag{12}$$

For simplicity, we scale each executive's wage by their starting salary in the public sector.[31] Since our primary dataset starts in 1996, we do not observe the starting salary of executives who joined the government prior to 1996. For these executives, we use their first available salary as their initial salary. As a result of this scaling, the executive's wage at time 0 is 1, which implies that $l_0 = 0$. To estimate l_t, we regress the log of the relative salary on tenure while controlling for executive, agency, city, and occupation fixed effects.[32] Based on the results, which are presented in Table A.3, we set the deterministic trend (l_t) to be 0.0292. This means that the annual pay raise is 2.9%.

Similarly, we model the private sector multiplier (Equation 7) as a linear function of the

[31] We thus effectively focus on the evolution of salary within executive, rather than across executives.
[32] We do so to remove unobserved heterogeneity; see longer discussion in Appendix A.1.

executive's work experience:

$$\phi_t = p_0 + p_t \times t \tag{13}$$

To calibrate the parameters, we study data from Federal Salary Council (2023). The report was prepared by the Federal Salary Council, which advises the president on how to adjust the federal payroll to reflect changes in the private sector labor markets. According to their data, the gap between federal pay and private sector pay in 1996 (the starting year in our sample) was 12.5%, implying that $p_0 = 0.1178$. Moreover, the public-private gap in 2022 was 24%. It follows that the compound annual growth rate over this 26-year period was 2.54%, which is the value we choose for $p_t = 0.0254$.

Next, we turn to the executive pay cap ($\overline{w}$). For tractability, we normalize it by the executive's own wage. The scaled variable represents the growth potential of the executive's salary. We model the growth potential as growing linearly with time t, starting at the initial level $\overline{w}_0$:

$$\log(\overline{w}(t)) = \overline{w}_0 + \overline{w}_t \times t \tag{14}$$

To estimate $\overline{w}_0$, we calculate the average initial log growth potential in the year of hiring (for executives whose initial tenure year is in our data), which yields 0.1118, implying that the starting salary is about 12% lower than the maximum allowable salary in that year. We then regress the log growth potential on time trend while controlling for executive, agency, city, and occupation fixed effects. Based on the results, which are presented in the second column of Table A.3, we set the deterministic trend ($\overline{w}_t$) to be 0.0234. This estimate implies that, on average, growth potential is increasing by 2.32% with each year of tenure.

We set the executive's risk aversion coefficient at $\gamma = 3$.[33] The risk-free interest rate r equals 2.02%, which is the average 3-month Treasury bill rate over the sample period. We assume that the executive works for a maximum of $T = 40$ years and lives for additional

[33] It is close to, but higher than, the value of 2.05 reported in Page (2018) using CEOs in the private sector. This is because public sector employees are likely more risk averse. In Figure A.3, we demonstrate that lower risk aversion results in greater effort and more turnover.

$t_N = 15$ years after retiring from the public sector. Similar to Briggs et al. (2021), we set the retirement replacement factor (λ) to 60%.

Finally, we turn to the key parameters of the model: the pay-for-performance (α_{P4P}), the private sector discount (θ), the persistence and volatility of productivity (ρ and σ), and cost of effort (ξ). We estimate those using the simulated method of moments (SMM). We first solve the model numerically, given the parameters, and generate simulated data from the model. Then, we compute a set of moments from the simulated and the actual data. The SMM estimation procedure determines the parameter values that minimize the weighted distance between the model-implied moments and their empirical counterparts.[34]

4.4 Identification

The SMM estimators are identified when the empirical moments equal the simulated moments if and only if the structural parameters are at their true value. A sufficient condition for this is a one-to-one mapping between a subset of structural parameters and the selected moments. In other words, the moments must vary when the structural parameters vary. Note that all the moments are somewhat sensitive too all the parameters, because effort and exit decisions are intertwined with the wage dynamics. However, some relationships are strongly monotonic in the underlying parameters, and are thus useful for identifying the corresponding parameter. When structurally estimating the model, we include all the meaningful moments generated by our model to understand which features of the data it can and cannot explain. Concretely, we focus on exit rate; variance and serial correlation of detrended wages (residual wage after controlling for the deterministic growth rate); mean, variance and serial correlation of pay gaps (difference between the executive's pay and the maximum allowable pay); and covariance between wages and pay gaps.

The private sector discount rate θ is identified by the exit rate. Intuitively, for any level of salary we can find a value of θ such that the executive is indifferent between staying

[34] Appendix A.1 provides further details on the estimation procedure.

in the government or switching to the private sector. The volatility of productivity σ is identified by the variance of the detrended wages: when σ is higher and the executive is paid for performance, the variation in detrended wages increases. The productivity persistence ρ is identified by the serial correlation of detrended wages, since high persistence yields a higher serial correlation. The pay-for-performance parameter α_{P4P} is identified by the mean pay gap: the greater the exposure to pay-for-performance, the greater the incentive to exert effort, and thus the higher the chance of hitting the pay cap (low pay gap).[35] Finally, the cost of effort ξ is identified by the covariance between wages and pay gaps, and the serial correlation of pay gaps. When the cost of effort is high, the employee exerts less effort. Consequently, the noise component of productivity becomes more dominant. This results in more volatile pay gaps and weaker correlation between wages and pay gaps, that is, less negative correlation (closer to zero).

5 Quantitative implications

In the previous sections, we presented empirical evidence on executive behavior (Section 3) and developed a structural model to formalize their decisions (Section 4). We now combine the two strands and study the quantitative implications of our findings.

5.1 Characterizing federal executives

In this section, we estimate the structural parameters that describe federal executives. Table 4 summarizes the results. Note that the estimated parameters are statistically significant with low standard errors (Panel A), suggesting that the model is well identified.[36] Furthermore, comparing the data-implied and model-implied (simulated) moments, the estimated

[35]Importantly, α_{P4P} and σ have the opposite effect on effort. Consequently, their relation to the covariance between wages and pay gaps has the opposite sign, and also their relation to turnover rate. This helps separately identify the two parameters.

[36]In Table A.4, we further show that the model parameters are locally identified by the moments, using the diagnostic measure of Andrews, Gentzkow, and Shapiro (2017).

model fits the data fairly well (Panel B), and the differences between the simulated and actual moments are small. For example, the simulated mean of pay gaps is 7.03% vs. 7.48% in the data while the simulated variance of pay gaps is 0.15% vs. 0.12% in the data.

We find that the persistence and volatility of productivity parameters are 0.819 and 0.118, respectively. This implies that the productivity process is fairly persistent and smooth. Perhaps more interestingly, we find that pay-for-performance for federal executives is 21% ($\alpha_{P4P} = 0.2074$), while the deterministic component of executive pay accounts for the remaining 79%.[37] It implies that the pay-for-performance sensitivity of federal executives is significantly lower than pay-for-performance sensitivity of private sector executives.[38] Early literature (Murphy, 1985, 1999) suggested that bonus and incentive pay accounted for 40% of total CEO compensation. Its importance has, however, steadily increased in the past decades and reached up to 75-80% in late 2000s (Frydman and Jenter, 2010; Murphy, 2013) and even up to 90% in 2019 (Edmans, Gosling, and Jenter, 2023). For example, as noted by Frydman and Jenter (2010), the incidence of option compensation has increased more than twofold, as it comprised 20% of total pay in early 90s and about half in early 2000s.

Next, we estimate the discount factor of the private sector at 68%.[39] This substantial discount could come from at least three sources. First, federal executives are in powerful positions, overseeing thousands of employees and issuing directives that affect large sections of the economy. They can also derive utility from serving the public interest (Loeb and Page, 2000; Finan, Olken, and Pande, 2015). The private sector offers a higher pay, but the loss of regulatory power and call-of-duty motive acts as a discount rate to the monetary gains. Second, several post-employment restrictions could limit the financial gains during the first years in the private sector. This includes cooling-off requirements and various

[37] To be clear, we can only show that executives behave as if the pay-for-performance is 21%. In other words, we are unable to estimate the true magnitude of pay-for-performance but can only provide one which is consistent with what we observe in the data.

[38] Note that our model uses the same α_{P4P} for public and private sector. However, the private sector wage has no floor and it also includes the multiplier ϕ. Because of that, the effective pay-for-performance sensitivity is substantially higher in the private sector.

[39] The parameter θ is estimated at 3.11, which means that federal executives discount the outside option by $1 - 1/3.11 = 68\%$.

restrictions on the type of activities in which a high-ranking ex-regulator can engage (Law and Long, 2012; Strickland, 2020; Cain and Drutman, 2014; Kalmenovitz, Vij, and Xiao, 2022). Finally, various benefits associated with high-level government positions will likely become unavailable in the private sector, which contributes to the discount rate θ.[40] To provide some context, an executive with 10 years of experience earning the average salary in our sample expects to earn \$310,260 in the private sector (constant 2023 USD), which is 45% higher than his salary in the public sector. However, due to the discount factor, he behaves as if the private sector only paid $1/\theta$ of this amount, which is \$99,283.

Finally, the cost of effort ξ is estimated at 0.001. While this value alone does not have an intuitive interpretation, we can quantify its importance by looking at two examples. First, we calculate the elasticity of wages to ξ. We find that, for every 1% increase in the cost of effort, log wages decline by 0.024%, since the executive exerts less effort. Digging deeper, we quantify the trade-off between wage gains and effort disutility. We look at an executive with 25 years of experience, who exerts effort at the mean level in the simulated data and has a neutral productivity level. We then compare his current log wage to a counterfactual one, where he exerts additional 1% effort. In this case, the executive's log salary will increase by 0.21%. However, the salary gains are more than offset by the effort disutility, and on balance the executive's utility declines (and therefore this is not his optimal level of effort). To break even, the extra 1% effort would have to increase log salary by at least 0.27%. In other words, the current monetary payoff for effort does not compensate for the disutility it creates.

5.2 Responding to restructured executive pay

In this section, we study how the design of executive pay affects effort and exit decisions. We focus on the two key parameters, pay-for-performance (α_{P4P}) and pay cap ($\overline{w}_0$). For each parameter, we start from the baseline value which we estimated in the previous section. We

[40] See, for instance, a description of benefits for SES positions by the Department of Energy and the media.

then change the parameter by ±25% relative to the base value, while holding all the other parameters constant. In other words, we conduct a series of counterfactual experiments to see how effort and exit would have changed if the underlying structural parameters would have been different. Figure 4 summarizes the results.

The choice of effort is positively influenced by the two components of executive pay. This dynamics is illustrated in Panel A. First, pay-for-performance increases the reward for being productive. Therefore, the executive exerts more effort, which translates to higher productivity level. Similar logic applies to changes in the pay cap: when the executive is close to or at the pay cap, their incentive to exert effort are low, since they cannot obtain higher wage. When the pay cap is raised, the executive sees a greater upside from exerting effort. As a result, optimal level of effort increases. Visually, as we move from the bottom of the figure to the top (more pay-for-performance), the area becomes darker which indicates greater effort. As we move from left to right (higher pay cap), the area darkens which indicates greater effort.

In contrast, with respect to exit, the two components of executive pay pull in opposite directions. This dynamics is illustrated in Panel B. On the one hand, pay-for-performance increases the incentive to switch to the private sector. Intuitively, the uncapped wage is more likely to reach the upper bound of government pay. Therefore, with the same level of effort, the executive would prefer moving to the private sector where pay is uncapped. Moreover, more performance pay increases the volatility of wages, which risk-averse executives dislike. On the other hand, a higher pay cap reduces the incentive to quit, since there are better salary growth opportunities in the government.[41] Visually, as we move from the bottom of the figure to the top (more pay-for-performance), the area becomes darker which indicates higher exit rates. As we move from left to right (higher pay cap), the area becomes lighter which indicates lower exit rates.

Next, we quantify how executive pay affects effort and exits. The results are summarized

[41] To be precise, our model predictions pertain to higher initial pay cap ($\overline{w}_0$) or, equivalently, to higher pay cap growth rate ($\overline{w}_t$).

in Table 5. In Panel A, we start by computing the elasticity of effort and exit to pay-for-performance and pay caps. We find that a 1% increase in pay-for-performance increases exits by 4.06%, while a 1% increase in the pay cap lowers exits by 6.37%. However, a 1% increase in pay-for-performance increases effort by 0.08%, while a 1% increase in the pay cap increases effort by 0.02%. In other words, the elasticity of exit to pay-for-performance is lower than the elasticity of exit to pay cap, but the elasticity of effort to pay-for-performance is greater than the elasticity of effort to pay cap.

With those quantities in mind, we turn to assess the executive pay reform. As noted earlier (Section 3), the reform increased both the pay cap and the pay-for-performance, which led to substantially higher turnover rates among treated executives. Based on the previous discussion, this means there was a substantial increase in pay-for-performance, to offset the countervailing effect of the increase in pay caps. From the data, we know that the pay cap $\overline{w}_0$ was raised by 17.99%. We also know, based on the difference-in-differences results, that exit rates increased by 2.5-3.7 percentage points. Guided by the model, we can now quantify by how much has pay-for-performance increased after the reform. Using the lower bound of the treatment effect (2.5 p.p.), we estimate that the reform increased pay-for-performance by 16.8%, relative to the baseline estimated value. With the upper bound of the treatment effect (3.7 p.p.), we estimate that the reform increased pay-for-performance by 20%.[42]

Finally, we investigate how the transformation of executive pay affected effort (based on the simulated moments). As explained, the pay cap was raised by 18%, while our estimates show that pay-for-performance increased by 17-20%. We find that, combined, both factors contributed to greater executive effort. Concretely, the higher pay cap increased effort by 0.22%. Pay-for-performance, on the other hand, had a substantially greater impact, increasing effort by 0.56-0.63%. Intuitively, pay-for-performance directly influences the incentive

[42] The percentage effect on turnover (19-26% relative to the mean) is lower than the one reported in Table 2, because we estimate the model on the full sample of executives (not just around the treatment year) and exclude the control group.

to exert effort (via the productivity process), while pay cap only does so indirectly if the executive's uncapped pay is close to the cap. Combining both parameters, we find that the reform increased the average effort by nearly 1%.[43]

In sum, the new executive pay scheme had a non-trivial impact on executive behavior. The new policy increased the growth potential (higher pay cap), and simultaneously increased the pay-for-performance component of wages. The combined changes increased the level of effort by 1%, but also provided executives with a strong incentive to switch to the private sector, where the pay is uncapped and the rewards for effort are more substantial.

5.3 Heterogeneous executives

In this section, we examine the heterogeneous impact of the reform. The key factor we focus on is the distance between the executive's pay and the government-wide pay ceiling. Recall that the reform increased the pay cap and the pay-for-performance, each having the opposite effect on exits (Section 5.2): the higher ceiling reduced exit rates, while the higher pay-for-performance increased exit rates. On average, the pay-for-performance effect dominates the pay ceiling effect. While this is true on average, it also provides a cross-sectional prediction: employees who are close to the pay cap are especially sensitive to the pay-for-performance effect. For them, the chances of hitting the pay cap are high, which means that the upside from government pay is even weaker. Thus, we predict that the higher exit rates are concentrated among executives who are close to the pay cap.

To test this prediction we estimate a triple difference-in-difference specification (triple diff), essentially an expanded version of Equation 1:

$$\begin{aligned} Exit_{i,t+1} =& \alpha + \beta \cdot HighPayGAP_i \cdot Post_t \cdot Treated_i + HighPayGAP_i \cdot Post_t \\ &+ HighPayGAP_i \cdot Treated_i + HighPayGAP_i + X_{i,t}^{'} + \lambda_{a\times t} + \epsilon_{i,t}, \end{aligned} \tag{15}$$

[43] The total effect is not a linear combination of the two separate effects, due to interactions in the model.

where $HighPayGAP_i$ is an indicator equal to one if the employees i's ex-ante pay gap is greater than the yearly median.[44] Under this specification, we can include agency×year fixed effects which controls for any time-varying characteristics at the agency level correlated with the decision to exit. Our focus is on β, which captures the differential response in exit decisions by treated executives with high and low pay gaps after the reform. Our prediction is that β will be negative because being farther away from the pay ceiling should attenuate the reform's impact on exit decision. Note that the variables $Post$, $Treated$, and $Post \cdot Treated$ are all subsumed under year×agency fixed effects. In an alternative specification, we replace year×agency fixed effects with year and agency fixed effects (separately), and add back to Equation 15 the interaction of $Post \cdot Treated$. We focus on the restricted control groups, where we compare treated executives to executives in control agencies who earn similar wages or officially hold a managerial rank.

Our findings are summarized in Table 6. In columns (1)-(2), control employees have salary at least as high as the pay floor of SES. Columns (3)-(4) control employees are those with managerial pay rank. Odd columns estimates Equation 15 and even columns replace year×agency fixed effects with year and agency fixed effects. The coefficient on $HighPayGAP_i \cdot Post_t \cdot Treated_i$ is negative and statistically significant across all specification, indicating that the reform's effect on exit probability is attenuated for executives with a high pay gaps. Using the estimates from columns (2) and (4), we calculate the reform's impact on the probability of exit for high pay gap treated executives, which equals to the sum of coefficients on $HighPayGAP_i \cdot Post_t \cdot Treated_i$ and $Post_t \cdot Treated_i$. The results indicate that the reform's impact on the exit probability of treated executives with a high pay gap is economically and statistically indistinguishable from zero. Collectively, the findings are consistent with the prediction of our model and the baseline results.

[44] We use pre-treatment average values, since the post-reform pay gap itself is affected by the reform ("bad control").

5.4 Alternative policies

In this section, we study how alternative policies could influence effort and exit. Our results are summarized in Figure 5.

(1) Compensation packages - The first policy we explore is a restructuring of the executive pay package. Recall that in Section 5.2 we computed the elasticity of effort and exit to pay-for-performance and pay caps. We find that a 1% increase in pay-for-performance increases exits by 7.24% and increases effort by 0.04%, while a 1% increase in the pay cap lowers exits by 6.45% and increases effort by 0.02%. Based on those calculations, we consider a "zero-exit" policy which would induce greater effort without inducing changes in turnover rates. To achieve that, one would need to increase both pay-for-performance (more exits) and the pay cap (less exits), the latter more than the former due to the weaker elasticity. We present a range of such policies in Figure 5, Panel A. For instance, a combination of 9% increase in pay-for-performance and 10% increase in the pay cap will have a net zero effect on exits. Recall that the reform raised the pay cap by 18% and pay-for-performance by 16-20%, resulting in higher exit rates. This is represented by the area above the plotted line, where pay-for-performance is pushed "too high" which leads to more exits.

(2) Costly effort - The second policy we evaluate is a reduction in the cost of effort. For instance, allowing federal executives to work from home, or adopting AI technologies to streamline some of the more mundane tasks. Our results are summarized in Figure 5, Panel B. We find that lowering the cost of effort will increase effort, as expected, but will also increase exits. Intuitively, as the executive exerts more effort, he receives more pay-for-performance compensation and gets closer to the pay cap. Therefore, from the executive's perspective, the upside from staying in the public sector is limited. As a result, the probability of exit increases.[45] Quantitatively, we find that a 1% decrease in the cost of effort would translate to 0.1% increase in effort relative to the mean, and increase exit rate by

[45] This relation between effort and exit was also revealed in the optimal exit policy (Figure 3), where we show that the exit region expands with effort.

1.6%. A more substantial reduction of the cost by 10% would increase effort by 0.7% and exits by 5.3%. In other words, we find that the cost of effort has a large quantitative effect on both effort and exits. Finally, we compute the impact of effort on wages. We find that the aggressive policy will increase wages by 0.2% relative to the mean, which would translate to $436.3 in constant 2023 USD.

(3) Discount rate - The third policy we evaluate relates to the discount rate. For instance, allowing federal executives to advertise their past position in the government, or relaxing some of the post-employment restrictions. Our results are summarized in Figure 5, Panel C. Increasing the discount rate (higher θ) will reduce exits, as expected, but it will also decrease effort. The primary effect of changing θ is that when the executive discounts the outside option more, he has less incentives to exit the government, since the perceived benefit of switching is smaller. At the same time, the secondary effect of changing θ is that the executive is less inclined to exert effort, because it now has a lower impact on the value of the outside option. Quantitatively, we focus on 1% increase of θ, which leads to 0.1% decrease in $1/\theta$. In this scenario, exit rates will decline by 24% while effort will decline by 0.01%. While the discount rate has a direct large effect on exit, as expected, our results show that it also has a non-trivial adverse effect on effort.

6 Conclusions

We study pay-for-performance in the public sector. We source a comprehensive data set on the senior executives of the federal government, who hold the leadership positions in their respective agencies. We then exploit an overhaul of the compensation packages of federal executives, which doubled their pay ceiling and tied their pay to performance. In a difference-in-differences specification, we find that the reform triggered a wave of exits among treated federal executives, increasing their turnover rates by 2.5-3.7 percentage points.

To understand the dynamic which leads to this behavior, we develop a structural model that links executive pay to exit and effort. In our model, a federal executive has an outside option in the private sector. The pay in both sectors increases with tenure and productivity. However, the public sector pay is capped from above while the private sector pay has no cap. Because of that, pay-for-performance will motivate more effort but also increase the incentive to exit: with the same level of effort, the executive would prefer the private sector where pay is uncapped. We structurally estimate our model, and find that 21% of federal executive pay is based on performance (compared to 80% in the private sector). Despite the relatively small incentive, performance pay has a large quantitative impact: a 1% increase in pay-for-performance will, on average, increase effort by 0.04% and exits by 7.24%. We conclude with a range of alternative policies, such as a "zero-exit" policy to increase effort without accelerating turnover.

Our paper highlights the consequences of performance-based pay in the public sector. Any increase in performance pay will lead to a (small) bump in executive effort, but it will also trigger a wave of resignations, since executives will value the private sector even more. Those findings contribute to the nascent literature on regulatory incentives and performance. We are the first to study the structure of regulatory pay, and specifically the role of pay ceiling and performance-based pay. We also show how the pay structure directly affects the revolving door: the incentive to accept a private sector job increases with pay-for-performance and decreases with the pay ceiling. Our quantitative analysis can inform the debate on how to improve the performance of regulatory agencies further.

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Figure 1: **Trends in executive pay**

The figure plots the evolution of pay for federal executives (Senior Executive Service), from 1979 to 2022. On the left, we plot the upper and lower bounds (1^{st} and 99^{th} percentiles) and the gap between the two. On the right, we plot the mean and standard deviation of pay across all executives. The statistics are based on the adjusted pay (base pay plus locality rate) and not adjusted for inflation. The shaded area represents the executive pay reform, which was implemented during 2002-2004. See Section 2.3.

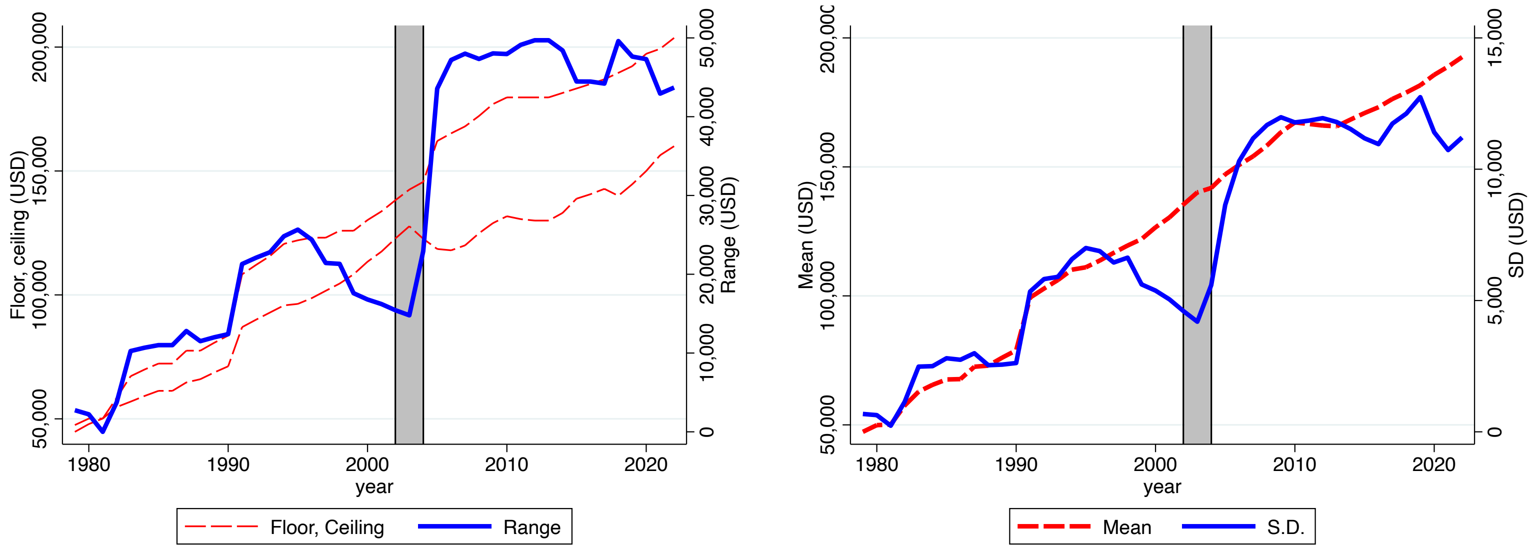


Figure 2: **Turnover dynamics**

The figure reports the coefficients (η_k) from Equation 2. The control group is executives with at least the minimum salary of SES executives, and we include $Transition \times Treated$ to account for the possibility that administration transition causes managerial ranked executives to be more likely to leave. The vertical bars display 95% confidence intervals. See Section 3.

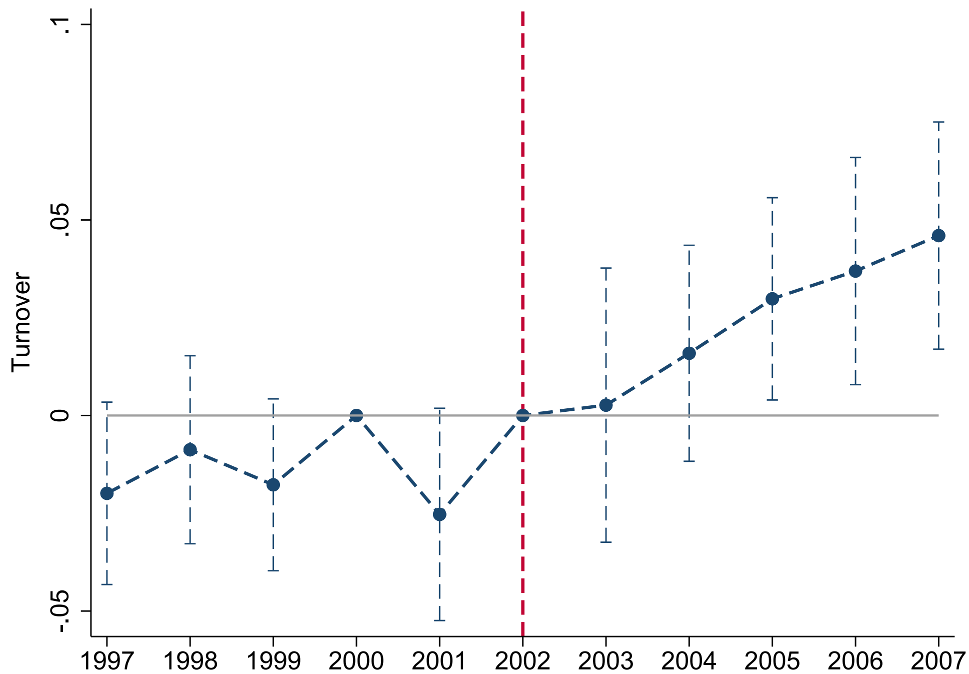


Figure 3: **Optimal executive policies**

On the left, we plot the optimal effort policy. Darker areas correspond to lower levels of effort exerted (as % change from the lowest value of 1). On the right, we plot the optimal exit policy. The shaded area represents the region in which the executive quits the public sector job. The darker shade region corresponds to a low level of effort while the lighter shade region to a high level of effort. The policies are calculated using the parameters in Table 3 and Table 4. See Section 4.2.

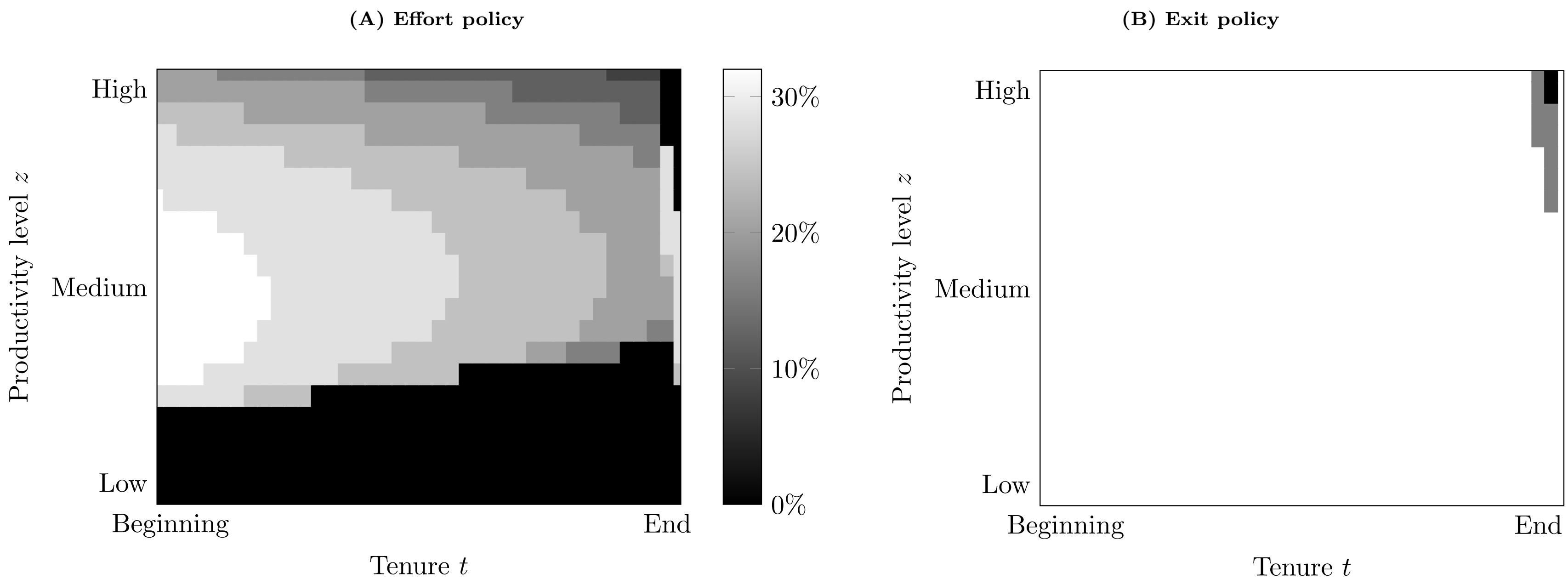


Figure 4: **Quantifying the response to executive pay**

The figure shows how effort (left) and exit (right) respond to the two parameters of executive pay packages: pay-for-performance α_{P4P} and pay cap $\overline{w}_0$. The values of the two parameters are expressed as % of the baseline estimated values from Table 4. The remaining parameters are kept unchanged. See Section 5.2 and Table 5.

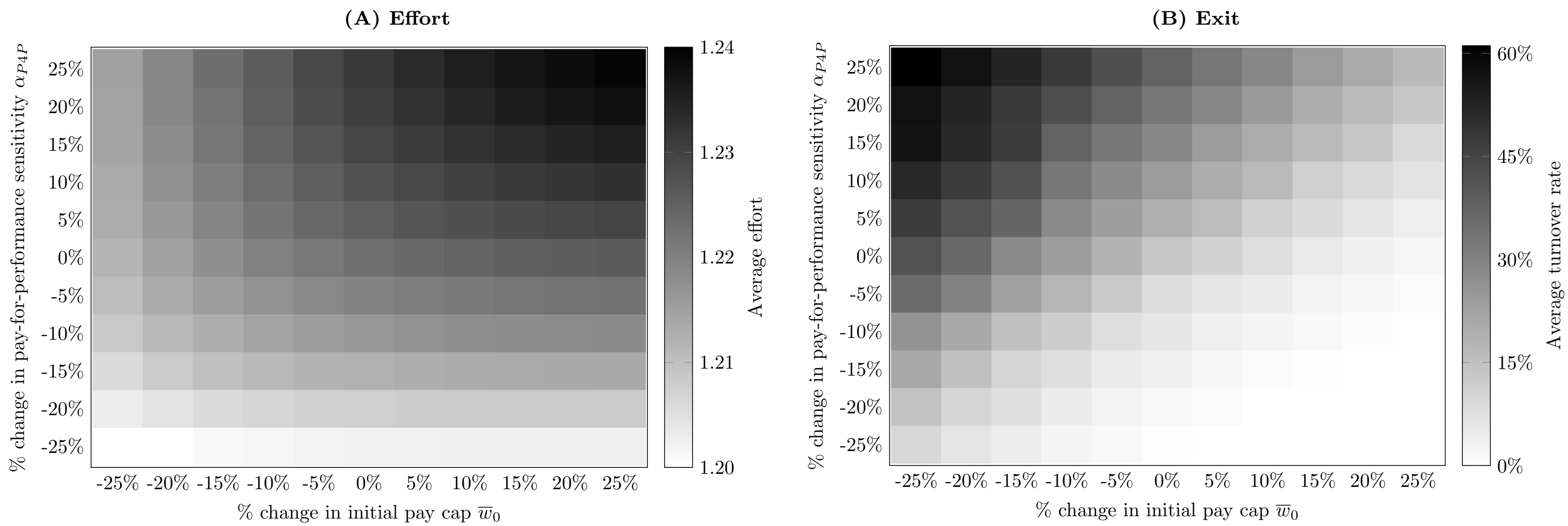
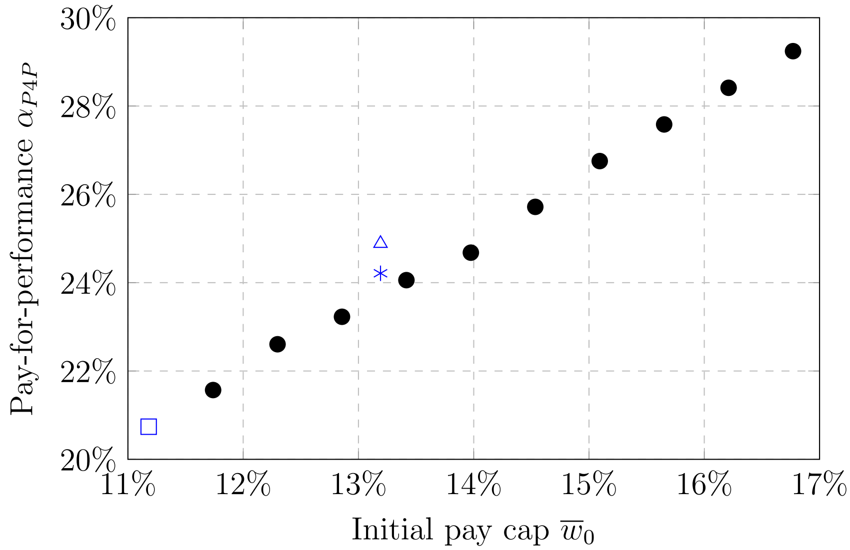
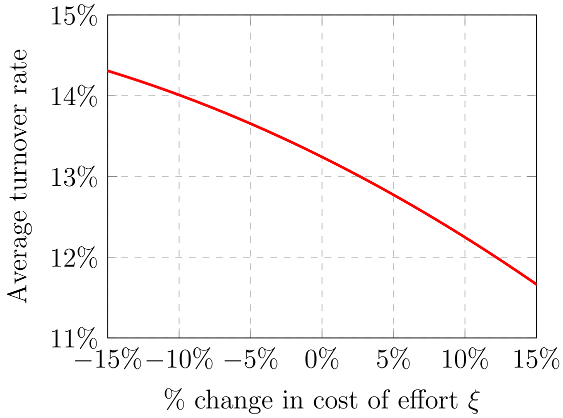


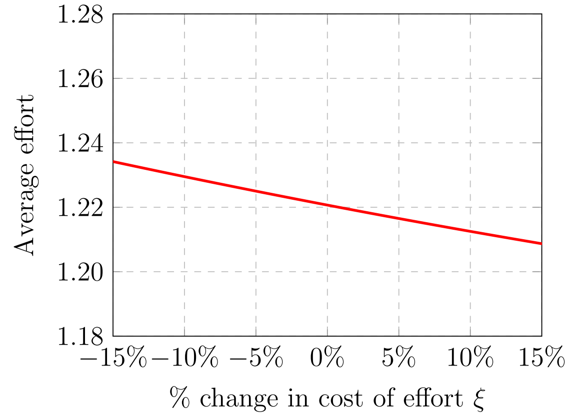
Figure 5: **Evaluating alternative executive pay policies**

Panel A. Net zero change in turnover. The figure presents different combinations pay-for-performance α_{P4P} and initial pay cap $\overline{w}_0$, which result in the lowest possible change in turnover rate relative to the baseline value, while holding all other parameters fixed. The square indicates the baseline values from Table 3 and Table 4, and the triangle (asterisk) indicates the values associated with the lower (upper) bound of the treatment effects (from Table 5).



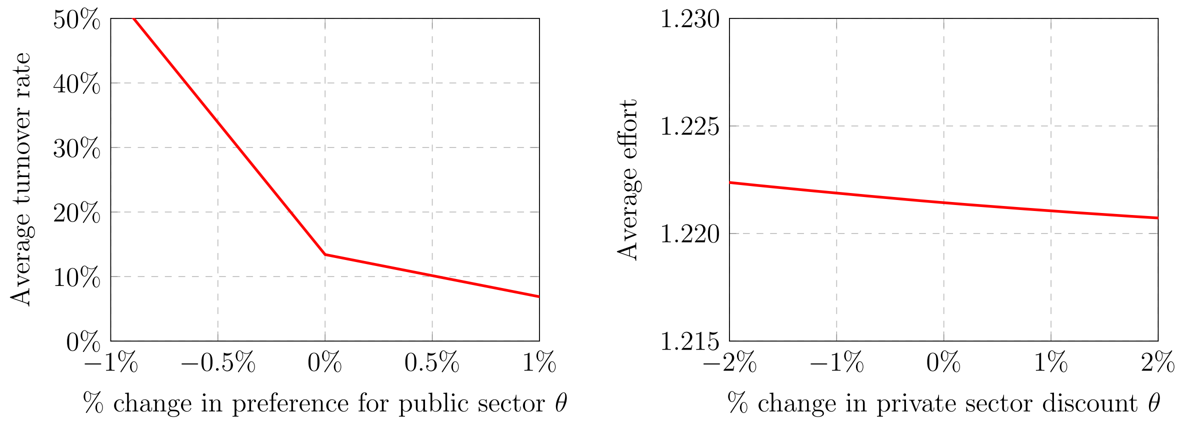
Panel B. Reducing the costs of effort. The graphs show the effects of changing the cost of effort on the turnover and mean effort. Each curve is a second-order polynomial interpolation of moments from a discrete set of counterfactual experiments, starting from the baseline values of structural parameters and varying only the respective parameter, while keeping all other parameters constant.





Magnitude:	%Δ Cost of effort ξ	
	−1%	−10%
%Δ Mean turnover	1.64%	5.29%
%Δ Mean effort	0.06%	0.71%
%Δ Mean productivity	0.07%	0.69%
%Δ Mean log wages	0.02%	0.19%

Panel C. Reducing the discount rate. The graphs show the effects of changing the private sector discount on exit and effort. Each curve is a second-order polynomial interpolation of moments from a discrete set of counterfactual experiments, starting from the baseline values of structural parameters and varying only the respective parameter, while keeping all other parameters constant.



-0.1% change in $1/\theta$	
%Δ Mean turnover	-24.61%
%Δ Mean effort	-0.01%

Table 1: **Descriptive statistics**

The sample includes all federal executives who held an executive position at any point between 1996-2021. In Panel A, we focus on years in which the executive held an executive position. In Panel B, we include the years before being elevated to the executive rank. $BasePay$ is the executive's base pay, $LocalityPay$ is the locality adjustment, $Bonus$ is the cash bonus, and $TotalComp$ is the sum of those three components, all in constant 2023 USD. $\Delta BasePay$ is the year-on-year change in base pay. $Tenure$ is the number of years since joining the public sector. $Exit = 1$ when the regulator ultimately left the government, regardless of their rank at the time of exit. $Male$ is based on the executive's first name. See Section 2.2.

Statistic:	Avg.	Median	S.D.	Min	Max	Obs.
Panel A: Executive period						
$BasePay$	218,553	219,583	16,114	149,056	322,786	139,606
$LocalityPay$	4,454	0.0	7,449	-230072	43,740	139,517
$Bonus$	1,211	0.0	6,446	0.0	133,772	140,038
$TotalComp$	224,198	226,775	17,032	0.0	401,876	139,531
$\Delta BasePay$	1.0	0.4	3.1	-21.8	35.8	112,681
$Tenure$	22.5	24.0	10.8	0.0	63.0	140,035
$Exit$	13.2	0.0	33.8	0.0	100.0	140,038
$Male$	69.9	100.0	45.9	0.0	100.0	139,029
Panel B: Full career						
$BasePay$	171,482	177,511	54,863	0.0	512,803	329,060
$LocalityPay$	12,464	10,651	13,335	-230072	263,012	328,764
$Bonus$	1,302	0.0	4,761	0.0	195,568	330,446
$TotalComp$	185,143	201,252	53,669	0.0	512,803	328,926
$\Delta BasePay$	2.9	0.9	6.4	-3.7	33.4	286,791
$Tenure$	18.9	19.0	10.8	-2.0	73.0	330,435
$Exit$	9.0	0.0	28.7	0.0	100.0	330,446
$Male$	68.2	100.0	46.6	0.0	100.0	327,858

Table 2: **Pay for performance and exits**

Results from estimating Equation 1. $\mathbb{1}(Exit) = 1$ if the executive exits the government in year $t+1$, $Post = 1$ from 2002 onwards, and $Treated = 1$ for agencies participating in the SES pay system. $Transition = 1$ in the year of administration change (i.e., in 2000). Pay controls are $Tenure$, $BasePay$, $Bonus$, and $LocalityPay$, all measured before the reform. Standard errors clustered by agency are in parentheses. See Section 3.

Outcome:				$\mathbb{1}(Exit)$			
Treated×Post	0.025***	0.026***	0.036***	0.037***	0.037***	0.031***	0.033***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)
Treated	0.018***						
	(0.006)						
Post	-0.012**						
	(0.005)						
Transition×Treated			0.050***	0.051***	0.069***	0.068***	0.068***
			(0.010)	(0.010)	(0.014)	(0.014)	(0.014)
Year FE	-	Yes	Yes	Yes	-	-	-
Agency FE	-	Yes	Yes	Yes	Yes	Yes	-
Pay controls	-	-	-	Yes	Yes	Yes	Yes
Occupation×Year FE	-	-	-	-	Yes	Yes	Yes
State×Year FE	-	-	-	-	-	Yes	Yes
Agency×State FE	-	-	-	-	-	-	Yes
R^2	0.002	0.011	0.012	0.017	0.032	0.042	0.044
N	237,484	237,471	237,471	237,471	236,846	235,123	235,064
Effect (%Mean)	33.02	34.13	47.70	48.83	49.29	40.87	44.24

Table 3: **Parameters estimated outside of the model and definitions of moments**

The table summarizes the values of parameters estimated outside of the model (Panel A) and the definitions of variables used to create the model-implied moments (Panel B). See Section 4.3.

Panel A: Parameters estimated outside of the model

Parameter	**Symbol**	**Value**
Risk aversion	γ	3
Risk-free interest rate	r	0.0202
Maximum tenure	T	40
Years in retirement	N	15
Retirement replacement factor	λ	0.6
Wage trend intercept	l_0	0
Wage trend coefficient	l_t	0.0292
Private sector premium intercept	p_0	0.1823
Private sector premium coefficient	p_t	0.0254
Pay cap intercept	$\bar{w}_0$	0.1118
Pay cap coefficient	$\bar{w}_t$	0.0234

Panel B: Definitions of variables

Moment	**Model**	**Data**
Log relative wage	$\alpha_{base} f_w(t) + \max\{0,\ \alpha_{P4P} \log(z_t)\}$	$\log(\text{relative wage}_{it})$
Pay gap	$(\overline{w}(t) - \widetilde{w}_t^g)/\widetilde{w}_t^g$	$(\text{pay cap}_{it} - \text{wage}_{it})/\text{wage}_{it}$
Turnover rate	$\sum$ quits / $\sum$ executives	$\sum_{it} \text{quits}_{it}$ / $\sum_{it} \text{executives}_{it}$

Table 4: **Characterizing federal executives**

The table reports the structural estimates and the model-implied moments, based on the full sample of federal executives between 1996-2021. The model is estimated using the simulated method of moments, which chooses model parameters by minimizing the distance between the moments from a simulated panel of firms and their data counterparts. Panel A reports the the estimated parameters and their standard errors, clustered at the executive level. Panel B reports the simulated and actual moments. α_{P4P} is the sensitivity to pay-for-performance; θ is the discount rate of the private sector; ρ is the persistence of productivity; σ is the volatility of productivity; ξ is the cost of effort. See Section 5.1 and Appendix A.1.

Panel A: Estimated parameters

Parameter	**Symbol**	**Estimate**	**Std. error**
Pay for performance	α_{P4P}	0.2074	0.0008
Preference for public sector	θ	3.1129	0.0016
Productivity persistence	ρ	0.8193	0.0042
Productivity volatility	σ	0.1178	0.0011
Effort aversion	ξ	0.0011	0.0001

Panel B: Moments

Moment	**Simulated**	**Actual**
Variance of residual log wage	0.0013	0.0019
Serial correlation of residual log wage	0.7029	0.7479
Mean pay gap	0.0676	0.0748
Variance of pay gap	0.0015	0.0012
Serial correlation of pay gap	0.7070	0.6293
Mean turnover	0.1341	0.1386
Covariance of wages and pay gaps	-0.0004	-0.0005

Table 5: **How executives respond to restructured pay packages**

In Panel A, we compute the mid-point elasticity of effort and exits to pay-for-performance and to the pay cap. In Panels B and C, we compute the implied change in pay-for-performance and effort after the executive pay reform in 2002-2004. The change in pay cap ($\overline{w}_0$) is calculated from the data, and the change in turnover rate ($\%\Delta Turnover$) equals the treatment effect from Table 2; we use separately the lower bound (Panel B) and the upper bound (Panel C). We then compute the implied change in pay-for-performance (α_{P4P}), based on our structural model. Finally, we compute the resultant change in effort. See Section 5.2 and Figure 4.

Panel A. Elasticities

	Mean turnover	Mean effort
$\overline{w}_0$	-6.37%	0.02%
α_{P4P}	4.06%	0.08%

Panel B. Lower bound: 2.5 p.p. increase in turnover

	%Δ Mean turnover	%Δ Mean effort
17.99% increase in $\overline{w}_0$	-69.13%	0.22%
16.75% increase in α_{P4P}	139.30%	0.56%
Combined effect	19.39%	0.97%

Panel C. Upper bound: 3.7 p.p. increase in turnover

	%Δ Mean turnover	%Δ Mean effort
17.99% increase in $\overline{w}_0$	-69.13%	0.22%
20% increase in α_{P4P}	143.18%	0.63%
Combined effect	26.40%	1.10%

Table 6: **The Role of Pay Gaps**

This table examines heterogeneous effects with respective pay gaps. $\mathbb{1}(Exit) = 1$ if the executive exits the government in year $t+1$, $Post = 1$ from 2002 onwards, and $Treated = 1$ for agencies participating in the SES pay system. $HiighPayGAP = 1$ if executives' pre-reform average pay gap is above the yearly median. In columns (1)-(3), the control group is restricted to those with a salary of at least the minimum salary of SES. In columns (4)-(6), the control group is restricted to those with managerial pay rank. Control variables include $Tenure$, $Salary$, $Bonus$, $LocalityPay$, and $Treated \times Transition$. The total effect is the coefficient on $Treated \times Post \times HighPayGAP$ + $Treated \times Post \times$, measuring the impact of the reform on the turnover rate of treated executives with high pay gap after the reform. P-value is from T-tests that examines whether total effect is different from zero. Standard errors clustered by agency are in parentheses. See Section 5.3.

Outcome:	$\mathbb{1}(Exit)$			
Control sample:	≥ Min Salary of SES		Managerial Rank	
	(1)	(2)	(3)	(4)
Treated×Post×HighPayGAP	-0.041**	-0.048**	-0.079**	-0.057*
	(0.019)	(0.021)	(0.031)	(0.034)
Treated×Post		0.046***		0.061*
		(0.018)		(0.033)
Post×HighPayGAP	0.014	0.017	0.027	0.006
	(0.017)	(0.019)	(0.030)	(0.033)
Treated×HighPayGAP	0.036**	0.039**	0.083***	0.066**
	(0.015)	(0.015)	(0.028)	(0.027)
HighPayGAP	-0.037**	-0.039***	-0.078***	-0.059**
	(0.015)	(0.015)	(0.028)	(0.028)
Controls	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Agency FE	No	Yes	No	Yes
Agency×Year FE	Yes	No	Yes	No
R^2	0.038	0.020	0.035	0.018
N	59,054	59,512	45,574	46,008
Total Effect		-0.00		0.00
P-value		0.79		0.68

Appendix

A.1 Structural estimation: additional

We follow Lee and Ingram (1991) when estimating the model using simulated method of moments. One important issue to address when using SMM is related to the unobserved heterogeneity in the data. In the model, the only source of heterogeneity is the draws of productivity shock (ε). In reality, productivity shocks could be correlated with unobserved factors such as talent or ability, or with factors not explicitly captured by the model such as geographical location or agency. To address this challenge, we follow Hennessy and Whited (2007) and extract as much of observed heterogeneity from data as possible to make the model- and data-implied moments comparable, that is we control for executive-, agency-, city- and occupation fixed effects when computing all moments except for means, which are calculated using the raw data. We then add back the sample mean to each variable, to reconcile the average levels of these variables in the data.

Let the pooled time series of all firms be $x_i = x_1, \ldots, x_N$, where $N = n \times T$ is the total number of firm-year observations. Using the transformed data, we compute a set of moments $h(x_i)$. We create the simulated moments by first solving the model given a vector of parameters $\Theta = (\alpha_{P4P}, \theta, \rho, \sigma, \xi)$ and then generating simulated data y from the model. We simulate $S = 10$ datasets of $N = 2,000$ executive-years, following Michaelides and Ng (2000), who find that a simulation estimator behaves well in finite samples if the simulated sample is approximately ten times as large as the actual data sample. The resulting moments in a given simulated sample are given by the vector $h(y_s, \Theta)$.

The simulated methods of moments estimator $\widehat{\beta}$ is then the solution to

$$\widehat{\Theta} = \arg\min_{\Theta} \left[g(x) - g(y, \Theta)\right]' W \left[g(x) - g(y, \Theta)\right], \tag{A.1}$$

where $g(x) = \frac{1}{N}\sum_{i=1}^{N} h(x_i)$ and $g(y, \Theta) = \frac{1}{S}\sum_{s=1}^{S} h(y_s, \Theta)$ are the sample means of the actual and model-implied data, and W a positive definite weight matrix, which we calculate following Bazdresch, Kahn, and Whited (2017) as the optimal clustered weight matrix. We use simulated annealing to find the optimum to the minimization problem.

Under mild regularity conditions, the SMM estimator is asymptotically normal

$$\sqrt{N}(\widehat{\Theta} - \Theta) \xrightarrow{d} \mathcal{N}(0, V), \tag{A.2}$$

where V is the covariance matrix as in Newey and McFadden (1994).

Finally, we compute the diagnostic measure of Andrews, Gentzkow, and Shapiro (2017) to investigate whether the model parameters are locally identified by the underlying moments. The benefit of the measure is that a reported high sensitivity means not only that the moment is sensitive to the underlying parameter, but also that the parameter is precisely estimated. The results are presented in Table A.4.

Each column in Table A.4 corresponds to a structural parameter, and each row corresponds to a moment used in the estimation procedure. The sensitivities in the table are trimmed at 0.2 in absolute value to ease the presentation of key relationships, similar to Hajda and Nikolov (2022). The results confirm the intuition behind the identification of the structural parameters. For instance, the pay for performance α_{P4P} is closely linked to mean and variance of pay gaps and the covariance of wages and pay gaps while the persistence and volatility of productivity are sensitive to variance and serial correlation of residual log wages and pay gaps, respectively. It should be noted, however, that the elasticities are only local and, moreover, highly sensitive to the numerical properties of the gradient. Because of that it might appear that some moments are not informative about the underlying parameter while in reality they do provide substantial identifying information. One example of that is the effect of the preference for public sector parameter θ on the mean turnover rate: while the Andrews, Gentzkow, and Shapiro (2017) sensitivity are smaller than 0.4 in absolute value (-0.0285), is the largest for θ out of all the parameters and are substantial over a wider range of the parameter values. It should also be noted that the sign and magnitudes of the elasticities for α_{P4P} and σ are different, in line with the intuition outlined in Section 4.3.

Figure A.1: **Executive turnover over time**

The figure reports turnover rates for federal executives between 1996-2021. The vertical dashed line represents transitions of Administrations.

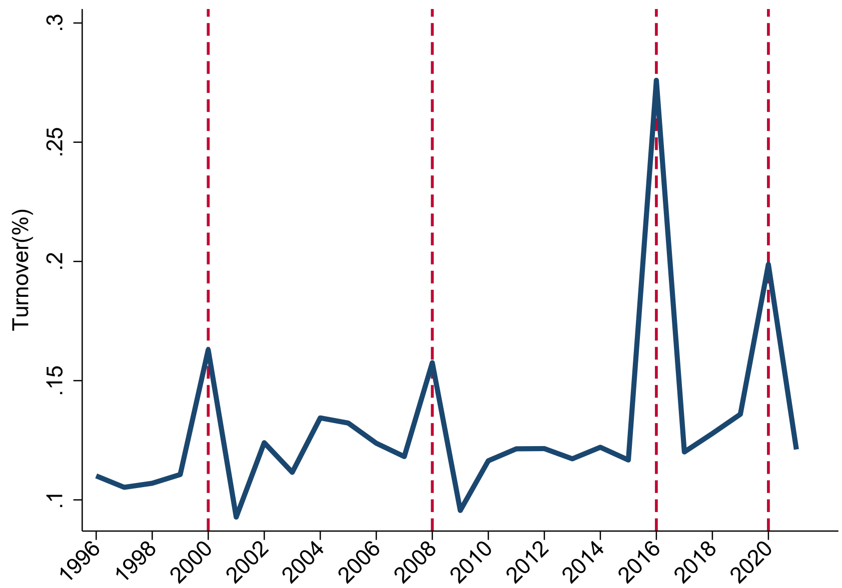


Figure A.2: **Turnover dynamics**

The figure is similar to Figure 2, except that we use restricted control groups. In Panel A, the control group is executives with at least the minimum salary of SES executives. In Panel B, the control group is executives with managerial pay rank. The vertical bars display 95% confidence intervals.

Figure A.3: **The role of risk aversion**

The graphs show the effects of changing the risk aversion on the turnover and mean effort. Each curve is a second-order polynomial interpolation of moments from a discrete set of counterfactual experiments, starting from the baseline values of structural parameters and varying only the respective parameter, while keeping all other parameters constant.

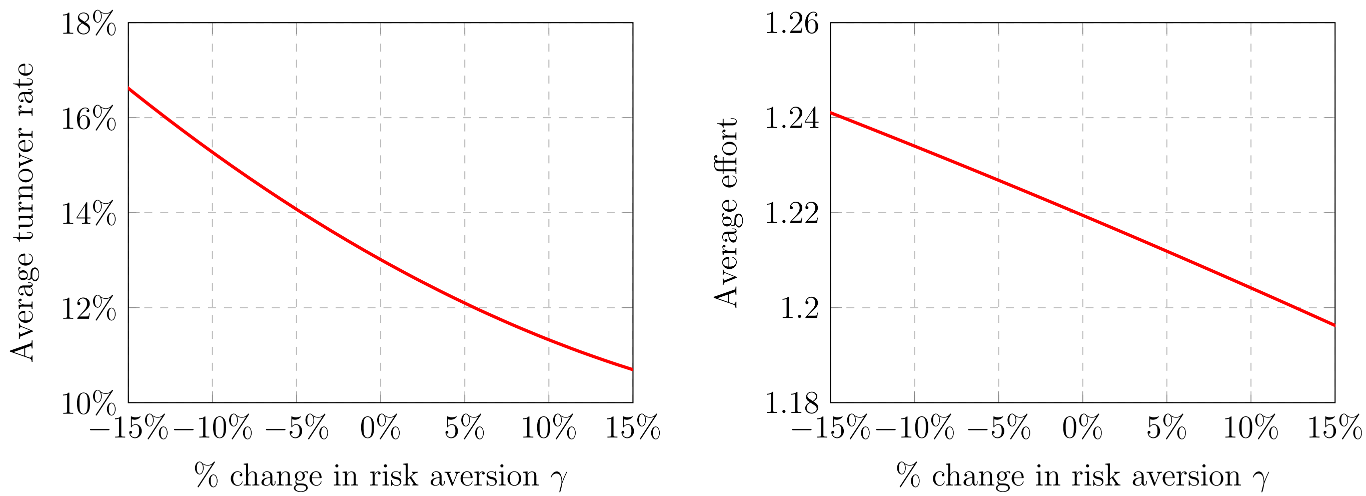


Table A.1: **Pay for performance and exits: robustness**

This table is similar to Table 2, except for the following. In columns 1-3, the treatment year is 2004 rather than 2002. In columns 4-6, the control group includes executives from control agencies (not participating the SES system) who themselves hold a managerial pay rank. In columns 7-9, the control group includes executives from control agencies whose salary is greater or equal to the lower bound of SES pay. See Section 3.

Outcome:	$\mathbb{1}(Exit)$								
	Treatment= 2004			Managerial rank			$\geq$ Min SES pay		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treated×Post	0.035***	0.043***	0.036***	0.037***	0.023***	0.021**	0.025***	0.020***	0.023***
	(0.005)	(0.005)	(0.007)	(0.012)	(0.008)	(0.010)	(0.007)	(0.006)	(0.007)
Treated	0.020***			0.006			0.016*		
	(0.006)			(0.012)			(0.008)		
Post	-0.017***			-0.024**			-0.012*		
	(0.004)			(0.012)			(0.006)		
Transition×Treated		0.045***	0.063***		-0.003	0.037		0.036***	0.055***
		(0.010)	(0.014)		(0.033)	(0.045)		(0.014)	(0.021)
Year FE	-	Yes	-	-	Yes	-	-	Yes	-
Agency FE	-	Yes	-	-	Yes	-	-	Yes	-
Pay controls	-	Yes	Yes	-	Yes	Yes	-	Yes	Yes
Occupation×Year FE	-	-	Yes	-	-	Yes	-	-	Yes
State×Year FE	-	-	Yes	-	-	Yes	-	-	Yes
Agency×State FE	-	-	Yes	-	-	Yes	-	-	Yes
R^2	0.003	0.017	0.044	0.001	0.016	0.023	0.003	0.020	0.028
N	237,484	237,471	235,064	46,025	46,019	45,453	59,521	59,512	58,873
Effect (%Mean)	46.92	57.72	47.98	38.28	23.85	21.97	27.33	22.41	25.57

Table A.2: **Pay for performance and exits: alternative specification**

Results from estimating Equation 3. The sample is a cross-section (not a panel) of executives. $Treated = 1$ if the executive is in the SES system, and 0 if the executive is in a control agency outside the SES system. $Exit = 1$ if the executive quit the government at any point after 2002. *Basepay*, *LocalityPay*, and *Bonus* are calculated before 2002 (pre-reform). See Section 3.

Outcome:	$\mathbb{1}(Exit)$	
	(1)	(2)
Treated	0.146***	0.111***
	(0.023)	(0.031)
Tenure		0.026
		(0.019)
BasePay		-0.001
		(0.008)
LocalityPay		-0.075***
		(0.019)
Bonus		0.051***
		(0.015)
R^2	0.014	0.023
N	22817	22817
Effect (%Mean)	43.48	33.22

Table A.3: **Estimates of relative wage and pay cap trends**

The table presents the estimates of the deterministic trend of wages l_t from Equation 12 (column 1) and of the deterministic trend of wage growth potential $\overline{w}_t$ from Equation 14 (column 2). Log*(Rel. Salary)* is the executive's salary scaled by their initial salary. Log*(Rel. Max Salary)* is the executive's maximum salary over their entire career, scaled by their initial salary. Both outcomes are expressed in logs. *Tenure* is years of experience in the public sector since the beginning of the sample period. The symbols $*$, $**$, and $***$ indicate significance at the 10 percent, 5 percent, and 1 percent level, respectively. See Section 4.3.

	log*(Rel. Salary)*	log*(Rel. Max Salary)*
	(1)	(2)
Tenure	0.0296***	0.0234***
	(0.0000)	(0.0000)
Executive FE	Yes	Yes
Agency FE	Yes	Yes
Occupation FE	Yes	Yes
City FE	Yes	Yes
Within R^2	0.800	0.700
N	114,288	114,288

Table A.4: **Local sensitivity of parameters to moments**

The table presents the sensitivities of the structural parameters to moments using the full-sample estimates and the normalized diagnostic tool of Andrews, Gentzkow, and Shapiro (2017). Blank entries indicate sensitivities lower than 0.2 in absolute value. α is the sensitivity to pay-for-performance; θ is the preference for public sector; ρ is the persistence of productivity; σ is the volatility of productivity; ξ is the cost of effort. See Appendix A.1.

	α_{P4P}	θ	ρ	σ	ξ
Variance of residual log wage			-0.495	0.411	
Serial correlation of residual log wage			1.163	-0.568	0.264
Mean pay gap	-0.969	0.370	0.355	0.394	1.034
Variance of pay gap	0.556	0.824	0.343	0.444	-0.288
Serial correlation of pay gap		-0.739		-0.575	
Mean turnover					
Covariance of wages and pay gaps	0.218	-0.293			