Working for the Revolving Door

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Abstract

The lobbying sector covets people with government experience. That opens lucrative *revolving door* opportunities, which can impact the appeal of working in government. We develop a model of the revolving–door labor market to study how workers flow into, through, and out of government. The key feature of our model is that government experience provides *connections* to other workers, but these connections can change over time as former colleagues exit government. Thus, individual revolving decisions are linked to aggregate revolving behavior. We show that many lobbyists have fairly brief government careers but some stay much longer. Moreover, the interdependence of worker decisions generates 'superstar' lobbyists, who are significantly more valuable than other lobbyists. We compare policies designed to address concerns about the revolving door and characterize how they differentially impact aggregate outcomes. Importantly, the equilibrium effects of connections can dampen or enhance the responsiveness of workers to these kinds of policy changes. Finally, these forces also impact workers' behavior in government, depending on whether their activities complement or substitute for connections in the revolving–door labor market.

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1 Introduction

Lobbying firms actively seek lobbyists with previous experience working in government (LaPira and Thomas, 2017). Accordingly, the prospect of lucrative lobbying employment can influence the decisions of government workers. This *revolving door* of workers out of government and into lobbying impacts a number of important outcomes. First, the opportunity to revolve both attracts individuals to government but also drain workers from the public sector, thus influencing turnover in government.[1] Second, workers may alter their behavior in government, in order to appeal to future employers.[2] Finally, even after exiting government, revolving door lobbyists may exert excessive influence on policy due to their prior experience.[3] Overall, revolving door lobbyists can significantly impact governance and markets.[4] Consequently, it is essential to understand how the revolving door shapes individual labor decisions and, in turn, aggregate outcomes.

Revolving door lobbyists are particularly valued due to their connections in government. Indeed, the premium placed on government connections is a defining characteristic of the revolving door.[5] Empirical studies have established that government connections are crucial for lobbyists (Bertrand et al., 2014; Kang and You, 2016). For revolvers in particular, their value as a lobbyist is highly dependent on maintaining their contacts in government. For example, staffers-turned-lobbyists connected to a U.S. senator suffer an average drop of 24% in revenue when their senator leaves office (Blanes i Vidal et al., 2012). However, it is not only connections to elected officials that matter. Staffers-turned-lobbyists with stronger connections to staffers still on the Hill also bring in greater revenue (McCrain, 2018b). Strickland (2020) further demonstrates this contingent value of connections in the context of state legislators in United States.

In this paper, we study how lobbyists being rewarded for their connections shape the revolving door. To do so, we integrate connections into a model of career decisions by

[1] Previous studies have shown that turnover in government is associated with decreased performance in the case of both bureaucrats (Lee, 2018; Akhtari et al., 2022; Lewis et al., 2022) and Congressional staff (Crosson et al., 2018; McCrain, 2018a; Ommundsen, 2023).

[2] The literature has found both positive and negative effects of the revolving door on pre-revolving behavior. On one hand, workers may grant favors to potential future employers (Cornaggia et al., 2016; Tabakovic and Wollmann, 2018; Tenekedjieva, 2021; Li, 2021). On the other hand, they may work harder to impress future employers or build human capital (deHaan et al., 2015; Kempf, 2020; Shepherd and You, 2020).

[3] This issue has generated significant concern in the public discourse on the revolving door. See Baumgartner et al. (2009) and McKay and Lazarus (2023) for empirical evidence on this point.

[4] For example, Silicon Valley Bank made extensive use of revolvers to lobby for weaker banking regulations (Giorno, 2023), which helped contribute to its ultimate collapse.

[5] Additionally, the mechanism by which connections are valuable is unique to the revolving door. A lobbyist's contacts are only valuable if the contacts continue to work in the public sector. This is in contrast to other industries where contacts are important, but remain valuable even if the contact switches jobs.

revolving-door workers. Our analysis focuses on government workers who are unelected. Although ex-politicians are prominent examples of revolving-door lobbyists, the vast majority of revolving-door lobbyists are former bureaucrats or Congressional staffers (LaPira and Thomas, 2014). In our model, each worker initially decides whether to enter the private sector or government. If a worker enters government then she also chooses when (if ever) to revolve and become a lobbyist. Workers are heterogeneous in their public service motivation, which determines their willingness to work in government. However, all else equal, any worker's value in the lobbying sector increases with her government tenure. Thus, the worker's tradeoff between staying in government or revolving changes over time.

The key feature of our model is that any worker's value as a lobbyist depends on her government connections. Specifically, workers are connected if they worked in government at the same time. Thus, a worker's payoff as a lobbyist depends on the decisions of other workers to stay in government. In short, a revolving door lobbyist is less valuable if all of her former colleagues also leave government. Due to this endogeneity, in equilibrium, a revolver's value decreases over time as her connections retire, or also exit government.

We start by characterizing the career dynamics of workers through the revolving door. The bulk of revolvers are workers with moderate levels of public service motivation. Intuitively, workers with moderate public service motivation balance their motivation to contribute in government against their value from lobbying wages after revolving. Specifically, workers with low public service motivation never enter, those in an intermediate range are willing to enter but revolve after a moderate stint in government, and the highest remain in government for so long that very few ever become willing to revolve. Moreover, we shed light on the dynamics of the flow of revolving workers. We show that tenure length among revolvers is monotonic and convex in public service motivation — those on the lower end leave earlier and those on higher end stay for increasingly longer careers. Thus, in a given a cohort of revolvers, the size of flows through the revolving door eventually decreases with seniority. Instead, most revolving happens earlier on, but only after an initial period where no one exits.

Next, we study the revenue that is generated by revolvers in equilibrium. Understanding differences in the revenues generated by individual lobbyists is particularly important because it can reflect differences in their influence. Furthermore, studying the distribution of revenue allows us to understand the forces that shape empirical observations. We show that revolvers being rewarded for their connections has important consequences for the distribution of revenue. In particular, connections create a 'superstar' effect whereby the top lobbyists are significantly more valuable. This is due to two effects. First, a revolver who exits government after a longer tenure is more valuable due to her greater experience. Second, a more recent

revolver is more valuable because more of her connections still work in government compared to an earlier revolver. These effects combine to push towards the distribution of revenue being right-skewed with mean greater than its median. In particular, this implies that the distribution of revenue is more right-skewed when connections are valuable compared to a world in which connections do not matter.

Given the numerous concerns about the revolving door, many governments have implemented "cooling-off periods" that restrict the lobbying activities of former government employees for a certain period of time. An alternative proposal is to decrease the relative attractiveness of revolving by increasing government wages. The *direct* effect of either approach is to discourage revolving, but this change also has an *indirect* effect on incentives. That is, depending on whether the change on net encourages more workers to stay in government or discourages more workers from entering government, it can amplify or dampen the effect of the policy due to the value of connections. Additionally, we show that aggregate outcomes respond very differently to each type of policy. Hence, longer cooling-off periods and higher government wages should not be used as substitutes for addressing the revolving door. Thus, accounting for strategic externalities in the revolving door is important for interpreting existing empirical work on cooling-off periods, as well as thinking through how to design regulations.

Finally, we extend the model so that workers can take a costly action before revolving that increases their value as a lobbyist — e.g., work harder to build human capital or choose a policy that favors industry. We show how the degree to which different workers engage in this behavior depends crucially on whether the action acts as a complement or substitute to connections in the production of lobbying output. If they are complements, then revolvers who exit later take a greater action than those who revolve earlier, because later revolvers have more valuable connections which amplifies the impact of the action. In this case, the action reinforces the superstar effect discussed earlier, as the most valuable revolvers further increase their value. If instead the action and connections are substitutes, then early revolvers distort their action more than later revolvers. We also analyze the effect of cooling-off periods in discouraging such behaviors. Once again, because the regulation alters connections, there is an indirect effect of the regulation on revolvers' willingness to take the action. Whether this indirect effect dampens or enhances a revolver's responsiveness to the regulation also depends on whether the action and connections are complements or substitutes.

2 Connections with the Literature

We contribute to the theoretical understanding of the revolving-door labor market: who participates, how they behave, and their output as lobbyists. We study workers with *career concerns* (Fama, 1980; Holmström, 1999), so future employment opportunities can affect labor decisions today and encourage behavior that raises their appeal to potential employers.

In existing theories, government service provides an opportunity to signal ability or build human capital (e.g., Mattozzi and Merlo, 2008; Delfgaauw and Dur, 2008; Bond and Glode, 2014). We emphasize that it provides government connections — which are usually lumped into human capital — and account for the observation that an individuals connections diminish as their former colleagues leave (Strickland, 2020). Crucially, this observation highlights that the value of connections is dynamic and interdependent. We incorporate these features into a unified framework in order to study strategic links between who works in government, how they behave and how long they stay, as well as the distribution of lobbying revenue. By doing so, we add to related work studying one worker's entry and exit (Mattozzi and Merlo, 2008; Delfgaauw and Dur, 2008) by providing a richer picture of government careers, revolvers, and the effects of revolving door regulations. Other models of the revolving door instead concentrate on an individual worker, a byproduct of which is that they abstract from connections between workers. These papers have focused on other parts of the cycle: government out to lobbying (Che, 1995; Bar-Isaac and Shapiro, 2011), private sector into government (Hübert, Rezaee and Colner, 2023), or the full cycle (Salant, 1995).

We also shed new light on political selection (Besley, 2005; Dal Bó and Finan, 2018; Gulzar, 2021) and government careers (Caselli and Morelli, 2004; Messner and Polborn, 2004; Mattozzi and Merlo, 2007, 2008, 2015; Keane and Merlo, 2010). Specifically, we trace different workers' desires to enter and stay in government jobs, rather than run for elected office (as in, e.g., Osborne and Slivinski, 1996; Besley et al., 1997; Mattozzi and Merlo, 2007). These careers typically feature intrinsic motivation (Frank and Lewis, 2004; Le Grand, 2006; Perry and Hondeghem, 2008) due to, e.g., organizational ideals (Dixit, 2002; Besley and Ghatak, 2005), individual altruism (Prendergast, 2007), valuing public output (Francois, 2000; Glazer, 2004) or their own individual contribution (Andreoni, 1990; Bénabou and Tirole, 2003). We fix those motives in order to study how they combine with instrumental motives to build connections, rather than signal ability (Mattozzi and Merlo, 2007; Delfgaauw and Dur, 2008, 2010; Bond and Glode, 2014) or impact policy implementation (Forand et al., 2023). Moreover, we allow them to vary across workers in order to study the composition of government workers and their behavior (as in, e.g., Besley and Ghatak, 2005; Gailmard and Patty, 2007).

Our model also contributes to understanding when and why workers move between industries. Others have shown that young workers may move between jobs in order to find a good fit (Johnson, 1978; Jovanovic, 1979a,b), learn about their ability in different industries (Miller, 1984; Antonovics and Golan, 2012; Papageorgiou, 2014), or build their managerial skill through experience in different occupations (Gayle, Golan and Miller, 2015). Our approach follows the tradition of occupational choice (Roy, 1951) rather than search (McCall, 1970), and features occupation-specific human capital (Becker, 1962). Workers have perfect information but build human capital over time in one occupation (government) that, unique to this paper, (i) pays off by only after they leave for a different occupation (lobbying) and (ii) depreciates endogenously as former colleagues leave. Thus, we highlight connections between individual career incentives versus broader labor market forces (e.g, Moscarini, 2001, 2005). In our setting, individual incentives to revolve depend on expectations about whether and when other workers will revolve: as more workers revolve, government careers shorten and therefore connections diminish faster, which discourages revolving.

Finally, we provide a new logic for the emergence of *rainmaker* lobbyists (Ban et al., 2019) — i.e., *superstars* who make substantially more than the rest. Such top-end inequality has been observed in a variety of contexts (Gabaix, 2009, 2016; Guvenen et al., 2021) and has a variety of explanations: consumers sharing information (Adler, 1985), firms competing to hire workers (Glode and Lowery, 2016; Bénabou and Tirole, 2016; Acharya et al., 2016), tax schedules (Piketty et al., 2014), entrepreneurship and creative destruction (Jones and Kim, 2018), and cross-sector spillovers (Gottlieb et al., 2023). The most prominent explanation, however, is talent. Within an industry, superstars can emerge when talented workers have complementary tools that magnify their innate differences (Sattinger, 1975), enabling some of them to attract substantially more consumers (Rosen, 1981) or charge substantially higher prices (Gabaix and Landier, 2008; Terviö, 2008).[6] We provide a new logic for superstars that is also driven by innate differences. In our setting, workers with small differences in public sector motivation can have large differences in human capital that enable them to make much higher wages. Our rationale emerges from the interdependence of connections and their dynamics, which are natural features in our revolving door context.

3 The Model

We incorporate connections into a dynamic model in which workers decide whether to enter government and then when to revolve. We keep most elements of the economy stark, e.g., we abstract from market frictions and political uncertainty, in order to isolate the effects of

[6] Another talent-based explanation is that firms are too cautious when searching for talent (Terviö, 2009).

connections on equilibrium behavior and outcomes.

Players and Timing. Time flows continuously and is indexed by $t \in [0, \infty)$. At each date there is a measure-one continuum of workers. Workers in our model are heterogeneous in their *age*, a, and *public service motivation*, ψ.[7] Worker i's public service motivation ψ_i is drawn from a distribution G that is strictly increasing, twice-differentiable, and has full support on $\mathbb{R}$. Workers die (or exit the market) according to a Poisson process with arrival rate $\delta > 0$ and are replaced by a new worker with age 0.[8] Each newly born worker's public service motivation is also drawn from G.

Initially, worker i chooses whether to enter government or the private sector. Subsequently, at each instant t that worker i is in government she decides whether to remain in government or revolve and become a lobbyist. Once i enters the private sector, or revolves after working in government, she makes no further decisions for the remainder of the game. Throughout, let $\mathbb{I}^g_{it}$ be an indicator that takes a value 1 if worker i is in government at time t, and value 0 otherwise.

Revolver Output. After a worker revolves, her production as a lobbyist at each point in time depends on her tenure in government, denoted τ, and the quantity of government connections she has at time at t, denoted q_{it}. Specifically, if worker i enters government at time t_1 and exits government at t_2, then at time t she generates lobbying revenue $F(q_{it}, \tau) = q_{it} \cdot v(\tau)$, where $\tau \equiv t_2 - t_1$.[9] Worker i's output at time t increases in the number of her connections q_{it}, which we define precisely below. Additionally, we assume $v' > 0, v'' \leqslant 0, 0 \leqslant v'''$, $\lim_{\tau \to \infty} v(\tau) = \infty$, $\lim_{\tau \to \infty} v'(\tau) < \infty$, and $v''(\tau)$ is uniformly continuous.[10] Thus, output is increasing in government tenure but at a decreasing rate.

Connections. Worker i is connected to another worker j if their tenures in government overlapped. Therefore the quantity of worker i's government connections at any point in time is the set of i's connections who currently work in government. More formally, define worker i and j as *connected* if there exists a time t such that $\mathbb{I}^g_{it} = 1$ and $\mathbb{I}^g_{jt} = 1$. Let $\mathcal{C}_{it}$ be the set of j at time t who are connected to i and who are currently in government, $\mathbb{I}^g_{jt} = 1$.

[7] In our model, we can interpret public service motivation generally as any factor that leads an individual to have a taste for working in government. For example, civic duty, interest in policy issues, or ideological motivations.

[8] Attrition with replenishment is a common feature of labor market models (see, e.g., Moscarini, 2005; Rogerson et al., 2005; Shi, 2009).

[9] We leave unmodeled the exact process by which revolvers engage in lobbying. See Schnakenberg and Turner (2023) for a review of the theoretical literature on special interest influence.

[10] Similar results hold if we assume $v(\tau)$ is bounded above by some $\overline{v}$ sufficiently large.

We then define q_{it} as the Lebesgue measure of $\mathcal{C}_{it}$.[11]

At times, we compare our model to a benchmark case in which revolvers are not rewarded for their connections. In this case, we fix q_{it} as an exogenous scalar $q_{it} = \overline{q} > 0$ for all i and t.

Payoffs. Worker i's cumulative dynamic payoff is given by

$$\int_0^\infty e^{-(\delta+\rho)s}\Big[w_s + \mathbb{I}_{is}^g \psi_i\Big]\, ds, \tag{1}$$

where w_s is i's wage at time s and $\rho > 0$ is the discount rate.

In the private sector, the worker receives an exogenous private sector wage w_p.[12] While in government, worker i's flow utility is given by $\psi_i + w_g$, the sum of her public service motivation and an exogenous government wage $w_g > 0$. Finally, worker i's flow payoff as a revolver is equal to her lobbying output at time t, $w_r(t;\tau) = q_{it} \cdot v(\tau)$. We assume that $0 \leqslant v(0) < w_p$.

Discussion of the Model. Before proceeding, we first discuss a few features of the model.

First, we assume that tenure and connections are complements. This captures that workers who stay longer build deeper relationships with other workers, and thus can better leverage their contacts after revolving. Furthermore, workers who spend more time in government acquire more expertise which can make it easier for them to make persuasive arguments and influence their connections. Finally, this may capture in reduced form that an individual meets more people over time.

Second, after revolving, we do not allow workers to reenter government. This is consistent with the data, in which only a very small percentage of revolvers ever reenter government (Kalmenovitz et al., 2022). Additionally, workers who reenter government may do so for significantly different reasons than the incentives studied here, e.g., for the purpose of influencing policy rather than building human capital (Hübert et al., 2023). Studying a model with reentry is an interesting topic for future work.

Third, the value of a connection is independent of the seniority of the connection. In practice, it could be that being connected to more senior government workers is more valuable than being connected to junior workers. Qualitatively similar results hold if there is a function that weights connections by their tenure. As such, we opt for the simpler formulation

[11] Implicitly we are assuming workers use strategies such that $\mathcal{C}_{it}$ is a measurable set.

[12] Because the worker makes no further choices after entering the private sector, our results are unaltered if we allow w_p to vary over time and interpret $\int_0^\infty e^{-\delta s} w_p ds$ as i's expected lifetime income from the private sector.

in which all connections are equally valuable.

Equilibrium. We look for a steady state equilibrium in which the distribution of worker characteristics in each sector is constant.[13] Under our assumptions on the death rate and birth of new workers, for the age distribution to be in a steady state the share of workers age a at any time must be $e^{-\delta a}$. For the composition of each sector to be constant, each worker of type (ψ, a) must choose the same sector to work in at each point in time. Additionally, since all newly born workers have age 0, the decision to enter government must only depend on public service motivation. Thus, the choices of workers in the steady state can be determined by two functions $\gamma : \mathbb{R} \to \{0, 1\}$ and $\eta : \mathbb{R} \times [0, \infty) \to \{0, 1\}$, where $\gamma(\psi) = 1$ indicates whether a worker with public service motivation ψ enters government or the private sector, and $\eta(\psi, a) = 1$ indicates whether a worker of public service ψ is in government at age a. Let $\sigma = (\gamma, \eta)$.

Given a σ, we can characterize continuation payoffs from working in each sector. The continuation value from revolving at age τ, or equivalently tenure τ, is

$$V_r(\tau; \sigma) = \int_0^\infty e^{-(\delta+\rho)s} v(\tau) q_i(s)\, ds,$$

where

$$q_i(s) = \int_{-\infty}^{\infty} \int_s^\infty \gamma(\psi)\eta(\psi, a) e^{-\delta a}\, da\, dG(\psi).$$

Then the value to a worker with public service motivation ψ from entering government and revolving at age τ is

$$V_g(\tau; \psi, \sigma) = \frac{1 - e^{-(\delta+\rho)\tau}}{\delta + \rho}(\psi + w_g) + \frac{e^{-(\delta+\rho)\tau}}{\delta + \rho} V_r(\tau).$$

Finally, the continuation value from entering the private sector is $V_p = \frac{w_p}{\delta+\rho}$.

Considering the optimization problem of a newly born worker, define $\tau^*(\psi) = \arg\max_\tau V_g(\tau; \psi, \sigma)$ and $V_g^*(\psi; \sigma) = \max_\tau V_g(\tau; \psi, \sigma)$. Then $\sigma^* = (\gamma^*, \eta^*)$ is an equilibrium if:

$$\gamma^*(\psi) = \begin{cases} 1 & \text{if } V_g^*(\psi; \sigma^*) \geqslant V_p \\ 0 & \text{otherwise} \end{cases}$$

[13] If the economy is not in a steady state then workers will decide whether to revolve or not based on anticipated changes in the fundamental characteristics of the population. These considerations seem unlikely to play a prominent role for potential revolvers who work in well-established public sectors.

and

$$\eta^*(\psi, a) = \begin{cases} 1 & \text{if } a \leqslant \tau^*(\psi) \\ 0 & \text{otherwise.} \end{cases}$$

4 Characterization of Equilibrium

We establish that an equilibrium exists and is unique, characterize who enters government, and how long they stay. We show that: (i) workers with sufficiently low public service motivation never enter government, (ii) the rest will revolve and their tenure is monotonic in ψ_i — those on lower end leave earlier and those on higher end stay longer — and (iii) workers with very high public motivation are likely to retire without revolving. Crucially, these individual decisions depend on expectations about lobbying wages, which depend on aggregate revolving behavior.

4.1 Exit decision

To begin, we analyze exit for each age cohort of government workers. Intuitively, each worker weighs their value from continued government service against their potential lobbying wages. Specifically, staying in government provides realized value from further public service and wages (through $\psi_i + w_g$), as well as increased option value from more valuable connections (by increasing $v(\tau)$). On the other hand, leaving through the revolving door provides a flow of revolving wages.

Fixing a strategy profile, a worker who exits government at time t can anticipate the quantity of her connections that remain in government at each time $t' > t$. It is convenient to write a revolver's payoff as a function of the time elapsed since exiting government. Thus, if a worker revolves at time t, then her discounted payoff from her time t' revolving wage is $e^{-\delta s} v(\tau) q_i(s)$, where $s = t' - t$. As such, the dynamic payoff from revolving to a worker with tenure τ can be written as:

$$V_r(\tau; Q) = v(\tau, Q) \cdot Q,$$

where

$$Q = \int_0^\infty e^{-(\delta+\rho)s} q_i(s) ds \tag{2}$$

represents the accumulation of i's flow of connections after revolving. Essentially, Q de-

pends on expectations about i's lobbying career and the government careers of her time-τ connections. Specifically, it accumulates the expected (discounted) duration for each of i's government connections with her time-τ colleagues.

Consequently, for each worker i beginning her career, her continuation payoff from working in government and then revolving after a tenure τ is

$$V_g(\tau; \psi_i, Q) \equiv \frac{1 - e^{-(\delta+\rho)\tau}}{\delta + \rho} (\psi_i + w_g) + \frac{e^{-(\delta+\rho)\tau}}{\delta + \rho} v(\tau) \cdot Q. \tag{3}$$

Thus, if worker i enters government she chooses τ to solve $\max_{\tau \geqslant 0} V(\tau; \psi_i, Q)$. Each worker's optimal government tenure balances their anticipated lobbying wages against their benefits from continued government service. Specifically, in equilibrium, if i enters government her tenure τ^* must solve

$$v(\tau) \cdot Q = \psi_i + w_g + \frac{v'(\tau)}{\delta + \rho} \cdot Q. \tag{4}$$

The left-hand side is i's total discounted lobbying wages after tenure τ. The right-hand side is i's benefits from continued government employment: additional public service and wage, as well as the marginal increase to the flow of lobbying wages. The characterization of τ^* implies that i stays in government at each age $a < \tau^*$ and then exits when $a = \tau^*$.

All government workers in the same cohort anticipate the same lobbying wages if they revolve at time t, but they differ in their public service motivation. Inspecting equation (4), the gain from remaining is government is greater for workers with higher public service motivation. This observation yields the following characterization of exit behavior.

Lemma 1. *In every equilibrium, there exists a function $\overline{\psi}^* : \mathbb{R}_+ \to \mathbb{R}$ such that a worker i with tenure τ revolves if and only if $\psi_i \leqslant \overline{\psi}^*(\tau)$.*

All else equal, workers with greater ψ_i are more motivated to remain in government. Therefore exit behavior in equilibrium is fully characterized as a mapping from government tenure to public service motivation by a function $\overline{\psi}^*$. In equilibrium, this function must be consistent with the optimal decision to exit and, thus, is determined from equation (4):

$$\overline{\psi}^*(\tau) = -w_g + Q \cdot \left(v(\tau) - \frac{v'(\tau)}{\delta + \rho} \right). \tag{5}$$

Thus, for a fixed Q, worker i's equilibrium tenure τ^* satisfies

$$\overline{\psi}^{*-1}(\tau) = \tau^*(\psi_i) = \arg\max_{\tau \geqslant 0} V_g(\tau; \psi_i, Q).$$

The function $\overline{\psi}^*$ depends on Q, so i's expectation about her flow of connections impacts her decision to revolve. Furthermore, the quantity of connections a revolver has in government is dependent on how long other workers remain in government, hence, Q is endogenous to $\overline{\psi}^*$ in equilibrium.

4.2 Entry Decision

Next, we characterize who enters government. Entering government gives workers the opportunity to build human capital that is valuable for lobbying, whereas the private sector yields a fixed flow of wages w_p. Specifically, for worker i, spending time in government is worthwhile if and only if

$$\max_{\tau} V_g(\tau; \psi_i, Q) \geqslant \frac{w_p}{\delta + \rho}. \tag{6}$$

Intuitively, workers with greater public service motivation derive relatively greater enjoyment from working in government compared to the private sector. As such, we obtain the following result on entry.

Lemma 2. *In every equilibrium, there exists a cut-point $\underline{\psi}^* \in \mathbb{R}$ such that worker i enters government if and only if $\psi_i \geqslant \underline{\psi}^*$.*

Importantly, entry is affected by expectations about aggregate revolving behavior and lobbying wages, through Q. That is, $\underline{\psi}^*$ depends on Q. In turn, increasing the number of workers who enter government increases the quantity of connections, all else equal. Thus, Q also depends on $\underline{\psi}^*$ in equilibrium.

4.3 Equilibrium Characterization

To summarize, a worker's behavior in any equilibrium is characterized by: (i) an entry threshold $\underline{\psi} \in \mathbb{R}$, and (ii) an exit function $\overline{\psi} : \mathbb{R}_+ \to \mathbb{R}$ mapping tenure to public service motivation. Given this characterization, a worker's connections after time s has elapsed since revolving can be written as

$$q_i(s) = \int_s^{\infty} e^{-\delta n} \Big[1 - G\Big(\max\{\underline{\psi}, \overline{\psi}(n)\} \Big) \Big] dn. \tag{7}$$

Worker i's connections are dictated by several components. After worker i exits, she does not overlap with the new workers who enter government. Thus, after time s has elapsed since exiting, a revolver is not connected to any government workers ages 0 to s. Additionally, for

workers age $a \geqslant s$ with whom i overlapped in government, only a fraction $e^{-\delta a}$ survive to age a. Finally, there is endogenous exit through the revolving door: by age a, only workers with public service motivation $\psi_i \geqslant \max\{\underline{\psi}, \overline{\psi}(a)\}$ remain in government.

Thus, fixing a cut-off $\underline{\psi}$ and function $\overline{\psi}(\tau)$, from equation (7) we can specify the quantity of total discounted connections $Q \in [0, \frac{1}{\delta(2\delta+\rho)}]$.[14] Accordingly, equations (2), (5), and, (6) together fully determine an equilibrium $(\underline{\psi}^*, \overline{\psi}^*(\tau), Q^*)$. Proposition 1 establishes existence, uniqueness, and characterization of equilibrium.

Proposition 1. *A unique equilibrium exists and is characterized by a* $(\underline{\psi}^*, \overline{\psi}^*(\tau), Q^*)$ *that solves*

$$\underline{\psi} = \frac{w_p - e^{-(\delta+\rho)\overline{\psi}^{-1}(\underline{\psi})} v(\overline{\psi}^{-1}(\underline{\psi})) \cdot Q}{1 - e^{-(\delta+\rho)\overline{\psi}^{-1}(\underline{\psi})}} - w_g, \tag{8}$$

$$\overline{\psi}(\tau) = -w_g + Q \cdot v(\tau) - Q \cdot \frac{v'(\tau)}{\delta + \rho}, \tag{9}$$

$$Q = \int_0^\infty e^{-(\delta+\rho)s} \int_s^\infty e^{-\delta n} \Big[1 - G\Big(\max\{\underline{\psi}, \overline{\psi}(n)\}\Big)\Big] \, dn \, ds. \tag{10}$$

Next, we use this analysis to study the flow of workers through the revolving door. Specifically, we study (i) the dynamics of revolving within a cohort, as well as (ii) the composition of revolvers leaving at each date. To do so, we first present further characterization on the entry and exit decisions of revolvers.

Proposition 2. *In equilibrium,* $\overline{\psi}^*$ *is strictly increasing and concave in* τ*, with* $\overline{\psi}^*(0) < \underline{\psi}^* < w_p - w_g$.

In principle, every government worker could serve a long tenure to build high quality connections. In terms of their revolving payoff, they all face a similar tension between exiting now for the current stream of lobbying wages or waiting for a superior stream. However, a worker's willingness to wait depends on her taste for government. Hence, workers with higher ψ_i spend a longer time in government. Over time, waiting has less impact on wages because of the diminishing improvement in connection quality. Consequently, revolving is more appealing in each period. However, because there are diminishing marginal returns for increasing the value of government connections, $v'' \leqslant 0 \leqslant v'''$, higher ψ workers wait an increasingly long time before revolving.

The last part of Proposition 2 has two implications for workers entering government. First, all workers with public service motivation $\psi_i > w_p - w_g$ always enter government. Clearly, entering is better if worker i's flow payoff from government is greater than her flow

[14] Notice that Q is bounded above by $\int_0^\infty e^{-\delta s} \int_s^\infty e^{-\delta n} dn ds = \frac{1}{\delta(2\delta+\rho)}$.

payoff from the private sector. Moreover, entering government creates the option to leave through the revolving door, thus, $\underline{\psi}^*$ is strictly less than the difference in the private and public sector wages. Second, all workers who enter government wait a positive amount of time before revolving. A worker who revolves immediately does not build sufficiently valuable connections for lobbying to be more lucrative than the private sector, $v(0) \cdot q_i^* \leqslant v(0) < w_p$. Additionally, v is increasing most rapidly at the start of the worker's career, which discourages immediate exit.[15]

Figure 1 illustrates these dynamics of entry and exit for a cohort of workers born at the same time.

Figure 1

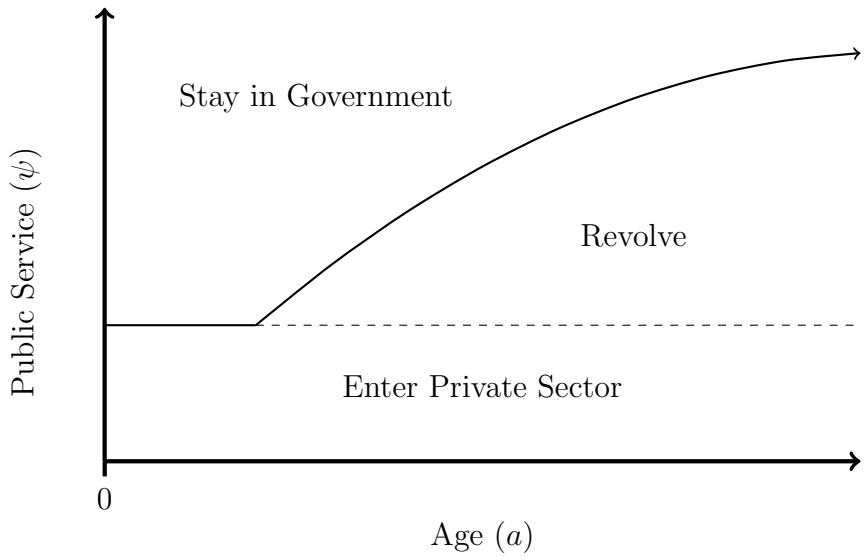


Figure 1 indicates several attributes of how a cohort changes over time. First, in each cohort, after an initial period to build valuable enough connections, the least public-minded start to leave. Over time, the cohort gets more homogeneous as the least public-minded, i.e., lowest ψ, revolve into lobbying. Many of them revolve fairly soon and only a select few wait much longer. Specifically, the cohort's flow out of government slows gradually but never stops. Thus, across cohorts, the amount of revolvers decreases with seniority. Moreover, the young wave is more diverse than the senior trickle. And, at each date, the composition of revolvers is skewed young and less public-minded.

[15] As such, even if $v(0) > w_p$, workers entering government will wait a positive amount of time before revolving as long as $v'(0)$ is sufficiently large.

5 Connections and Revolver Revenue

Next, we study heterogeneity in the revenue generated by revolvers — i.e., among everyone who previously revolved and is still working as a lobbyist. Studying revolver revenue is particularly important in our model because it captures the quantity and quality of connections of a lobbyist. As such, inequality in the distribution of revenue can reflect significant disparity in the influence of different revolvers.

Specifically, we compare differences in revenue generated across revolvers and analyze the steady-state distribution of lobbying revenues that is induced in our setting by the steady-state distribution of government workers. A key factor is the dynamics of individual connections. As time passes, some workers revolve into lobbying and replace retiring lobbyists, while the remaining lobbyists gradually lose their government connections as former colleagues leave. This flow of workers through the revolving door plays a key role in shaping the revenue distribution, since each revolver's revenue is determined by their tenures in government and lobbying.

To see these forces, consider the revenue of an age-a worker who exited with tenure τ. The time elapsed since they revolved into lobbying is $s = a - \tau$, so this worker's lobbying revenue is:

$$r(s, \tau) = v(\tau) \cdot q_i(s) = v(\tau) \cdot q_i(a - \tau). \tag{11}$$

Fixing a revolver's exit time τ, her connections decrease over time as other workers revolve or die. Symmetrically, fixing an age a, workers who revolved after a longer tenure, i.e., τ is closer to a, have more connections remaining in government. Thus, within each cohort, workers who revolved later always have more connections *and* those connections are more valuable than their peers who revolved earlier. This interaction suggests that revenue may be increasing very rapidly in tenure. Differentiating twice, we obtain:

$$\frac{\partial^2 r}{\partial \tau^2} = v''(\tau) q_i(s) - 2v'(\tau) q_i'(s) + v(\tau) q_i''(s). \tag{12}$$

As discussed above, later revolvers have both a greater quantity and more valuable connections, which makes the second term in (12) positive. Furthermore, q_i is convex in time elapsed since revolving. Concavity of v, however, pushes against the other two forces, as the value of connections increases at a diminishing rate.

Lemma 3 builds on these observations and provides conditions under which the revenue function is convex.

Lemma 3. *For age-a workers, instantaneous revolver revenue $r(a-\tau,\tau)$ is increasing in tenure, τ. Moreover, if τ sufficiently large, then $r(a-\tau,\tau)$ is convex in τ.*

Convexity of revenue for large τ implies that the distribution of revolver revenue features *superstars* who generate substantially more revenue than other revolving-door lobbyists. This group always consists of recent revolvers with extensive government experience, since they have more connections remaining and each is highly valuable. Additionally, the forces in the model push towards the group of superstars being relatively small. First, the exit function $\overline{\psi}^*$ is concave in tenure, thus, (endogenously) most workers choose to exit government too early to become a superstar. Second, convexity of $e^{-\delta a}$ implies that (exogenously) most workers die or retire before they are able to generate revenues in the upper tail of the distribution.

To further unpack these forces we now study the equilibrium distribution of revenue. To do so, suppose that v is linear, which shuts down the effect of v's curvature on revenue, and focuses on how connections shape the distribution. In particular, if v is linear, then lobbying revenue is convex in tenure over all τ.

Proposition 3. *Assume $v(\tau)$ is linear and G is unimodal. There exists $z <$ mode G such if $\underline{\psi}^* > z$, then the mean of the distribution of revolver revenue is greater than its median.*

In general, the degree of inequality in the equilibrium distribution of revenue depends on the shape of G. However, the proposition provides plausible conditions which guarantee that the mean of G will be greater than the median. For example, this condition always holds when the private sector wage w_p is sufficiently large.

Recall from the equilibrium characterization that revolving tenures are convex in ψ (linear in this case with linear v). Furthermore, revenue is convex in τ. Consequently, small differences in ψ lead to large differences in revenue and make the distribution of revenue more right-skewed relative to the public service distribution. Figure 2 depicts the pdf of revenue when ψ is uniformly distributed with a large support. This further shuts down impact of the shape of G and highlights how connections and revolving incentives combine to distort the distribution of revenue.

The inequality in revenue across revolvers pushes the distribution of revenue to be right-skewed with a mean greater than the median. This aligns with the empirical distribution of revolver-lobbyist revenues, which has a long right-tail — where the average wage is approximately twice as large as the median wage (Blanes i Vidal et al., 2012; McCrain, 2018b). Our results provide a logic suggesting that this regularity depends critically on the dynamic nature of connections.

Finally, we reinforce the importance of connections for creating superstars. To see this, we compare our setting to the model in which connections are not valuable for lobbying.

That is, alter the model so that the flow payoff from lobbying is simply $v(\tau) \cdot \overline{q}$. To make the models comparable we choose $\overline{q}$ such that $\int_0^\infty e^{-(\delta+\rho)s}\overline{q}ds = Q^*$. This ensures that the equilibrium entry condition ($\underline{\psi}$) and exit function ($\overline{\psi}(\tau)$) are equivalent under both models. However, as the next lemma highlights, there are different implications for revolver revenue.

Lemma 4. *Assume connections do not matter. For age-a workers, instantaneous revolver revenue $r(a-\tau,\tau)$ is increasing and concave in tenure, τ.*

Because connections do not matter, the revenue a lobbyist generates does not decrease after revolving. As such, there is not an interaction by which later revolvers are more valuable and have more connections. Instead, differences in revenue, as a function of τ, are driven only by the shape of v. Thus, for the most valuable revolvers, increasing tenure leads to smaller increases in revenue. Proposition 4 characterizes how this impacts the distribution of revenues.

Proposition 4. *Assume $v(\tau)$ is linear. The distribution of revolver revenue is more right-skewed when connections matter.*

In this comparison between when connections matter versus when they do not, the distribution of revolver *tenures* τ^* is the same. Yet, when connections do not matter revenue is a concave transformation of tenure (linear in this case). In contrast, when connections matter it is a (strictly) convex transformation. Thus, the distributions of *revenues* is different and, moreover, more right-skewed when connections matter.

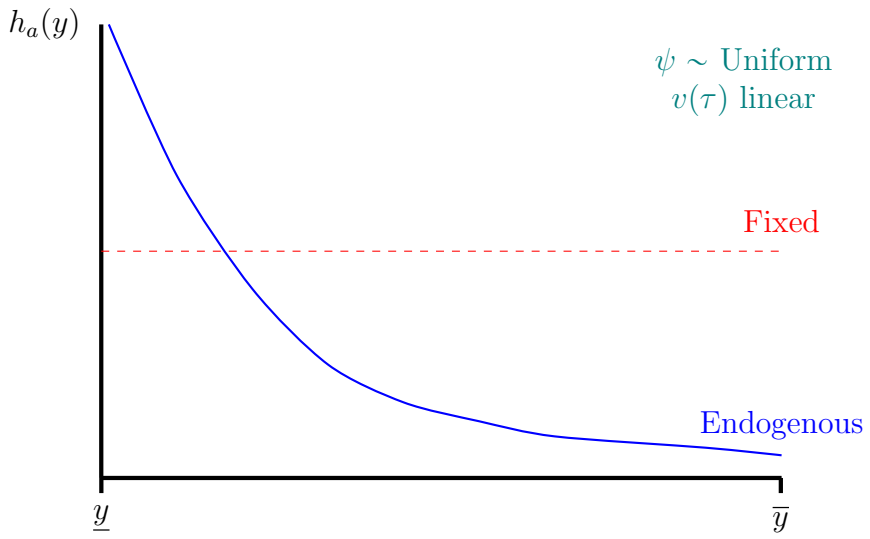
Empirical studies suggest that expertise is particularly important for revolving bureaucrats (LaPira and Thomas, 2014; Bolton and McCrain, 2023). Consequently, connections may have less impact on their output. If this is the case, our results predict that the distribution of lobbying revenue among former bureaucrats should be more equal and less skewed than the distribution for former congressional staffers.

6 Effects of Policy Interventions

Given the potential impacts of the revolving door on governance, there are many attempts to mitigate its downsides. First, one rationale of proposals to increase public sector wages is that it will help discourage workers from revolving. Second, many governments implement regulations specifically targeted at the revolving door. In this section we study each of these policy interventions and compare their effects on several outcomes of interest.

Policymakers confront a number of different objectives when considering the revolving door. Here, we take a positive approach to the problem and analyze how three different

Figure 2: Distribution of Revolver Revenues for an Age Cohort of Workers



Note: Figure 2 illustrates two densities of revolver revenues for one age-cohort of workers at a particular date. For both, v is linear and ψ is uniformly distributed. The blue line depicts the density if connections depreciate endogenously (in blue) from Q^*. The red line depicts the case in which connections remain fixed (exogenously) at $\bar{Q} = Q^*$.

quantities in the model respond to changes in policy. Which policy is optimal will depend on which factors are most pressing in different contexts.

First, we analyze the size of government. One worry about tight revolving door restrictions or low wages is that they make it difficult to attract workers to the public sector and retain existing employees. The size of government in equilibrium is characterized by

$$S^* = \int_0^\infty e^{-\delta n}\Big(1 - G(\max\{\underline{\psi}, \overline{\psi}(n)\})\Big)dn. \tag{13}$$

Second, we analyze the composition of workers in government. In particular, we study the average public service motivation of a government worker, $\mathbb{E}[\psi_i | i \text{ in government}]$. Given weak monetary incentives in the public sector, it is frequently argued that high public service motivation workers are crucial to government performance (James, 1989; Perry and Wise, 1990). Likewise, models of the bureaucracy highlight the importance of intrinsic policy motivations for generating productive effort (Gailmard and Patty, 2007; Prendergast, 2007). Empirically, much of the public administration literature has confirmed a positive relationship between performance and public service motivation (see Ritz et al. (2016) for a review) and ideological alignment between civil servants and politicians improves procurement outcomes (Spenkuch et al., 2023).[16] As such, this quantity can be considered as a measure of

[16]In the latter case we may conceptualize ψ_i as relating to the ideological match between i and the agency

the quality of the government labor force.

Finally, a significant worry about revolvers is that they will have excessive influence on policy due to their connections. To address this concern we analyze how changes in revolving door restrictions and wages impact a lobbyist's influence. Specifically, we study the (expected) lifetime revenue $v\big(\tau^*(\psi)\big) \cdot Q^*$ generated by a revolver with public service motivation ψ_i, as this reflects quantity and quality of a lobbyist's connections. While the previous two quantities are measures that capture important ex ante revolving outcomes, this measure captures potential ex post problems arising from the revolving door.

Throughout this section we consider the case where the discount rate ρ is large. This ensures that workers are not so forward-looking they essentially ignore the direct effects of the policy changes in their own payoff. This seems plausible, and allows us to focus on the primary effects of regulation changes that are debated in policy discussions. Furthermore, focusing on one case emphasizes how the forces of the model act through direct individual incentives differently to indirect effects via connections.

6.1 Public Sector Wages

Lemma 5 begins by studying how increasing the government wage w_g impacts $\underline{\psi}^*$ and Q^*.

Lemma 5. *If ρ is sufficiently large, then as w_g increases: $\underline{\psi}^*$ decreases and Q^* increases.*

Increasing w_g makes entering government more attractive, relative to the private sector. Additionally, it makes remaining in government more attractive relative to exiting through the revolving door. As such, this encourages more entry, lowering $\underline{\psi}^*$, and discourages exit, and hence both forces also push towards increasing Q^*.

Next, we show how these forces impact the exit decisions of revolvers:

$$\frac{\partial \overline{\psi}^*}{\partial w_g} = \underbrace{-1}_{\text{Direct Effect} < 0} + \underbrace{\frac{\partial Q^*}{\partial w_g}\left(v(\tau) - \frac{v'(\tau)}{\delta+\rho}\right)}_{\text{Indirect Effect} > 0}. \tag{14}$$

The direct effect of increasing w_g is to incentivize workers to remain longer in government. However, because increasing w_g increases Q^* there is also an indirect effect on behavior. In principle, the direction of this indirect effect depends on the sign of $v(\tau) - \frac{v'(\tau)}{\delta+\rho}$. However, $v(\tau) - \frac{v'(\tau)}{\delta+\rho} < 0$ only for tenures such that $\overline{\psi}^*(\tau) < \underline{\psi}^*$. Thus, in equilibrium, we only observe a positive indirect effect of w_g, which pushes workers to revolve sooner. Moreover, this indirect effect causes workers to respond differently to a change in w_g. For low τ, (14)

or legislative office in which she works.

is negative. Thus, for a worker i who does not exit too late, i.e., ψ_i is low, increasing w_g makes the worker remain in government longer. That is, the indirect effect of w_g through Q^* reinforces the direct effect. On the other hand, if τ is very large, then the indirect effect is magnified and overturns the direct effect. Thus, very late revolvers, i.e., future superstars, exit sooner. However, when ρ is very large, the indirect effect is small and hence increasing w_g leads most workers to remain in government longer.

Proposition 5 now leverages these insights to characterize the effects of w_g on our quantities of interest.

Proposition 5. *If ρ is sufficiently large, then increasing w_g...*

1. *increases the size of government S^*,*
2. *decreases $\mathbb{E}[\psi_i | i \text{ in govt}]$,*
3. *and increases $v\big(\tau^*(\psi)\big) \cdot Q^*$ for all ψ.*

By drawing new workers into government and incentivizing most existing workers to wait longer before revolving, increasing w_g is effective at increasing the size of government. However, the higher wage attracts lower ψ_i workers to enter government. Moreover, the workers remaining in government longer are those with lower public service at a given tenure, who would otherwise have revolved. Thus, the average public service motivation of a government worker decreases. Additionally, by increasing Q^* and the time (most) workers spend in government, the value of workers who do revolve increases. Indeed, the increase in Q^* is also sufficient to offset the shorter tenure of late revolvers.

Although increasing w_g influences behavior, the endogeneity of connections alters the impact. To see this, consider the model where connections do no matter, so $q_i(s)$ is fixed at some $\overline{q}$. In this case,

$$\frac{\partial \overline{\psi}^*}{\partial w_g} = -1 < 0.$$

Importantly, there is no indirect effect. In contrast, as shown above, when connections matter there is an indirect effect: increasing w_g increases entry and tenure for most workers. In doing so, any individual revolver will have more contacts remaining in government, which encourages workers to revolve. Therefore, outcomes are less responsive to changes in the government wage because connections are important for revolvers. As discussed in the previous section, connections may be relatively less important for lobbyists coming from the bureaucracy than for those coming from Congress. As such, we would expect bureaucrats to be more responsive to changes in w_g than Congressional staffers.

6.2 Revolving Door Restrictions

To capture the effects of cooling-off periods, we alter the model so that after revolving a worker must wait λ length of time until starting to generate revenue as a lobbyist. For simplicity, we assume the revolver obtains a flow payoff of 0 while waiting to lobby. Thus, worker i's dynamic payoff from revolving after a tenure of τ in government is given by

$$v\big(\tau\big) \cdot Q(\lambda),$$

where

$$Q(\lambda) = \int_{\lambda}^{\infty} e^{-(\delta+\rho)s} q(s) ds. \tag{15}$$

The equilibrium of this model is characterized analogously to the baseline model, but with Q^* now defined according to (15).

To study the effects of cooling-off periods, we first analyze how increasing λ changes $\underline{\psi}^*$ and Q^*. The direct effect of increasing λ is to decrease the amount of time spent lobbying, and thus decrease Q^*. Additionally, by lowering the potential payoff from lobbying, this discourages workers from entering government. Lemma 6 establishes that in equilibrium these direct effects dictate how Q^* and $\underline{\psi}^*$ respond to changes in λ for sufficiently impatient players.

Lemma 6. *If ρ is sufficiently large, then as λ increases: $\underline{\psi}^*$ increases and Q^* decreases.*

The change in $\underline{\psi}^*$ pins down how the regulation affects the entry of decisions of workers. Specifically, as anticipated, tighter restrictions discourage entry. We now turn to how workers' exit decisions respond to changes in the length of the cooling-off period. Tighter restrictions decrease Q^*, which encourages workers to extend their tenure in government. In particular, consider the effect of λ on $\overline{\psi}^*(\tau)$

$$\frac{\partial \overline{\psi}^*}{\partial \lambda} = \frac{\partial Q^*}{\partial \lambda}\Big(v(\tau) - \frac{v'(\tau)}{\delta+\rho}\Big).$$

Whether $\overline{\psi}^*(\tau)$ increases or decreases in response to λ depends on the sign of $v(\tau) - \frac{v'(\tau)}{\delta+\rho}$. However, as before, this sign is always positive for tenures such that $\overline{\psi}^*(\tau) > \underline{\psi}^*$. Thus, in equilibrium, conditional on entering government, workers have longer tenures following an increase in λ.

Although all workers increase their time in government following an increase in λ, they differ in how responsive they are to a change in the restriction. Because $v(\tau)$ is greatest for

the longest tenured workers, it is the very late superstar revolvers who are most responsive to changes in λ. That is,

$$\frac{\partial^2 \overline{\psi}^*}{\partial \lambda \partial \tau} = \frac{\partial Q^*}{\partial \lambda}\left(v'(\tau) - \frac{v''(\tau)}{\delta + \rho}\right) < 0.$$

Having established how workers respond to an increase in λ, we now study how λ impacts our outcomes of interest.

First, notice that increasing the length of the cooling-off period has cross-cutting effects on the size of government. Increasing λ drives out low ψ workers, which shrinks the size of government. However, the higher ψ workers in government stay for a longer period of time before revolving. Thus, whether longer cooling-off periods increase or decrease the size of government depends on if the *entry effect* or the *exit effect* dominates.

More precisely, we define the entry effect for a particular cohort as the change in the mass of workers age n in government:

$$\text{Entry}_n = -e^{-\delta n}\frac{\partial \underline{\psi}^*}{\partial \lambda} g(\underline{\psi}^*) < 0.$$

Thus, the impact of λ on entry is the relevant effect for cohorts age $n < \tau^*(\underline{\psi}^*)$, as no workers from such a cohort have started to revolve. Instead, for a cohort age $n > \tau^*(\underline{\psi}^*)$, the exit effect determines the change in the mass of workers age n who are in government:

$$\text{Exit}_n = -e^{-\delta n}\frac{\partial \overline{\psi}^*}{\partial \lambda} g(\overline{\psi^*}(n)) > 0.$$

Second, as for the size of government, the entry and exit effects determine whether the average public sector motivation increases or not. By increasing $\underline{\psi}^*$, a longer cooling-off period cuts off the workers with the lowest public service motivation. However, it also encourages workers to remain in government longer. Because of the death rate δ, the bulk of this increased tenure effect is on younger revolvers who have relatively lower public service motivation. Thus, longer cooling-off periods do not have a clear effect on the quality of the government workforce.

Third, a longer cooling-off period is unambiguously successful at hampering the ability of revolvers to leverage their connections. Increasing λ decreases Q^*, which all else equal lowers the lifetime revenues of lobbyists. On the other hand, workers choose to stay longer in government, which increases their $v(\tau^*)$. However, it is never optimal to stay sufficiently longer to completely offset the decreased value of revolving through Q^*.

Proposition 6 formalizes this discussion.

Proposition 6. *If ρ is sufficiently large, then increasing λ...*

1. *decreases the size of government S^* if and only if*

$$-\int_0^{\tau^*(\underline{\psi}^*)} \text{Entry}_n \, dn > \int_{\tau^*(\underline{\psi}^*)}^{\infty} \text{Exit}_n \, dn, \tag{16}$$

2. *increases $\mathbb{E}[\psi_i | i \text{ in govt.}]$ if*

$$-\int_0^{\tau^*(\underline{\psi}^*)} \frac{\text{Entry}_n}{1 - G(\underline{\psi}^*)} dn > \int_{\tau^*(\underline{\psi}^*)}^{\tau^*(\psi)} \frac{\text{Exit}_n}{1 - G(\underline{\psi}^*(n))} dn \tag{17}$$

   for all $\psi > \underline{\psi}^*$,

3. *and decreases $v(\tau^*(\psi)) \cdot Q^*$ for all ψ.*

In the context of our model, whether whether (16) and (17) hold is highly dependent on where we are in the parameter space. More generally, whether the entry or exit effect is greater may depend on factors outside the model. For example, features of the specific sector or government entity, how informed prospective government workers are about regulations relative to current workers, and the time horizon. Additionally, when designing regulations, whether entry or exit is more important will depend on the specific goals of policymakers.

As with the case of w_g, the endogeneity of connections alters the effectiveness of regulations. If connections do not matter then:

$$\frac{\partial \overline{\psi}^*}{\partial \lambda} \propto -e^{-\delta\lambda}\overline{q} < 0.$$

Instead, when connections matter, λ has an indirect effect on Q^* as other revolvers alter their behavior in response to tighter restrictions:

$$\frac{\partial \overline{\psi}^*}{\partial \lambda} \propto \underbrace{-e^{-(\delta+\rho)\lambda} q^*(\lambda)}_{\text{Direct Effect } (<0)} + \underbrace{\int_\lambda^\infty e^{-(\delta+\rho)s} \frac{\partial q^*(s)}{\partial \lambda} ds}_{\text{Indirect Effect } (?)}.$$

When connections matter for lobbying, the equilibrium effects of λ can be muted or amplified due to the indirect effect. Which direction it goes depends on whether increasing λ causes connections to decrease overall, due to the entry effect, or increase overall, due to the exit effect causing workers remain in government longer. Thus, if the entry effect prevails then the indirect effect is negative and the importance of connections for lobbyists makes workers especially responsive to regulations. On the other hand, if the exit effect is

more important, then the indirect effect again pushes against the direct effect, dampening the responsiveness of workers to cooling-off periods.

Our results suggest that a longer cooling-off period has a significantly different impact on equilibrium outcomes than increasing the government wage. This is especially true when the entry of new workers into government are greater than the exit of workers. On one hand, increasing w_g bolsters the size of the government workforce, while increasing λ can decrease it. On the other hand, higher government wages lower the average quality of the government workforce, while longer cooling-off periods can increase it. Moreover, unlike w_g, increasing λ lowers the lifetime influence of revolving door lobbyists. Finally, the equilibrium effects due to the value of connections can reinforce the responsiveness of workers to longer cooling-off periods, while they always work against changes in the government wage.

7 Behavior in Government

Thus far, we have abstracted away the option to take actions while in government that increase an individual's appeal to potential lobbying firms. In practice, these actions can take various forms. Workers may support or enforce policies in ways that are favorable for industry (Cornaggia et al., 2016; Tabakovic and Wollmann, 2018; Tenekedjieva, 2021; Li, 2021). Alternatively, they may work harder to build valuable human capital and impresses potential employers outside government (deHaan et al., 2015; Kempf, 2020; Shepherd and You, 2020).

To allow for these forms of behavior in our model, we extend the model so that before exiting each worker i can take an action $x \geqslant 0$ at cost $c(x)$, where $c' > 0, c'' > 0, c(0) = 0, c'(0) = 0$, and $\lim_{x\to\infty} c(x) = \infty$. Letting $\kappa(\tau, q_s) = v(\tau) \cdot q(s)$ denote the total value of connections for a τ-tenure worker after time s has elapsed since revolving, we define i's lobbying value after choosing x as $F(\kappa, x)$. We assume that $F_x > 0$, $F_{xx} \leqslant 0$ and, fixing x, that F inherits the same properties as $v(\tau) \cdot q(s)$. In particular, higher actions make the worker more valuable or attractive to lobbying firms but at a cost, such as exerting more effort or lower performance in the worker's current role. We take a purposefully stark approach to modeling in-government behavior so that it can capture in reduced form a number of different actions, e.g., investment in building expertise, misallocating time in government, or supporting policies favorable to industry.

In equilibrium, if worker i chooses to exit at tenure τ she must chooses her action x^* to maximize her revolving payoff given τ. Specifically, in equilibrium, individual i chooses her

tenure and action (τ^*, x^*) to solve:

$$\int_0^\infty e^{-(\delta+\rho)s} F\big(\kappa(\tau, q_s^*), x\big) ds = \psi_i + w_g + \frac{v'(\tau)}{\delta+\rho} \int_0^\infty e^{-(\delta+\rho)s} q_s^* F_\kappa\big(\kappa(\tau, q_s^*), x\big) ds \tag{18}$$

$$\int_0^\infty e^{-(\delta+\rho)s} F_x\big(\kappa(\tau, q_s^*), x\big) ds = c'(x) \tag{19}$$

This condition yields the following proposition, which characterizes the relationship between revolver i's tenure and her choice of action x_i^*.

Proposition 7. *If worker i revolves at later tenure than worker j in equilibrium, then: (i) $F_{x\kappa} > 0$ implies $x_i^* > x_j^*$; whereas (ii) $F_{x\kappa} < 0$ implies $x_i^* < x_j^*$.*

Each worker's incentive to act in a distortionary way before revolving changes over time due to changes in the value of their connections. A key factor is whether connections and the action are complements or substitutes in lobbying wages. Specifically, if κ and x are complements, then taking a greater action is more appealing as the value of i's connections increase. In contrast, choosing a larger x is relatively less appealing if κ and x are substitutes. An implication is that longer tenure revolvers will choose higher actions if there are complementarities in production between κ and x, but lower actions if they are substitutes. Thus, complementarities between connections and expertise/effort will amplify the connection-driven superstar feature of lobbying wages.

We can also study the effect of a cooling-off period of length λ on behavior in government. Suppose a worker revolves after tenure $\overline{\tau}$. Modifying equation (19) to account for the regulation, such a worker chooses x^* to solve:

$$\int_\lambda^\infty e^{-(\delta+\rho)s} F_x\big(v(\overline{\tau}) \cdot q_s^*, x\big) ds = c'(x). \tag{20}$$

For a fixed exit time $\overline{\tau}$, consider the effect of increasing the λ on a worker's action in equilibrium:

$$\frac{\partial x^*}{\partial \lambda} \propto \underbrace{-e^{-(\delta+\rho)\lambda} F_x\big(\kappa(\overline{\tau}, q_\lambda^*), x\big)}_{\text{Direct Effect} < 0} + \underbrace{\int_\lambda^\infty v(\overline{\tau}) \frac{\partial q_s^*}{\partial \lambda} F_{x\kappa}\Big(\kappa(\overline{\tau}, q_s^*), x\Big) ds.}_{\text{Indirect Effect ?}} \tag{21}$$

The direct effect of the restriction is to discourage workers from taking the action, as the longer cooling-off period lowers the amount of time that i benefits from the action. As before, whether increasing λ increases or decreases connections depends on the relative magnitudes of the entry or exit effects. Moreover, the indirect effect of λ depends critically on how κ and x combine to affect lobbying output. Suppose $\frac{\partial q_s}{\partial \lambda} < 0$, i.e., when the size of government

overall decreases because increasing λ leads to fewer workers entering the public sector. In this case, if κ and x are substitutes then the indirect effect is positive and dampens the responsiveness of an $\overline{\tau}$-tenured worker's in-government behavior. In contrast, the indirect effect reinforces the direct effect if κ and x are complements, increasing κ makes an $\overline{\tau}$-tenured worker significantly less inclined to take higher actions. Of course, these conclusions are reversed if the effect of λ on exit dominates and hence $\frac{\partial q_s}{\partial \lambda} > 0$. Thus, by disentangling the interaction between connections and government, as well as how cooling-off periods impact entry versus exit, we can better understand the effectiveness of regulations on the revolving door.

8 Conclusion

We develop a model of the labor market for revolving door lobbyists. Our model emphasizes that revolvers are primarily rewarded for the value of their connections in government. In particular, that connections formed from government experience are only valuable as long as those contacts stay behind in government. This endogeneity of an individual's connections to the choices of other workers has important implications for equilibrium behavior and outcomes.

First, because a lobbyist's connections change after revolving, this leads to the emergence of superstars who generate substantially more revenue than other lobbyists. Understanding theses differences is important because it may reflect differences in the influence of revolvers. This insight can explain the shape of the empirical distribution of revolver revenue, which is significantly right-skewed. Furthermore, in cases where connections are relatively less important, e.g., former bureaucrats vs. former staffers, we expect there to less inequality in the distribution of revolver revenue.

Second, we analyze the effects of policies aimed at curbing the revolving door. We find that increasing public sector wages is effective for attracting and retaining workers. However, this comes at the expense of lowering the average quality (public service motivation) of the government workforce and increasing the value of lobbyists' connections. On the other hand, longer cooling-off periods are effective at decreasing the value of revolvers and can increase the average quality of government workers, but may lower the size of the workforce. Thus, our analysis provides guidance on how to approach regulating the revolving door, depending on which concerns are most pressing.

Third, we highlight the importance of identifying the settings in which connections are substitutes or complements for actions in government that workers might take to improve their payoff as a revolver. For example, working hard and building expertise may comple-

ment connections because a lobbyist can leverage their connections to make more effective arguments; or because they will be viewed more favorably by their previous colleagues. Granting policy favors, on the other hand, may act as a substitute for connections from the perspective of the revolver. While this is not directly helpful for lobbying, it may make the worker more appealing to potential employers, offsetting the need to be as well connected. Of course, favors may instead complement connections if it raises the probability of a worker receiving a job offer. Thus, it would be valuable to further understand how different actions in government improve a revolver's value. Moreover, while existing work has sought to disentangle whether connections or expertise are more important for lobbying, we show that their interaction can have important consequences.

Our paper provides an initial attempt to model how connections influence the revolving door. In doing so, we have abstracted from many important political and economic details that arise in different applications. For example, our framework can be extended to incorporate turnover in the political party in power, a richer model of lobbying, and labor market frictions. Additionally, we have only considered two blunt tools, government wages and cooling-off periods, for addressing the revolving door. Another valuable direction for future work would be to study more flexible or complicated regulations and consider a broader set of welfare considerations.

A Appendix

Lemma 1. *In every equilibrium, there exists a function* $\overline{\psi}^* : \mathbb{R}_+ \to \mathbb{R}$ *such that a worker* i *with tenure* τ *revolves if and only if* $\psi_i \leqslant \overline{\psi}^*(\tau)$.

Proof. Fix an equilibrium σ^*. By definition, $\eta^*(\psi', a) = 1$ if and only if $\tau^*(\psi') > a$. Since $\tau^*(\psi_i) = \arg\max_\tau V_g(\tau; \psi_i, \sigma^*)$, we know τ^* solves

$$\begin{aligned} 0 = &- w_g - \psi_i + v(\tau) \int_0^\infty e^{-(\delta+\rho)s} \int_{-\infty}^\infty \int_s^\infty \gamma^*(\psi)\eta^*(\psi, a)e^{-\delta a} da\, dG(\psi)\, ds \\ &- \frac{v'(\tau)}{\delta+\rho} \int_0^\infty e^{-(\delta+\rho)s} \int_{-\infty}^\infty \int_s^\infty \gamma^*(\psi)\eta^*(\psi, a)e^{-\delta a} da\, dG(\psi)\, ds. \end{aligned}$$

Then, the implicit function theorem yields

$$\frac{\partial \tau^*}{\partial \psi_i} = \frac{1}{v'(\tau^*)Q^* - v''(\tau^*)Q^*} > 0,$$

so τ^* is a strictly increasing function of ψ_i. Letting $\overline{\psi}^*$ denote the inverse of τ^* yields the result. □

Lemma 2. *In every equilibrium, there exists a* $\underline{\psi}^* \in \mathbb{R}$ *such that each worker* i *enters government if* $\psi_i \geqslant \underline{\psi}^*$ *and enters the private sector otherwise.*

Proof. Fix an equilibrium σ^*. It is straightforward that each worker i will not enter government if ψ_i is sufficiently low, but will enter if ψ_i is sufficiently high. To complete the proof and establish a unique $\underline{\psi}^* \in \mathbb{R}$ distinguishing these cases, we make two observations. First, i's payoff of not entering, V_p, is constant in ψ_i. Second, applying the envelope theorem yields that i's payoff from entering government, $V_g^*(\psi, \sigma^*)$, is strictly increasing in ψ. □

Proposition 1. *A unique equilibrium exists and is characterized by a* $(\underline{\psi}^*, \overline{\psi}^*(\tau), Q^*)$ *that solves*

$$\underline{\psi} = \frac{w_p - e^{-(\delta+\rho)\overline{\psi}^{-1}(\underline{\psi})} v(\overline{\psi}^{-1}(\underline{\psi})) \cdot Q}{1 - e^{-(\delta+\rho)\overline{\psi}^{-1}(\underline{\psi})}} - w_g, \tag{22}$$

$$\overline{\psi}(\tau) = -w_g + Q \cdot v(\tau) - Q \cdot \frac{v'(\tau)}{\delta+\rho}, \tag{23}$$

$$Q = \int_0^\infty e^{-(\delta+\rho)s} \int_s^\infty e^{-\delta n} \Big(1 - G(\max\{\underline{\psi}, \overline{\psi}(n)\})\Big)\, dn\, ds. \tag{24}$$

Proof. First, note, by construction, any solution to the above system of equations is an equilibrium.

Second, we show that any equilibrium must be characterized by solutions to the above system. By Lemma 2, in any equilibrium there exists $\underline{\psi}$ such that i enters government if and only if $\psi_i \geqslant \underline{\psi}$. Furthermore, by Lemma 1, there exists $\overline{\psi}(a)$ such that each worker i is in government at age a if and only if $\psi_i > \max\{\overline{\psi}(a), \underline{\psi}\}$. Thus, we must have:

$$Q = \int_0^\infty e^{-(\delta+\rho)s} \int_s^\infty e^{-\delta a} \Big[1 - G(\max\{\underline{\psi}, \overline{\psi}(a)\})\Big] da ds.$$

In equilibrium, each newly born worker i will revolve after a tenure that solves:

$$\max_\tau \frac{1 - e^{-(\delta+\rho)\tau}}{\delta+\rho}(\psi_i + w_g) + \frac{e^{-(\delta+\rho)\tau}}{\delta+\rho} v(\tau) \cdot Q.$$

Each worker's objective is concave in τ, so i's optimal stopping time, $\tau^*(\psi)$, is the unique solution to:

$$e^{-(\delta+\rho)\tau}(\psi_i + w_g) + \frac{e^{-(\delta+\rho)\tau}}{\delta+\rho} v'(\tau) \cdot Q - e^{-(\delta+\rho)\tau} v(\tau) \cdot Q = 0. \tag{25}$$

Next, we prove that a solution exists. To start, we show there is a $(\underline{\psi}^*, Q^*)$ that solves

$$\underline{\psi} = \frac{w_p - e^{-(\delta+\rho)\overline{\psi}^{-1}(\underline{\psi})} v(\overline{\psi}^{-1}(\underline{\psi}))}{1 - e^{-(\delta+\rho)\overline{\psi}^{-1}(\underline{\psi})}} - w_g \tag{26}$$

$$Q = \int_0^\infty e^{-(\delta+\rho)s} \int_s^\infty e^{-\delta n} \Big[1 - G\Big(\max\Big\{v(n) \cdot Q - \frac{v'(n)}{\delta+\rho} \cdot Q - w_g, \underline{\psi}\Big\}\Big)\Big] dn ds. \tag{27}$$

Consider (27). First, at $Q = 0$ the RHS is $\int_0^\infty e^{-(\delta+\rho)s} \int_s^\infty e^{-\delta n} \Big[1 - G\Big(\max\{-w_g, \underline{\psi}\}\Big)\Big] dn ds > 0$. Second, $1 - G(\cdot) < 1$ implies that the RHS is strictly less than $\int_0^\infty e^{-(\delta+\rho)s} \int_s^\infty e^{-\delta n} dn ds = \frac{1}{\delta(2\delta+\rho)}$, so the RHS is smaller than the LHS at $Q = \frac{1}{\delta(2\delta+\rho)}$. Since each side is continuous in Q, the intermediate value theorem yields a solution, which we denote $Q^*(\underline{\psi})$. Moreover, Q^* is unique because—given a fixed $\underline{\psi}$—the LHS is strictly increasing in Q while the RHS is is decreasing.

Plugging $Q^*(\underline{\psi})$ into (26) implies that $\underline{\psi}^*$ solves

$$\underline{\psi} = \frac{w_p - e^{-(\delta+\rho)\overline{\psi}^{-1}(\underline{\psi}, Q^*(\underline{\psi}))} v(\overline{\psi}^{-1}(\underline{\psi}, Q^*(\underline{\psi}))) \cdot Q^*(\underline{\psi})}{1 - e^{-(\delta+\rho)\overline{\psi}^{-1}(\underline{\psi}, Q^*(\underline{\psi}))}} - w_g. \tag{28}$$

Note that $Q(\psi) \in [0, \frac{1}{\delta(2\delta+\rho)}]$ always holds. Recall that $\overline{\psi}^{-1}(\psi, Q) = \tau(\psi, Q)$, so $\tau(\underline{\psi}, Q)$

is the solution to $v(\tau) - v'(\tau)/(\delta+\rho) = \frac{\underline{\psi}+w_g}{Q}$. Thus, there exists $\psi^- \in \mathbb{R} \cup \{-\infty\}$ such that $\lim_{\underline{\psi}\to\psi^-} \overline{\psi}^{-1}(\underline{\psi}, Q) = 0$. In turn, $\underline{\psi} \to \psi^- < \infty$ also implies that the RHS of (28) goes to $\frac{w_p - e^0 \cdot v(0)}{1-e^0} = \infty$. On the other hand, as $\underline{\psi} \to \infty$ we have $\lim_{\underline{\psi}\to\infty} \overline{\psi}^{-1}(\underline{\psi}, Q) > 0$ and therefore the limit of the RHS of (28) is finite. Thus, since both sides of (28) are continuous in $\underline{\psi}$, the intermediate value theorem yields existence of a solution $\underline{\psi}^*$. To demonstrate uniqueness, if we rearrange (28) then any $\underline{\psi}^*$ must solve:

$$\left(1 - e^{-(\delta+\rho)\overline{\psi}^{-1}(\underline{\psi}, Q^*(\underline{\psi}))}\right)\left(\underline{\psi} + w_g\right) - w_p + e^{-(\delta+\rho)\overline{\psi}^{-1}(\underline{\psi}, Q^*(\underline{\psi}))} v(\overline{\psi}^{-1}(\underline{\psi}, Q^*(\underline{\psi}))) \cdot Q^*(\underline{\psi}) = 0. \tag{29}$$

Differentiating yields $\frac{\partial LHS(29)}{\partial \underline{\psi}} = 1 - e^{-(\delta+\rho)\overline{\psi}^{-1}(\underline{\psi}, Q^*(\underline{\psi}))} > 0$. Thus, there is a unique solution $\underline{\psi}^*$ to (29).

To complete the argument, define $\overline{\psi}^*(\tau) = -w_g + v(\tau) \cdot Q^* - \frac{v'(\tau)}{\delta+\rho} \cdot Q^*$. □

Proposition 2. *In equilibrium: $\overline{\psi}^*(\tau)$ is strictly increasing and concave in τ, and $\overline{\psi}^*(0) < \underline{\psi}^* < w_p - w_g$.*

Proof. First, $\frac{\partial \overline{\psi}^*}{\partial \tau} = Qv'(\tau) - Q\frac{v''(\tau)}{\delta+\rho} > 0$, by $v' \geqslant 0$ and $v'' \leqslant 0$. Furthermore, differentiating again yields $\frac{\partial^2 \overline{\psi}}{\partial \tau^2} = v''(\tau)Q - \frac{Q}{\rho+\delta}v'''(\tau) \leqslant 0$, where the inequality follows from $v'' \leqslant 0$ and $v''' \geqslant 0$.

Finally, we prove the last claim. For the second inequality, note that $V_g^* > \frac{\psi+w_g}{\delta+\rho}$ in equilibrium. Thus, $\psi_i + w_g \geqslant w_p$ implies $V_g^* > V_p$, so i would enter in equilibrium. To verify the first inequality, suppose that $\overline{\psi}^*(0) \geqslant \underline{\psi}^*$. Then, workers with $\psi_i \in [\underline{\psi}^*, \overline{\psi}^*(0)]$ will revolve immediately after joining government. Thus, for these workers we must have $V_g^* = Q \cdot v(0) < \frac{v(0)}{\delta+\rho} \leqslant \frac{w_p}{\delta+\rho} = V^p$, where the last inequality follows from our assumption that $v(0) \leqslant w_p$. Combining these observations yields $\underline{\psi}^* \leqslant \psi_i < \underline{\psi}^*$, a contradiction. □

Lemma 3. *For age-a workers, instantaneous revolver revenue $r(a-\tau, \tau)$ is increasing in tenure, τ. Moreover, if τ sufficiently large, then $r(a-\tau, \tau)$ is convex in τ.*

Proof. Equation (12) implies that r is convex in τ if

$$\frac{\partial^2 r}{\partial \tau^2} = v''(\tau)q_i(s) - 2v'(\tau)q_i'(s) + v(\tau)q_i''(s) > 0.$$

We have:

$$q_i'(s) = -e^{-\delta s}\Big(1 - G(\max\{\overline{\psi}^*(s), \underline{\psi}^*\})\Big) < 0,$$

$$q_i''(s) = \delta e^{-\delta s}\Big(1 - G(\max\{\overline{\psi}^*(s), \underline{\psi}^*\})\Big) + e^{-\delta s} g(\max\{\overline{\psi}^*(s), \underline{\psi}^*\}) \cdot \left\{ \begin{array}{ll} \dfrac{\partial \overline{\psi}^*}{\partial s} & \text{if } \overline{\psi}^*(s) \geqslant \underline{\psi}^*, \\ 0 & \text{otherwise.} \end{array} \right\} > 0.$$

Thus, for all τ we have $-2v'(\tau)q_i'(s) \geqslant 0$ and $v(\tau)q_i''(s) \geqslant 0$, whereas $v''(\tau)q_i(s) \leqslant 0$.

To complete the proof, we verify two limits. First, $\lim_{\tau\to\infty} v''(\tau) = 0$ because we have assumed that $\lim_{\tau\to\infty} v'(\tau)$ is finite and $v''(\tau)$ is uniformly continuous, so Barbălat's Lemma yields $\lim_{\tau\to\infty} v''(\tau) = 0$, as required. Second, $\lim_{\tau\to\infty} v(\tau) \cdot q_i''(s) > 0$ since $q_i''(s) > 0$ is constant in τ and $v(\tau) > 0$ for all $\tau > 0$. □

Lemma A.1. *If $w_p \to \infty$ then $\underline{\psi}^* \to \infty$.*

Proof. To show a contradiction, suppose $\lim_{w_p\to\infty} \underline{\psi}^* < \infty$. Then, $\lim_{w_p\to\infty} \tau^*(\underline{\psi}^*) < \infty$. Therefore $\lim_{w_p\to\infty} \Big((\underline{\psi}^* + w_g)(1 - e^{-(\delta+\rho)\tau^*(\underline{\psi}^*)}) + e^{-(\delta+\rho)\tau^*(\underline{\psi}^*)} v(\tau^*(\underline{\psi}^*)) \Big) < \infty$, which is equivalent to $\lim_{w_p\to\infty} w_p < \infty$, a contradiction. □

Let the *distribution of revolver revenue* be denoted by H, with associated density h.

Proposition 3. *If v is linear and G is unimodal, then there exists $z <$ mode G such that $\underline{\psi}^* > z$ implies $\mathbb{E}[H] \geqslant$ median H.*

Proof. We prove the result in two steps. Step 1 characterizes H and h. Then, Step 2 verifies properties of h' that imply median $H < \mathbb{E}[H]$.

Step 1. Recall that ψ is distributed according to G. In equilibrium, $\overline{\psi}(a)$ is the maximum public service among age-a revolvers. Thus, for age-a revolvers we have $P_a(\psi \leqslant z) = \frac{G(z)-G(\underline{\psi})}{G(\overline{\psi}(a))-G(\underline{\psi})}$ for $z \in [\underline{\psi}, \overline{\psi}(a)]$ and $P_a(\psi \leqslant z) = 1$ for $z > \overline{\psi}(a)$. Furthermore, each age-a revolver of type $\psi \in [\underline{\psi}, \overline{\psi}(a)]$ generates revenue:

$$r_a(\psi) = v\Big(\tau^*(\psi)\Big) \cdot \int_{a-\tau^*(\psi)}^{\infty} e^{-\delta n} \Big(1 - G(\overline{\psi}(n))\Big)\, dn.$$

Let $A(y)$ solve $y = r_a(\overline{\psi}(a))$, which implies $A(y) = v^{-1}\Big(\frac{y}{Q^*}\Big)$ since $r_a(\overline{\psi}(a)) = v(a)Q^*$.

Using these properties, we can characterize H, the steady-state distribution of revolver revenue:

$$H(y) = \int_{\tau^*(\underline{\psi})}^{A(y)} \frac{\delta e^{-\alpha\delta}}{e^{-\delta\tau^*(\underline{\psi})}} d\alpha + \int_{A(y)}^{\infty} \frac{\delta e^{-\alpha\delta}}{e^{-\delta\tau^*(\underline{\psi})}} H_\alpha(y) d\alpha,$$

where H_a denotes the distribution of revenue among age-a revolvers and is equal to

$$H_a(y) = \frac{G\Big(r_a^{-1}(y)\Big) - G\Big(\underline{\psi}\Big)}{G\Big(\overline{\psi}(a)\Big) - G\Big(\underline{\psi}\Big)}$$

for $y \leqslant r_a(\overline{\psi}(a))$ and $H_a(y) = 1$ for $y > r_a(\overline{\psi}(a))$.

Thus, we obtain h, the associated pdf of revolver revenue:

$$h(y) = \frac{\delta}{e^{-\delta\tau^*(\underline{\psi})}} A'(y) e^{-A(y)\delta} - \frac{\delta}{e^{-\delta\tau^*(\underline{\psi})}} A'(y) e^{-A(y)\delta} H_{A(y)}(y) + \int_{A(y)}^{\infty} \frac{\delta}{e^{-\delta\tau^*(\underline{\psi})}} e^{-\alpha\delta} h_\alpha(y) d\alpha.$$

By construction, at the age $A(y)$ we have $r_{A(y)}(y) = y$ and therefore $H_{A(y)}(y) = 1$. Thus, the above simplifies to

$$\begin{aligned} h(y) =& \int_{A(y)}^{\infty} \frac{\delta}{e^{-\delta\tau^*(\underline{\psi})}} e^{-\alpha\delta} h_\alpha(y) d\alpha, \text{ where} \\ h_\alpha(y) =& \frac{1}{G\Big(\overline{\psi}(a)\Big) - G\Big(\underline{\psi}\Big)} \frac{\partial r_\alpha^{-1}}{\partial y} g(r_\alpha^{-1}(y)). \end{aligned}$$

Step 2. Differentiating h yields

$$h'(y) = -A'(y) \frac{\delta}{e^{-\delta\tau^*(\underline{\psi})}} e^{-A(y)\delta} h_{A(y)}(y) + \int_{A(y)}^{\infty} \frac{\delta}{e^{-\delta\tau^*(\underline{\psi})}} e^{-\alpha\delta} h'_\alpha(y) d\alpha. \tag{30}$$

The first term is negative, since $A'(y) > 0$ follows from v^{-1} strictly increasing. Thus, a sufficient condition for $h'(y) < 0$ is that $h'_\alpha(y) \leqslant 0$ for all α. From the definition of $H_\alpha(y)$, we get

$$h'_\alpha(y) = \frac{1}{G\Big(\overline{\psi}(a)\Big) - G\Big(\underline{\psi}\Big)} \Big[\frac{\partial^2 r_\alpha^{-1}}{\partial y^2} g(r_\alpha^{-1}(y)) + \Big(\frac{\partial r_\alpha^{-1}}{\partial y} \Big)^2 g'(r_\alpha^{-1}(y)) \Big]. \tag{31}$$

Since v is linear, we know r_α is convex, so r_α^{-1} is concave and $\frac{\partial^2 r_\alpha^{-1}}{\partial y^2} g(r_\alpha^{-1}(y)) \leqslant 0$. Furthermore, log-concavity g implies that $g' < 0$ for all $\psi >$ mode g. Since $\min_y r_\alpha^{-1}(y) = \underline{\psi}$, we know

that if $\underline{\psi} \geqslant$ mode G holds then $g'(r_\alpha^{-1}(y)) < 0$ for all y and, in turn, median $H <$ mode H. Thus, since median H and $\mathbb{E}[H]$ are both continuous in $\underline{\psi}$, there is a $z <$ mode G such that $\underline{\psi} > z$ implies mean $H >$ median H. Note then that Lemma A.1 that this condition must hold for all w_p sufficiently large. □

Lemma 4. *If connections do not matter, then age-a workers have instantaneous revolver revenue $r(a-\tau,\tau)$ that is increasing and concave in tenure, τ.*

Proof. Suppose $r(a-\tau,\tau) = v(\tau)\cdot\overline{q}$. Then, $r' = v'(\tau)\cdot\overline{q} > 0$ and $r'' = v''(\tau)\cdot\overline{q} \leqslant 0$, as required. □

Proposition 4. *If v is linear, then the distribution of revolver revenue is more right-skewed when connections matter.*

Proof. Because $\overline{q}$ is chosen such that $\overline{\psi}^*(\tau)$ and $\underline{\psi}^*$ are equivalent when connections do and do not matter, the equilibrium distribution of stopping times is equivalent. When connections do not matter, the distribution of revenue is given by a linear transformation of the distribution of stopping times and, hence, has the same skew as the distribution of stopping times. When connections do matter, the distribution of revenue is given by an increasing and convex transformation of the distribution of stopping times. Hence, it is more right-skewed than the distribution of stopping times (von Zwet, 2012), and thus more right-skewed than the distribution of revenue when connection do not matter. □

Define the following two functions:

$$\begin{aligned}\phi_1(Q,\underline{\psi}) = &\int_{\min\{\lambda,\overline{n}\}}^{\overline{n}} e^{-(\delta+\rho)s}\Big\{\int_s^{\overline{n}} e^{-\delta n}\Big(1-G(\underline{\psi})\Big)dn + \int_{\overline{n}}^{\infty} e^{-\delta n}\Big(1-G(\overline{\psi}(n))\Big)dn\Big\}ds \\ &+ \int_{\max\{\lambda,\overline{n}\}}^{\infty} e^{-(\delta+\rho)s}\int_s^{\infty} e^{-\delta n}\Big(1-G(\overline{\psi}(n))\Big)dnds - Q,\end{aligned} \tag{32}$$

$$\phi_2(Q,\underline{\psi}) = w_p - e^{-(\delta+\rho)\tau^*(Q,\underline{\psi})}\cdot v(\tau^*(Q,\underline{\psi}))\cdot Q - \Big(1-e^{-(\delta+\rho)\tau^*(Q,\underline{\psi})}\Big)(\underline{\psi}+w_g), \tag{33}$$

where $\overline{n}$ is the unique n that solves

$$-w_g + v(n)\cdot Q - \frac{v'(n)}{\delta+\rho}\cdot Q = \underline{\psi}. \tag{34}$$

Lemma A.2. *We have $\frac{\partial\phi_1}{\partial Q} < 0$, $\frac{\partial\phi_1}{\partial\underline{\psi}} < 0$, $\frac{\partial\phi_2}{\partial Q} < 0$, and $\frac{\partial\phi_2}{\partial\underline{\psi}} < 0$.*

Proof. First,

$$\begin{aligned}\frac{\partial \phi_1}{\partial Q} &= -1 - \int_{\min\{\lambda,\overline{n}\}}^{\overline{n}} e^{-(\delta+\rho)s} \int_{\overline{n}}^{\infty} e^{-\delta n} \cdot \left(v(n) - \frac{v'(n)}{\delta+\rho} \right) g(\overline{\psi}(n))\, dn\, ds \\ &\quad - \int_{\max\{\lambda,\overline{n}\}}^{\infty} e^{-(\delta+\rho)s} \int_{s}^{\infty} e^{-\delta n} \cdot \left(v(n) - \frac{v'(n)}{\delta+\rho} \right) g(\overline{\psi}(n))\, dn\, ds \\ &< 0,\end{aligned}$$

where the inequality follows because $v(n) > \frac{v'(n)}{\delta}$ for all $n > \overline{n}$.

Second, $\frac{\partial \phi_1}{\partial \underline{\psi}} = -\int_{\min\{\lambda,\overline{n}\}}^{\overline{n}} e^{-(\delta+\rho)s} \left(\int_s^{\overline{n}} e^{-\delta n}\, g(\underline{\psi})\, dn \right) ds < 0.$

Third, $\frac{\partial \phi_2}{\partial Q} = -e^{-(\delta+\rho)\tau^*(\underline{\psi})} v(\tau^*(\underline{\psi})) < 0.$

Finally, $\frac{\partial \phi_2}{\partial \underline{\psi}} = -\left(1 - e^{-(\delta+\rho)\tau^*(Q,\underline{\psi})}\right) < 0.$ □

Lemma A.3. *For ϕ_1, we have $\lim_{\rho\to\infty} \frac{\partial \phi_1}{\partial Q} = -1$ and $\lim_{\rho\to\infty} \frac{\partial \phi_1}{\partial \underline{\psi}} = 0$. And for ϕ_2, we have $\lim_{\rho\to\infty} \frac{\partial \phi_2}{\partial Q} = 0$ and $\lim_{\rho\to\infty} \frac{\partial \phi_2}{\partial \underline{\psi}} = -1$.*

Proof. First, we have

$$\begin{aligned}\lim_{\rho\to\infty} \frac{\partial \phi_1}{\partial Q} &= -1 - \lim_{\rho\to\infty} \left(\int_{\min\{\lambda,\overline{n}\}}^{\overline{n}} e^{-(\delta+\rho)s} \int_{\overline{n}}^{\infty} e^{-\delta n} \cdot \left(v(n) - \frac{v'(n)}{\delta+\rho} \right) g(\overline{\psi}(n))\, dn\, ds \right. \\ &\qquad \left. - \int_{\max\{\lambda,\overline{n}\}}^{\infty} e^{-(\delta+\rho)s} \int_{s}^{\infty} e^{-\delta n} \cdot \left(v(n) - \frac{v'(n)}{\delta+\rho} \right) g(\overline{\psi}(n))\, dn\, ds \right) \\ &= -1,\end{aligned}$$

which follows because (i) $\lim_{\rho\to\infty} e^{-(\delta+\rho)s} = 0$, (ii) $\lim_{\rho\to\infty} g(\overline{\psi}(n)) < \infty$,

$$\text{(iii)} \lim_{\rho\to\infty} \int_{\overline{n}}^{\infty} e^{-\delta n} \left(v(n) - \frac{v'(n)}{\delta+\rho} \right) g(\overline{\psi}(n)) < \infty, \text{ and}$$

$$\text{(iv)} \lim_{\rho\to\infty} \int_{\overline{s}}^{\infty} e^{-\delta n} \left(v(n) - \frac{v'(n)}{\delta+\rho} \right) g(\overline{\psi}(n)) < \infty.$$

To see why (iii) and (iv) hold, note that $e^{-\delta n} \cdot \left(v(n) - \frac{v'(n)}{\delta+\rho} \right) \leqslant e^{-\delta n} v(n)$ for all n. Then $\lim_{n\to\infty} e^{-\delta n} v(n) = 0$, since $\lim_{n\to\infty} v'(n) < \infty$ and L'Hopital's rule together yield $\lim_{n\to\infty} e^{-\delta n} v(n) = \lim_{n\to\infty} \frac{v'(n)}{\delta e^{\delta n}} = 0$.

Second, we have

$$\lim_{\rho\to\infty}\frac{\partial\phi_1}{\partial\underline{\psi}} = \lim_{\rho\to\infty} -\int_{\min\{\lambda,\overline{n}\}}^{\overline{n}} e^{-(\delta+\rho)s}\Big(\int_s^{\overline{n}} e^{-\delta n}\, g(\underline{\psi})\, dn\Big) = 0,$$

which follows because (i) $\lim_{\rho\to\infty} e^{-(\delta+\rho)s} = 0$ and (ii) $\lim_{\rho\to\infty}\int s^{\overline{n}} e^{-\delta n} g(\underline{\psi}) < \infty$, since $g(\underline{\psi}^*) < \infty$ implies that $e^{-\delta n} g(\underline{\psi}^*) < \infty$ for all $n \geqslant 0$.

Third, we have

$$\lim_{\rho\to\infty}\frac{\partial\phi_2}{\partial Q} = \lim_{\rho\to\infty} -e^{-(\delta+\rho)\tau^*(\underline{\psi})} v(\tau^*(\underline{\psi})) = 0,$$

which follows because $e^{-(\delta+\rho)\tau^*(Q,\underline{\psi})} \to 0$ as $\rho\to\infty$, since $\tau^* > 0$.

Finally, we have

$$\lim_{\rho\to\infty}\frac{\partial\phi_2}{\partial\underline{\psi}} = \lim_{\rho\to\infty} -\Big(1 - e^{-(\delta+\rho)\tau^*(Q,\underline{\psi})}\Big) = -1,$$

which also follows because $e^{-(\delta+\rho)\tau^*(Q,\underline{\psi})} \to 0$ as $\rho\to\infty$, since $\tau^* > 0$.

□

Lemma 6. *If ρ is sufficiently large, then $\frac{\partial Q^*}{\partial\lambda} < 0 < \frac{\partial\underline{\psi}^*}{\partial\lambda}$.*

Proof. Applying the implicit function theorem yields

$$\begin{bmatrix}\frac{\partial Q^*}{\partial\lambda}\\ \frac{\partial\underline{\psi}^*}{\partial\lambda}\end{bmatrix} = \frac{-1}{\frac{\partial\phi_1}{\partial Q}\frac{\partial\phi_2}{\partial\underline{\psi}} - \frac{\partial\phi_1}{\partial\underline{\psi}}\frac{\partial\phi_2}{\partial Q}}\begin{bmatrix}\frac{\partial\phi_2}{\partial\underline{\psi}}\cdot\frac{\partial\phi_1}{\partial\lambda} + \Big(-\frac{\partial\phi_1}{\partial\underline{\psi}}\Big)\cdot\frac{\partial\phi_2}{\partial\lambda}\\ -\frac{\partial\phi_2}{\partial Q}\cdot\frac{\partial\phi_1}{\partial\lambda} + \frac{\partial\phi_1}{\partial Q}\cdot\frac{\partial\phi_2}{\partial\lambda}\end{bmatrix}.$$

Since $\frac{\partial\phi_2}{\partial\lambda} = 0$ and $\frac{\partial\phi_1}{\partial\lambda} = -e^{-\delta\lambda}\int_\lambda^\infty e^{-\delta n}\Big(1 - G(\overline{\psi}(n))\Big)dn < 0$, Lemma A.2 implies $\frac{\partial\phi_2}{\partial\underline{\psi}}\cdot\frac{\partial\phi_1}{\partial\lambda} - \frac{\partial\phi_1}{\partial\underline{\psi}}\cdot\frac{\partial\phi_2}{\partial\lambda} > 0$ and $-\frac{\partial\phi_2}{\partial Q}\cdot\frac{\partial\phi_1}{\partial\lambda} + \frac{\partial\phi_1}{\partial Q}\cdot\frac{\partial\phi_2}{\partial\lambda} < 0$. Thus, $\frac{\partial Q^*}{\partial\lambda} < 0 < \frac{\partial\underline{\psi}^*}{\partial\lambda}$ holds if and only if

$$\frac{\partial\phi_1}{\partial Q}\frac{\partial\phi_2}{\partial\underline{\psi}} - \frac{\partial\phi_1}{\partial\underline{\psi}}\frac{\partial\phi_2}{\partial Q} > 0.$$

This inequality holds if ρ is sufficiently large, since the LHS is continuous in ρ and Lemma A.3 implies $\lim_{\rho\to\infty}\frac{\partial\phi_1}{\partial Q}\frac{\partial\phi_2}{\partial\underline{\psi}} - \frac{\partial\phi_1}{\partial\underline{\psi}}\frac{\partial\phi_2}{\partial Q} = 1$. □

Lemma 5. *If ρ is sufficiently large, then $\frac{\partial\underline{\psi}^*}{\partial w_g} < 0 < \frac{\partial Q^*}{\partial w_g}$.*

Proof. Applying the implicit function theorem yields

$$\begin{bmatrix} \frac{\partial Q^*}{\partial w_g} \\ \frac{\partial \underline{\psi}^*}{\partial w_g} \end{bmatrix} = \frac{-1}{\frac{\partial \phi_1}{\partial Q}\frac{\partial \phi_2}{\partial \underline{\psi}} - \frac{\partial \phi_1}{\partial \underline{\psi}}\frac{\partial \phi_2}{\partial Q}} \begin{bmatrix} \frac{\partial \phi_2}{\partial \underline{\psi}} \cdot \frac{\partial \phi_1}{\partial w_g} + \left(-\frac{\partial \phi_1}{\partial \underline{\psi}}\right) \cdot \frac{\partial \phi_2}{\partial w_g} \\ -\frac{\partial \phi_2}{\partial Q} \cdot \frac{\partial \phi_1}{\partial w_g} + \frac{\partial \phi_1}{\partial Q} \cdot \frac{\partial \phi_2}{\partial w_g} \end{bmatrix}.$$

By Lemma A.2, we have $\frac{\partial \phi_1}{\partial Q} < 0$, $\frac{\partial \phi_1}{\partial \underline{\psi}} < 0$, $\frac{\partial \phi_2}{\partial Q} < 0$, and $\frac{\partial \phi_2}{\partial \underline{\psi}} < 0$. Additionally, $\frac{\partial \phi_2}{\partial w_g} = -\left(1 - e^{-(\delta+\rho)\tau^*(\underline{\psi},Q)}\right) < 0$ and

$$\frac{\partial \phi_1}{\partial w_g} = \int_0^{\overline{n}} e^{-(\delta+\rho)s} \int_{\overline{n}}^{\infty} e^{-\delta n} g(\overline{\psi}(n)) dn ds + \int_{\overline{n}}^{\infty} e^{-(\delta+\rho)s} \int_s^{\infty} e^{-\delta n} g(\overline{\psi}(n)) dn ds > 0.$$

Thus, we have $\frac{\partial \phi_2}{\partial \underline{\psi}} \cdot \frac{\partial \phi_1}{\partial w_g} - \frac{\partial \phi_1}{\partial \underline{\psi}} \cdot \frac{\partial \phi_2}{\partial w_g} < 0$ and $-\frac{\partial \phi_2}{\partial Q} \cdot \frac{\partial \phi_1}{\partial w_g} + \frac{\partial \phi_1}{\partial Q} \cdot \frac{\partial \phi_2}{\partial w_g} > 0$. Therefore, $\frac{\partial \underline{\psi}^*}{\partial w_g} < 0 < \frac{\partial Q^*}{\partial w_g}$ holds if and only if

$$\frac{\partial \phi_1}{\partial Q}\frac{\partial \phi_2}{\partial \underline{\psi}} - \frac{\partial \phi_1}{\partial \underline{\psi}}\frac{\partial \phi_2}{\partial Q} > 0.$$

This condition holds for sufficiently large ρ, as shown in the proof of Lemma 6. □

Proposition 5. *If ρ is sufficiently large, then: $\frac{\partial S^*}{\partial w_g} > 0$, $\frac{\partial \mathbb{E}[\psi_i | i \text{ in govt.}]}{\partial w_g} < 0$, and $\frac{\partial v(\tau^*(\psi)) \cdot Q^*}{\partial w_g} > 0$ for all ψ.*

Proof. For part 1, differentiating we obtain

$$\frac{\partial S^*}{\partial w_g} = \int_0^{\overline{n}} -e^{-\delta n} \frac{\partial \underline{\psi}^*}{\partial w_g} g(\underline{\psi}^*) dn + \int_{\overline{n}}^{\infty} -e^{-\delta n} \frac{\partial \overline{\psi}^*}{\partial w_g} g(\overline{\psi}^*(n)) dn.$$

We further decompose this derivative into the terms where $\frac{\partial \overline{\psi}^*}{\partial w_g}$ is positive and where it is negative. Specifically, define $\tilde{n}$ as the unique n that solves $\frac{\partial \overline{\psi}^*(n)}{\partial w_g} = 0$, which can be written as:

$$\frac{\partial Q^*}{\partial w_g} = \frac{1}{v(n) - \frac{v'(n)}{\delta+\rho}}. \tag{35}$$

Then,

$$\frac{\partial S^*}{\partial w_g} = \int_0^{\overline{n}} -e^{-\delta n} \frac{\partial \underline{\psi}^*}{\partial w_g} g(\underline{\psi}^*) dn + \int_{\overline{n}}^{\tilde{n}} -e^{-\delta n} \frac{\partial \overline{\psi}^*}{\partial w_g} g(\overline{\psi}^*(n)) dn + \int_{\tilde{n}}^{\infty} -e^{-\delta n} \frac{\partial \overline{\psi}^*}{\partial w_g} g(\overline{\psi}^*(n)) dn.$$

By Lemma 5, sufficiently large ρ implies $\frac{\partial \underline{\psi}^*}{\partial w_g} < 0$. Furthermore, for $n \in (\overline{n}, \tilde{n})$ $\frac{\partial \overline{\psi}^*}{\partial w_g} < 0$ by construction of $\tilde{n}$. For the final term, recall from the proof of A.3 that $\lim_{\rho \to \infty} -e^{-\delta n} \frac{\partial \overline{\psi}^*}{\partial w_g} g(\overline{\psi}^*(n)) <$

∞ for all n. Thus, to establish $\frac{\partial S^*}{\partial w_g} < 0$ it is sufficient to verify that $\lim_{\rho\to\infty} \tilde{n} = \infty$. Towards a contradiction, suppose not. Then $\lim_{\rho\to\infty}$ RHS (35) $= \frac{1}{v(\tilde{n})} > 0$. To derive the contradiction we now show that $\lim_{\rho\to\infty} \frac{\partial Q^*}{\partial w_g} = 0$. From Lemma 5,

$$\frac{\partial Q^*}{\partial w_g} = \frac{-1}{\frac{\partial \phi_1}{\partial Q}\frac{\partial \phi_2}{\partial \underline{\psi}} - \frac{\partial \phi_1}{\partial \underline{\psi}}\frac{\partial \phi_2}{\partial Q}} \cdot \Big[\frac{\partial \phi_2}{\partial \underline{\psi}} \cdot \frac{\partial \phi_1}{\partial w_g} + \Big(-\frac{\partial \phi_1}{\partial \underline{\psi}}\Big) \cdot \frac{\partial \phi_2}{\partial w_g}\Big].$$

Notice that $\frac{\partial \phi_1}{\partial w_g} = 0$, hence

$$\frac{\partial Q^*}{\partial w_g} = \frac{\frac{\partial \phi_1}{\partial \underline{\psi}}\frac{\partial \phi_2}{\partial w_g}}{\frac{\partial \phi_1}{\partial Q}\frac{\partial \phi_2}{\partial \underline{\psi}} - \frac{\partial \phi_1}{\partial \underline{\psi}}\frac{\partial \phi_2}{\partial Q}}.$$

By Lemma A.3 $\lim_{\rho\to\infty} \frac{\partial \phi_1}{\partial Q}\frac{\partial \phi_2}{\partial \underline{\psi}} - \frac{\partial \phi_1}{\partial \underline{\psi}}\frac{\partial \phi_2}{\partial Q} = 1$. Thus,

$$\lim_{\rho\to\infty} \frac{\partial Q^*}{\partial w_g} = \lim_{\rho\to\infty} \frac{\partial \phi_1}{\partial \underline{\psi}}\frac{\partial \phi_2}{\partial w_g} = 0,$$

which contradicts $\lim_{\rho\to\infty} \tilde{n} < \infty$, as desired.

For part 2 let F^{w_g} be the equilibrium distribution of ψ for workers in government. To prove the result it is sufficient to show that if $w_g' > w_g$ then F^{w_g} first-order stochastically dominates $F^{w_g'}$. Specifically, we show that $F^{w_g}(\psi) \leqslant F^{w_g'}(\psi)$ for all ψ and it is strict for some ψ. By Lemma 5 we have that $\underline{\psi}_{w_g} > \underline{\psi}_{w_g'}$ for ρ large. Thus, for any $\psi < \underline{\psi}_{w_g'}$ we have $F^{w_g}(\psi) = 0 \leqslant F^{w_g'}(\psi) = 0$. For $\psi \in (\underline{\psi}_{w_g'}, \underline{\psi}_{w_g}]$ we have $F^{w_g}(\psi) = 0 < F^{w_g'}(\psi)$. Finally, consider $\psi > \underline{\psi}_{w_g}$. We have that F^w is given by

$$F^w(\psi) = \int_{\tau^*(\psi)}^{\infty} e^{-\delta\alpha} F_\alpha^w(\psi) d\alpha,$$
$$\text{where } F_\alpha^w(\psi) = \frac{G(\psi) - G(\overline{\psi}(\alpha))}{1 - G(\overline{\psi}(\alpha))}.$$

Letting $\tilde{n}$ be defined as in part 1 of the proof, we can write F^w as

$$F^w(\psi) = \int_{\tau^*(\psi)}^{\tilde{n}} e^{-\delta\alpha} F_\alpha^w(\psi) d\alpha + \int_{\tilde{n}}^{\infty} e^{-\delta\alpha} F_\alpha^w(\psi) d\alpha.$$

By construction of $\tilde{n}$ for $n \leqslant \tilde{n}$ $\frac{\partial \overline{\psi}^*}{\partial w_g} < 0$, thus $\tau_{w_g'}^*(\psi) < \tau_{w_g}^*(\psi)$. Therefore,

$$\int_{\tau_{w_g}^*(\psi)}^{\tilde{n}} e^{-\delta\alpha} F_\alpha^{w_g'} d\alpha + \int_{\tilde{n}}^{\infty} e^{-\delta\alpha} F_\alpha^w(\psi) d\alpha \leqslant F^{w_g'}(\psi).$$

Recall that $\lim_{\rho\to\infty}\tilde{n}=\infty$. On the other hand, $\lim_{\rho\to\infty}\tau^*(\psi)<\infty$ for $\psi<\infty$. Thus, for any government wage w

$$\lim_{\rho\to\infty}F^w(\psi)=\lim_{\rho\to\infty}\int_{\tau^*(\psi)}^{\tilde{n}}e^{-\delta\alpha}F^w_\alpha(\psi)d\alpha.$$

Therefore, a sufficient condition for $\lim_{\rho\to\infty}F^{w_g}$ FOSD $\lim_{\rho\to\infty}F^{w'_g}$ is

$$\begin{aligned}&F^{w_g}_\alpha<F^{w'_g}_\alpha \text{ for all } \alpha\in[\tau^*_{w_g}(\psi),\tilde{n}]\\&\Leftrightarrow G\Big(\overline{\psi}_{w'_g}(\overline{\psi}(\alpha))\Big)<G\Big(\overline{\psi}_{w_g}(\overline{\psi}(\alpha))\Big)\\&\Leftrightarrow \overline{\psi}_{w'_g}(\overline{\psi}(\alpha))<\overline{\psi}_{w_g}(\overline{\psi}(\alpha)),\end{aligned}$$

where the final inequality holds by $\frac{\partial\overline{\psi}^*}{\partial w_g}<0$ for all $\alpha\in[\tau^*_{w_g}(\psi),\tilde{n}]$ and $w'_g>w_g$. Because F^w is continuous in ρ, we have that if $w'_g>w_g$ then F^{w_g} FOSD $F^{w'_g}$ for all ρ sufficiently large.

For part 3, differentiating yields

$$\frac{\partial}{\partial w_g}\Big\{v(\tau^*)\cdot Q^*\Big\}=Q^*\frac{\partial\tau^*}{\partial w_g}v'(\tau^*)+v(\tau^*)\frac{\partial Q^*}{\partial w_g}.$$

Substituting for $\frac{\partial\tau^*}{\partial w_g}$ and simplifying this reduces to

$$v'(\tau^*)+\frac{\partial Q^*}{\partial w_g}\frac{v'(\tau^*)^2}{\delta+\rho}-v(\tau^*)\frac{v''(\tau^*)}{\delta+\rho}\frac{\partial Q^*}{\partial w_g}>0.$$

□

Proposition 6. *If ρ is sufficiently large, then increasing λ...*

1. *decreases the size of government S^* if and only if the entry effect is sufficiently large,*
2. *increases $\mathbb{E}[\psi_i|i \text{ in govt.}]$ if and only if the entry effect is sufficiently large,*
3. *and decreases $v(\tau^*(\psi))\cdot Q^*$ for all ψ.*

Proof. For part 1, differentiating we obtain

$$\frac{\partial S^*}{\partial\lambda}=\int_0^{\overline{n}}-e^{-\delta n}\frac{\partial\underline{\psi}^*}{\partial\lambda}g(\underline{\psi}^*)dn+\int_{\overline{n}}^{\infty}-e^{-\delta n}\frac{\partial\overline{\psi}^*}{\partial\lambda}g(\overline{\psi}^*(n))dn,$$

By ρ sufficiently large we have $\frac{\partial\underline{\psi}^*}{\partial\lambda}>0$ and $\frac{\partial\overline{\psi}^*}{\partial\lambda}<0$. The result then follows from the definitions of the entry and exit effects.

For part 2 let $F(\psi)$ be the equilibrium distribution of ψ in government under cooling-off period λ. We show that for any ψ that $\frac{\partial F}{\partial \lambda} < 0$ if and only if the entry effect dominates the exit effect. For $\psi > \underline{\psi}^*$ we have

$$F(\psi) = \int_0^{\tau^*(\underline{\psi}^*)} e^{-\delta n} \frac{G(\psi) - G(\underline{\psi}^*)}{1 - G(\underline{\psi}^*)} dn + \int_{\tau^*(\underline{\psi}^*)}^{\tau^*(\psi)} e^{-\delta n} \frac{G(\psi) - G(\overline{\psi}^*(n))}{1 - G(\overline{\psi}^*(n))} dn.$$

Differentiating yields

$$\begin{aligned}
\frac{\partial F}{\partial \lambda} = & \int_0^{\tau^*(\underline{\psi}^*)} -e^{-\delta n} \frac{\partial \underline{\psi}^*}{\partial \lambda} g(\underline{\psi}) \frac{1 - G(\psi)}{(1 - G(\underline{\psi}^*))^2} dn + \frac{G(\psi) - G(\underline{\psi}^*)}{1 - G(\underline{\psi}^*)} \Big(\frac{\partial \tau^*}{\partial \lambda} + \frac{\partial \tau^*}{\partial \psi} \frac{\partial \underline{\psi}^*}{\partial \lambda} \Big) e^{-\delta \tau^*(\underline{\psi}^*)} \\
& + \frac{\partial \tau^*}{\partial \lambda} \frac{G(\psi) - G(\overline{\psi}^*(\tau^*(\psi)))}{1 - G(\overline{\psi}^*(\tau^*(\psi)))} - \Big(\frac{\partial \tau^*}{\partial \lambda} + \frac{\partial \tau^*}{\partial \psi} \frac{\partial \underline{\psi}^*}{\partial \lambda} \Big) e^{-\delta \tau^*(\underline{\psi}^*)} \frac{G(\psi) - G(\underline{\psi}^*)}{1 - G(\underline{\psi}^*)} \\
& + \int_{\tau^*(\underline{\psi}^*)}^{\tau^*(\psi)} -e^{-\delta n} \frac{\partial \overline{\psi}^*(n)}{\partial \lambda} \frac{1 - G(\psi)}{(1 - G(\overline{\psi}^*(n)))^2} dn \\
= & \int_0^{\tau^*(\underline{\psi}^*)} -e^{-\delta n} \frac{\partial \underline{\psi}^*}{\partial \lambda} g(\underline{\psi}) \frac{1 - G(\psi)}{(1 - G(\underline{\psi}^*))^2} dn + \int_{\tau^*(\underline{\psi}^*)}^{\tau^*(\psi)} -e^{-\delta n} \frac{\partial \overline{\psi}^*(n)}{\partial \lambda} g(\overline{\psi}^*(n)) \frac{1 - G(\psi)}{(1 - G(\overline{\psi}^*(n)))^2} dn.
\end{aligned}$$

Thus, $\frac{\partial F}{\partial \lambda} > 0$ for $\psi > \underline{\psi}^*$ if and only if

$$\int_0^{\tau^*(\underline{\psi}^*)} -e^{-\delta n} \frac{\partial \underline{\psi}^*}{\partial \lambda} g(\underline{\psi}) \frac{1}{(1 - G(\underline{\psi}^*))^2} dn > \int_{\tau^*(\underline{\psi}^*)}^{\tau^*(\psi)} e^{-\delta n} \frac{\partial \overline{\psi}^*(n)}{\partial \lambda} g(\overline{\psi}^*(n)) \frac{1}{(1 - G(\overline{\psi}^*(n)))^2} dn. \tag{36}$$

If inequality (36) holds for all $\psi > \underline{\psi}^*$ then $\frac{\partial F}{\partial \lambda} \geqslant 0$ for all $\psi > \underline{\psi}^*$. The result then follows from the definitions of the entry and exit effects and first-order stochastic dominance.

For part 3, differentiating yields

$$\frac{\partial}{\partial \lambda} \Big\{ v(\tau^*) \cdot Q^* \Big\} = Q^* \frac{\partial \tau^*}{\partial \lambda} v'(\tau^*) + v(\tau^*) \frac{\partial Q^*}{\partial \lambda}.$$

Substituting for $\frac{\partial \tau^*}{\partial \lambda}$ and simplifying this reduces to

$$\frac{\partial Q^*}{\partial \lambda} \frac{v'(\tau^*)^2}{\delta + \rho} Q^* - v(\tau^*) \frac{v''(\tau^*)}{\delta + \rho} \frac{\partial Q^*}{\partial \lambda} Q^* < 0.$$

□

Proposition 7. *If worker i revolves at later tenure than worker j in equilibrium, then: (i) $F_{x\kappa} > 0$ implies $x_i^* > x_j^*$; whereas (ii) $F_{x\kappa} < 0$ implies $x_i^* < x_j^*$.*

Proof. Applying the implicit function theorem yields

$$\frac{\partial x^*}{\partial \tau^*} = -\frac{\int_0^\infty e^{-(\delta+\rho)} q_i^*(s) v'(\tau^*) F_{x\tau}(v(\tau^*) q_i^*(s), x^*) ds}{\int_0^\infty e^{-(\delta+\rho)} q_i^*(s) v'(\tau^*) F_{xx}(v(\tau^*) q_i^*(s), x^*) ds - c''(x)}.$$

The denominator is negative by assumption that $F_{xx} < 0$ and $c''(x) > 0$. Thus, $\frac{\partial x^*}{\partial \tau^*} \gtrless 0$ if $F_{x\tau} > 0$ and $\frac{\partial x^*}{\partial \tau^*} < 0$ if $F_{x\tau} < 0$. □

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