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Bureaucracy Intermediaries, Corruption and Red Tape

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Abstract

Intermediaries helping individuals and firms with the government bureaucracy are common in developing countries. Although such bureaucracy intermediaries are, anecdotally, linked with corruption and welfare losses, few formal analyses exist.

In our model, a government license can benefit individuals. We study individuals' net gain when acquiring the license through the regular bureaucratic procedure, through bribing or through intermediaries. For a given procedure, individuals using intermediaries are better off than if intermediaries and corruption had not existed. Intermediaries "grease the wheels". We then study incentives of corrupt bureaucrats to create red tape. When free to choose levels of red tape, bureaucrats implement more red tape and individuals are unambiguously worse off in a setting with intermediaries than with "direct" corruption only.

Intermediaries can thus improve access to the bureaucracy, but also strengthen incentives to create red tape - a potential explanation why license procedures tend to be long in developing countries.

JEL classification: D73; O12

Keywords: Bureaucracy, Corruption, Intermediaries, Red tape

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1 Introduction

Intermediaries that help individuals and firms with the government bureaucracy are present throughout the developing world. Yet, there is a limited understanding of what such bureaucracy intermediaries do. Although the prevalence of intermediaries is, anecdotally, linked with corruption in the government bureaucracy and a welfare loss, there are few formal analyses of the topic. On the empirical side, there is an almost complete lack of studies involving bureaucracy intermediaries.

This paper aims at filling a gap in the theoretical literature on bureaucracy intermediaries. In a model where individuals can get a benefit by going through a license procedure at the government bureaucracy, we study how individuals' net gain from the license is affected when the license can also be acquired through intermediaries. We study how the incentives of government bureaucrats to create red tape are affected when there are intermediaries, and what effects such "endogenous red tape" has on individuals' gain from the license.

The study focuses on one specific aspect of what intermediaries can offer individuals and firms - time saving. Individuals can acquire the license through the regular procedure, or by bribing corrupt bureaucrats to get a speedier treatment, or from an intermediary, each of which is associated with different time costs. From individuals' choice of how to acquire the license, we derive several interesting and novel results.

We first show that, ceteris paribus, individuals acquiring licenses through either corrupt bureaucrats or intermediaries are unambiguously better off than if corruption and intermediaries had not existed. Second, and importantly, we show that the incentives of bureaucrats to complicate bureaucratic procedures and add red tape differ in models with intermediaries. Bureaucrats find it optimal to create more red tape when there are intermediaries. Third, we show that, when corrupt bureaucrats can choose their "optimal" level of complication of the government bureaucracy, individuals' net gain is lower in a model with intermediaries than in a model with "direct" corruption only. In both cases, individuals' net gain from the license is, in turn, lower than in the case - without corruption and intermediaries - where the regular license procedure is (just) affordable to all individuals.

This paper is one of the first where the intermediary function is explicitly modeled. Individuals (and firms) are the clients of intermediaries, clients that demand licenses and permits from the government bureaucracy.[1] The intermediary has the technology to acquire these licenses and permits from the government bureaucracy, and can make a profit from the intermediation. In the

[1] In section 2, we document evidence on the prevalence of bureaucracy intermediaries in different parts of the world. Both individuals and firms use such intermediaries. The specific model in this paper is one of individuals' demand for intermediaries, a demand derived from time saving aspects. However, the model can be broadly interpreted to concern also firm demand for intermediaries.

paper, we study the impact from different degrees of competition between intermediaries on license allocations, incentives to create red tape and individuals' gain from licensing.

Time costs at the bureaucracy are fundamental for the analysis in this paper. The model is inspired by the fact, especially true in developing countries, that individuals and firms getting licenses typically have to spend considerable amounts of time in completing license procedures, including visiting multiple government offices at different locations and at different points in time.[2]

In the model presented, acquiring a license means completing a number of steps at the government bureaucracy. Each step of the procedure involves an interaction with a bureaucrat, is associated with a financial cost, a time cost of queueing and, importantly, a transport time cost. Individuals differ in their value of time. Bureaucrats are corrupt, meaning that they will, against bribe payments, let individuals skip the line at counters. Thereby, individuals avoid queueing time costs associated with the procedure. Transport time costs however, cannot be affected by corrupt bureaucrats. Intermediaries, on the other hand, act as a "one stop shop". Individuals go to the intermediary, fill in all relevant papers, pay a fee, and then get the license through no further interaction. From the perspective of the individual, all bureaucracy-related queueing and transport time costs are avoided.

For the purpose of the analysis in this paper, it is important to distinguish between different types of corruption. Here, corruption means "speed money". An individual can bribe a corrupt bureaucrat in order to not stand in a line, or use an intermediary (that in turn pays corrupt bureaucrats), which avoids time costs altogether. Bureaucrats thus accept speed money both directly - which lets individuals skip queues, and through intermediaries - which lets individuals avoid time costs altogether. The bureaucrat does his job however, in terms of making sure that the individual fulfills the necessary regulation.[3] We do not consider the case where corrupt bureaucrats and/or intermediaries allow undeserving individuals to obtain licenses or permits.[4]

[2] de Soto (1989) reported that starting a firm in Peru involved 11 different steps at 7 different government authorities. The procedure to obtain legal authorization to build a house on state-owned land involved 15 different steps at 6 different authorities, which in turn consisted of a total of 207 sub-steps at approximately 50 (sub-) offices/counters/desks. As reported in de Soto (2001), the formalization of property, or similar procedures, involved 168 steps in the Philippines, 77 in Egypt and 111 in Haiti. Since the writings of de Soto, the Doing Business project at the World Bank has documented procedures for starting firms, registering property, getting credit etc., in a large number of countries. For the very same procedure, the number of government offices that has to be visited, the time delays involved and the costs tend to be significantly higher in the developing world, compared to developed countries (World Bank, 2010).

[3] This is similar to what was termed "corruption without theft" by Shleifer and Vishny (1993). If a bureaucrat sells a passport for the official fee plus an additional fee (bribe), reports the issuance of the passport correctly and delivers the official fee to the government, corruption is "without theft".

[4] This paper has a different question than many recent studies of corruption and red

In addition, we need to distinguish "speed money" from "extortion". Extortion refers to the case when bureaucrats charge for doing their job at all. An individual has to pay an illegal fee in order to get a document that he/she is legally entitled to. Differently, in the case of "speed money", the option to stand in line the regular way still exists and the individual thus has the choice to not bribe.[5] The distinction between the two gets blurred however when there is "endogenous red tape", i.e. when corrupt bureaucrats have the choice of working slowly - thereby affecting individuals' incentive to pay speed money, as in Lui (1985), or affect the length/complexity of the bureaucratic procedure, as will be the case here.

Lui (1985) sets out to formally investigate what he calls the "Myrdal hypothesis", i.e. if corrupt bureaucrats have an incentive to slow down service. In Lui's model, the bureaucrat awards a license in a one-step procedure. The bureaucrat chooses a speed of service, i.e. how fast he works with each application, that is neither too fast - which would leave individuals in the queue with too much surplus even if they have a cost of waiting, nor too slow - which would make individuals choose to not queue (and bribe) at all.

In our model, bureaucrats do not choose a speed of service but can instead affect the length of the procedure. Many authors, e.g. Rosenn (1971), de Soto (1989), Tanzi (1998), La Porta et al. (1999), have hypothesized that bureaucrats deliberately create extra bureaucratic hurdles, or red tape, in order to extract bribes and, in addition, some have argued that such proceeds are channeled through intermediaries (Bertrand et al., 2008). As expressed by Rosenn, citing a typical Brazilian complaint regarding civil servants and the need to go through time consuming red tape; "êles criam dificuldades para vender facilidades (they create difficulties in order to sell facilities)" (Rosenn, 1971, p. 535).

We let n - the number of steps in the license procedure - which is first treated as an exogenous parameter, become a choice variable of the corrupt bureaucrats. In actual license procedures, we often observe that a multitude of offices have to be visited, documents should be stamped and certified, individuals have

tape. A typical question asked in the literature is how the existence of corruption – which arises from a principal/agent relationship - affects the allocation of (scarce) government benefits/licenses/permits, where the social benefit of allocating the permit to some (deserving) individuals is higher than allocating it to other (undeserving) individuals. In such settings, corruption means accepting bribes to let undeserving/unqualified individuals obtain benefits. Banerjee et al. (2009) provide a framework for studying the effects of corruption and the emergence of red tape in such settings. Additional references are also provided in this paper. Bertrand et al. (2008) document that in Delhi, India, using an intermediary/agent is the way to get a driver's license without actually learning how to drive. The result from this type of corruption is individuals with driver´s licenses but without proper driving skills. It involves a social cost which is not present in, and not the purpose of, the analysis in this paper. Here, all applicants are "deserving". The cost involved in the allocation of licenses is instead time costs at the bureaucracy. We study the impact of bureaucrats' acceptance of speed money and of the existence of intermediaries - both of which may reduce such time costs, on individuals' net gain from licensing.

[5] This distinction, important for the model in this paper, thus differentiates "speed money" from "corruption without theft" as analyzed by Shleifer and Vishny (1993) (see footnote 3).

to visit the same bureaucrat several times as the procedure progresses, etc. When endogenizing n, we thus have in mind corrupt bureaucrats that either have discretion over the actual implementation of the licensing procedure, or that lobby against legislators in order to influence n, or that channel some corruption proceeds to supervisors that have power over the implementation of the licensing procedure. We take the principal-agent relationship between the government and the corrupt bureaucrats as given and focus on how bureaucrats optimal choice of n differs between the cases with and without intermediaries. Comparing these optimally chosen n to a benchmark model without corruption and without intermediaries - we define as red tape any license steps in excess of the maximum regular procedure length that is affordable to all individuals.[6]

We assume "centralized corruption" (Shleifer and Vishny, 1993). All corrupt bureaucrats take one joint decision on bribe levels (and n). We first study the incentives to create red tape when there are no intermediaries, with results echoing those of Lui (1985). Importantly, we then proceed to study how bureaucrats' incentives to create red tape differ when there are intermediaries.[7] The effect from such endogenous red tape, on individuals' net gain from the license, is also addressed.

We start with a setting where intermediaries are perfect competition "downstream" firms, acquiring licenses from "upstream" profit maximizing corrupt bureaucrats. We explore how the degree of competition between intermediaries affect individuals' gains from licenses and incentives of bureaucrats to create red tape. Inspired by anecdotal evidence from several countries that an intermediary is typically a former bureaucrat, at the end of the paper we briefly speculate on how collusion between corrupt bureaucrats and a monopolist intermediary would affect result.

There are a few papers on bureaucracy intermediaries, somewhat related to this paper. Hasker and Okten (2008) analyze the impact from intermediaries on the degree of socially beneficial regulation that is de facto followed, when some bureaucrats accept bribes to reduce regulation for individuals. Similarly, Bose and Gangopadhyay (2009) analyze the effects of intermediaries on the amount of undeserving applicants that obtain licenses. In these models, the intermediary has an informational advantage over individuals, in that he knows which bureaucrats are willing to bend the rules (or accept undeserving individuals). This provides a clear rationale for individuals to use intermediaries.

In models with intermediaries having such an informational advantage, increased enforcement of corruption in the regular bureaucracy, higher penalties

[6] In our model, when we discuss the endogeneity of the length of the license procedure, red tape serves no other purpose than to extract rents. Related to footnote 4, see Banerjee et al. (2009) for a discussion of the function of red tape in models with deserving and undeserving individuals.

[7] In "Asian drama", Myrdal (1968) not only hypothesizes about the speed of bureaucratic service but also documents the existence of intermediaries.

for individuals that bribe bureaucrats, as well as increased uncertainty as to which are the corrupt bureaucrats, will typically act as an incentive to use intermediaries instead. Indeed, Hasker and Okten (2008) find that traditional means of combating corruption are less effective, and can even be counterproductive, when there are intermediaries. Bose and Gangopadhyay (2009) find, unsurprisingly, that the amount of undeserving applicants increases when there are intermediaries. In addition, in their model with endogenous queue lengths at counters, under certain conditions, not only undeserving but also deserving individuals will find the service of an intermediary useful, in locating corrupt (honest) bureaucrats.

Both papers provide a theoretical framework for the role of intermediaries observed in the Indian drivers' license context by Bertrand et al. (2008).[8]

The rest of the paper proceeds as follows: Section 2 presents stylized facts about bureaucracy intermediaries. Section 3 sets out the model, in which we first study license allocation absent corruption, then add corruption and intermediaries, after which we analyze incentives to create red tape. The main results of the paper are stated in two propositions in this section. Section 4 contains some model extensions/generalizations and section 5 concludes. All proofs are in the appendix in section 6.

2 Stylized facts about bureaucracy intermediaries

This section presents stylized facts about bureaucracy intermediaries in different parts of the world and provides a further rationale for the model to be presented.

Different types of intermediaries assisting with bureaucratic contacts are common throughout the developing world. Myrdal (1968) documents their existence in India and Oldenburg (1987) goes further with a more formal account of the role of intermediaries in a land consolidation program in Uttar Pradesh. Oldenburg identifies different roles of intermediaries within and outside the bureaucracy and details the functions of "brokers", "touts", "scribes", "consolidators", "helpers" and "barkers" within the land consolidation program. Levine (1975) documents the existence of intermediaries in the interface between the Ghanaian bureaucracy and firms and individuals.

[8] The present paper resembles these papers in that it contains the same three "actors", i.e. individuals, bureaucrats and intermediaries, but the type of corruption and the rationale for using the intermediary is different. In addition, the role of different degrees of competition between intermediaries is formally analyzed and we discuss two different forms of bureaucracy-intermediary interaction.

The prevalence of "despachantes", used in bureaucratic contacts in Brazil, is documented by Rosenn (1971) and, from a sociological and anthropological viewpoint, by DaMatta (1979, 1984). When studying the formalization of firms, Stone et al. (1996), Zylbersztajn and Graça (2003) and Zylbersztajn et al. (2007) provide evidence that using "despachantes" is the most common way to formalize a firm in Brazil. Husted (1994) describes how "coyotes" help individuals obtain drivers' licenses in Mexico. Such "coyotes" are an example of "tramitadores", a more general and widely used term for (mostly) informal intermediaries present in most of (Spanish-speaking) Latin America, assisting individuals and firms with bureaucratic procedures ("tramites"). Proética (2006) documents, for Peru, the degree of individuals' usage of "tramitadores" in different bureaucratic contacts. Lambsdorff (2002) refers to "tramitadores" helping out with the bureaucracy in El Salvador. Examples of reports documenting the use of such intermediaries by firms, at formalization are CIET (1998a, b) and IFC (2007b) for Bolivia, CIEN (2001) for Guatemala, IFC (2008) for Honduras and IFC (2007a) for Peru.[9] Gancheva (1999) describes the use of similar intermediaries by firms in Bulgaria.

Although none of the papers above, with the possible exception of Oldenburg (1987), is a specific study of intermediaries, they point at the different functions performed. In some settings, the main reason why individuals use bureaucracy intermediaries seems to be the intermediary's knowledge of how bureaucratic procedures actually work. In many countries with large and non-transparent bureaucracies, actually finding out what is required in order to get, say, a passport, is a challenge in itself. Rosenn (1971) writes: "The despachante functions effectively because he knows how to fill out the bewildering variety of forms, to whom the copies should be delivered, and what documentation will be required" (p. 537). Honduran firms claim that they use "tramitadores", when becoming formal, because of lack of unified information from the authorities regarding the formalization procedure (IFC, 2008). The same holds in a small sample of microenterprises in Guatemala (CIEN, 2001). For Bulgarian firms obtaining an operations permit, "the procedures are not clear, nor are they easily accessible to potential licenses applicants" (Gancheva, 1999, p. 22).

Time-saving in bureaucratic procedures is a related reason why individuals and firms use intermediaries. Data from the World Bank Enterprise surveys on senior management time spent in dealing with requirements of government regulation confirm that the time spent with regulation varies a great deal between different parts of the world. Whereas the OECD average is 1.2% of a work week, the world average is 7.5% and the Latin American/Caribbean average is 11.4% (World Bank, 2009). A 1996 report studying only a few countries showed similar values for the Latin American countries (World Bank, 1996). The numbers confirm earlier work by de Soto (1989).

[9] Another generic name, much in use in some parts of (Spanish-speaking) Latin America, for the type of intermediary in mind, is "gestor".

By frequent interactions, bureaucracy intermediaries learn how to handle the procedures at the government offices and can solve the bureaucratic matters faster than a particular individual or firm. The processing of many applications at the same time and having personal relations with bureaucrats are additional reasons why these intermediaries possess a "superior technology". As a result, the intermediary's cost for acquiring licenses are lower.

Furthermore, Stone et al. (1996) and Zylbersztajn and Graça (2003) indicate that firms use despachantes to become formal because these act much like "one stop shops". The time-saving achieved by using intermediaries thus consists of two parts: for intermediaries at the bureaucracy itself and for firms by eliminating the need to visit multiple offices. These two time-saving components are made explicit in the model in this paper.[10]

3 The model

Section 3.1 presents a model with individuals, that get a benefit if they go through a number of steps to acquire a government license, and a government bureaucracy, that awards the license. In section 3.2, we introduce corruption in the government bureaucracy, where bureaucrats accept bribes in order to let individuals avoid a time cost involved in getting the license. In section 3.3, intermediaries, allowing an alternative way to get the license, are introduced. In these first three sections, the procedure for getting the license is exogenously specified and we study what effect the introduction of corruption, and then intermediaries, has on license allocations and individuals' net gain from licensing.

Building on these results, we endogenize the number of steps that the license procedure consists of in section 3.4 and study bureaucrats optimal choice of the number of steps (or red tape). We perform this analysis for the settings with and without intermediaries, respectively, and study the effects on individuals' net gain from licensing.

The important assumptions made are pointed out along the way. Some of the assumptions are then relaxed or changed in section 4, where the main results of the paper are shown to hold also in alternative settings.

[10] From the supply side, one possible argument for the existence of bureaucracy intermediaries is that the government allows them to exist as a means of helping individuals and firms going through bureaucratic procedures. Bureaucracy intermediaries then become a "second best" option in societies where the government can do little to reform its bureaucracy. Another supply-side argument explaining their existence may be that intermediaries are easier to work with for bureaucrats because they "always have their papers in order". That is, the cost for handling applications from intermediaries is lower. Bureaucrats would then be able to serve more customers of the bureaucracy in less time, which would be socially beneficial.

3.1 Getting a license - the regular way

Consider a government license that brings a benefit of the value g to any individual. Acquiring the license means going through a bureaucratic procedure consisting of n different steps. Each step of the procedure consists of one visit to the government bureaucracy, where the individual interacts with a bureaucrat who is a monopolist in this step. The individual pays the official fee, and then proceeds to the next step of the procedure.

The bureaucracy's cost of completing the procedure for an individual, which is also the official fee for individuals, consists of two parts, $C + np$. The first part, C, is the cost that the bureaucracy faces in undertaking the controls associated with awarding the license, for instance checking relevant criminal and tax records, etc. The second part, p per step, is the bureaucracy's administrative cost of handling each application at each office.[11] We need $g - (C + np) \geq 0$ to make the license procedure beneficial, which can be expressed as $n \leq n_{\max} \equiv \frac{g-C}{p}$.

Individuals also face time costs in going to the bureaucracy. These time costs are "standing in line", represented by k, and transport time, represented by t, for each step. Individuals differ in how much they value time ("productivity"), parametrized as $0 \leq A^i \leq 1$, such that the total time cost of getting the license is $A^i nk + A^i nt$. Throughout the analysis, p, k and t will be positive and treated as exogenous parameters.[12]

An individual will acquire the license if the following condition is fulfilled:

$$g - (C + np) - A^i (nk + nt) > 0 \qquad \Longleftrightarrow \qquad A^i < \tfrac{g-(C+np)}{nt+nk}. \tag{1}$$

Individuals below the productivity threshold in (1) will thus acquire the license.[13]

[11] The division of costs into two parts reflects the fact the there are, for good reasons, socially relevant checks or controls or registration (reflected by C) that need to be undertaken in order to correctly award licenses, but the bureaucracy's implementation of how to perform these controls may differ however (reflected by np). An individual starting a firm, for example, typically has to register it with the tax authorities and with employment records. In some countries, this is done jointly in one place, in other countries this is done at two or several more offices. We can think of p as the costs of handling each application at each office, such as remuneration costs of staff, costs for office space, office equipment, office supplies etc. Although of no importance for the analysis, we can think of C as evenly split between all steps of the license procedure, i.e. C/n per step.

[12] The specification of costs of the license as $np + A^i nk + A^i nt$, rather than $p + A^i k + A^i t$, underlines that it is variations in n that will represent red tape below. This is different from e.g. Lui (1985) in which there is only one bureaucrat that chooses how fast to work (this would affect k in the present model) and from Bose and Gangopadhyay (2009), where the waiting times at the bureaucracy depend on the total number of applicants for licenses (this would also affect k).

[13] Except for queueing and transport time costs, in real license procedures there are also time costs related to waiting for the application to be approved and hence for the gain of the license to be realized. Such time costs, and differences in such costs depending on what channel is used to get the license, are not explicitly modeled in this paper.

Before proceeding, we make an assumption - briefly referred to in the introduction - to which we will return in section 3.4. For good reasons, license procedures consist of various complementary steps. Different government authorities, e.g. the police and the tax authorities, need to be involved in license procedures such as getting an ID or starting a firm. We assume, however, that the license procedure, in a setting without any bureaucratic corruption, would be such that all individuals can acquire the license. This is a plausible requirement for a government that desires to award the license in the first place - the procedure should not be too complicated. Let the maximum length of such a license procedure be n^*. Setting $A^i = 1$ in (1), the assumptions becomes

$$n^* \leq \frac{g-C}{p+t+k}. \tag{2}$$

Condition (2) is not a parameter restriction in the paper, it is a condition we assume a government interested in awarding licenses would adhere to. We return to the assumption in section 3.4.

3.2 A corrupt bureaucracy

Now assume that bureaucrats are willing to accept a bribe b in order to let the individual avoid the time cost of standing in one line ($A^i k$). By bribing, the individual can thus avoid a total queueing time cost of $A^i nk$.[14] As stressed in the introduction, bribing means paying "speed money", and the option of instead waiting in line and pay the official fee $C + np$ still exists. Furthermore, assume that bureaucrats, when taking bribes, can not price discriminate between individuals with different value of time. This is an important assumption in the paper, used throughout the analysis.

In characterizing bureaucrats' decisions on the bribe level b, the assumption of centralized corruption will be used (Shleifer and Vishny, 1993). The corrupt bureaucrats take one joint decision on bribe levels, and then split the revenue equally between them. Define this total bribe level as $B \equiv nb$.[15]

Having the option to pay speed money, the individual prefers to do so if the following condition is satisfied:

[14] We thus assume that all bureaucrats are corrupt. In section 4.2, we discuss, in the context of red tape, what changes if not all bureaucrats are corrupt.

[15] Note that we do not specify how many bureaucrats are responsible for the n exogenously specified steps of the bureaucratic procedure. We can imagine both a license procedure where the license applicant goes to n different government offices/counters/desks and faces n different bureaucrats, or a procedure where the applicant goes "back and forth" to a smaller number of offices/counters/desks with fewer than n bureaucrats in total (but still with n steps in the procedure). Irrespective of the number of bureaucrats, we model all as corrupt, i.e. all bureaucrats accept speed money. Another remark on the choice of model is that whether n is continuous or discrete does not matter for results. It would matter only if we chose to model corruption as decentralized, in the sense of Shleifer and Vishny (1993), which would be difficult to reconcile with our analysis of red tape in section 3.4.

$$g - B - A^i nt > g - (C + np) - A^i (nk + nt) \qquad \Longleftrightarrow \qquad A^i > \tfrac{B-(C+np)}{nk}. \quad (3)$$

The LHS in the first inequality is the net gain of the license when bribing, the RHS is net gain of going through the regular procedure.

Either all individuals with a value of time above the threshold in expression 3 bribe, or it will be too costly for the highest productivity individuals to face the remaining time cost $A^i nt$. The individual would then prefer to not get the license at all. In this case, the upper bribe threshold is given by the condition

$$g - B - A^i nt > 0 \qquad \Longleftrightarrow \qquad A^i < \tfrac{g-B}{nt}. \quad (4)$$

Intuitively, the larger is n, the larger are time costs and the more likely the upper threshold from expression 4 is too bind.

The corrupt bureaucrats have a total cost of completing the license of $C+np$. The joint profit maximization problem of bureaucrats thus becomes:

$$\text{Choose } B \text{ to Max } \pi_B = (B - (C + np)) \left(\text{Min} \left\{ 1, \tfrac{g-B}{nt} \right\} - \tfrac{B-(C+np)}{nk} \right). \quad (5)$$

From the intuition above regarding time costs for large values of n, and the resulting change in threshold in the demand function, we can expect the solution of the problem to be different for different regions of n. Solving the problem is straightforward, the few steps of the solution are in appendix 6.1. We get[16]:

$$B^* = (C + np) + \frac{nk}{2} \text{ if } 0 \leq n \leq n_1 \quad (6A)$$
$$B^* = g - nt \text{ if } n_1 \leq n \leq n_2 \quad (6B)$$
$$B^* = (C + np) + \tfrac{g-(C+np)}{2(1+t/k)} \text{ if } n_2 \leq n \leq n_{\max} \quad (6C)$$

The four panels of figure 1 display the solution to the problem, as a function of n. The general properties of the solution, displayed in the graphs and discussed below, do not depend on the parametrization of the problem.

Panel A shows the optimal bribe level B^* as a function of n. Panel B shows, for each value of n, the range of individuals that bribe (dark shaded area), the range of individuals that get the license the regular way (below the shaded area) and those that do not get the license at all (above the shaded area). For small values of n (expression 6A), bureaucrats can increase the bribe level linearly in n without losing any demand. Independent of the parametrization, all individuals with productivity levels above $A^i = 1/2$ will bribe rather than stand in line. The optimal bribe level, $B^* = (C + np) + \frac{nk}{2}$, with a mark-up $\frac{nk}{2}$ over cost, shows that bureaucrats capture part of the surplus related to individuals' time saving through bribing. For future reference, note that the n-range for which bureaucrats optimally choose a markup $\frac{nk}{2}$ over cost extends up

[16] $n_1 = \dfrac{g - C}{p + t + k/2}$, $n_2 = \dfrac{g - C}{p + t + k/(2 + k/t)}$, $n_{\max} = \dfrac{g - C}{p}$

to $n_1 = \frac{g-C}{p+t+k/2}$, i.e. beyond the maximum value of n for which all individuals would acquire a license, absent corruption (expression 2).

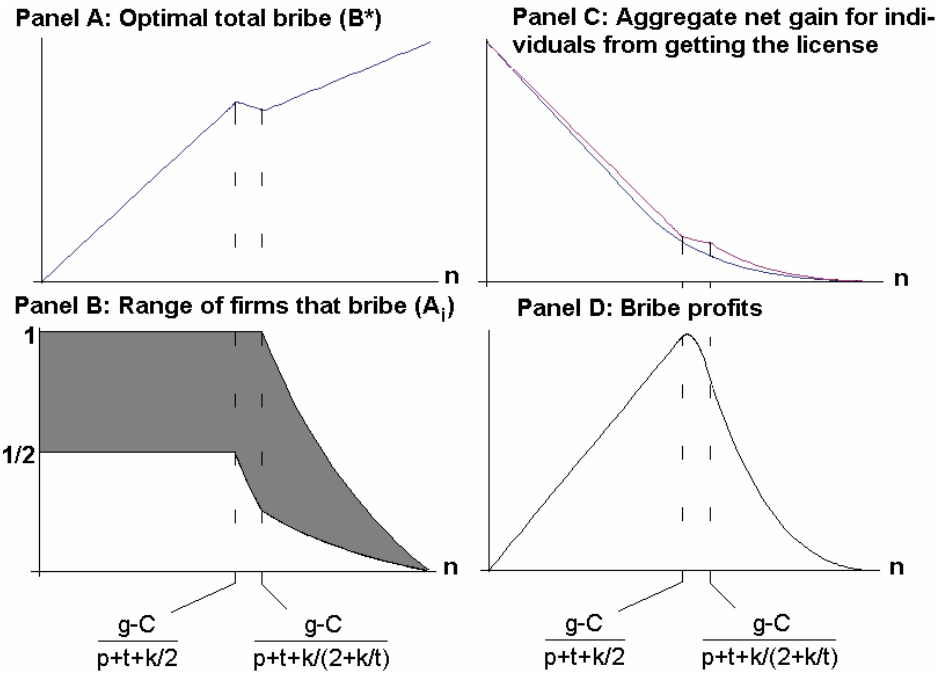

Figure 1. The solution to the license allocation problem with corruption: optimal bribe, range of firms that bribe, individuals' aggregate net gain from acquiring the license and bribe profits.

For somewhat larger values of n, the optimal bribe level decreases with n. Thereby the corrupt bureaucrats induce a larger share of all individuals to bribe. This is expression 6B and the intermediate n-range. For even larger values of n, the fact that the time cost $A^i nt$ is still present for firms that bribe dominates, and individuals with a high vale of time will not acquire the license at all. Individuals with a low value of time, that would stand in line for smaller values of n, now bribe in order to avoid $A^i nk$. The largest n for which any individual would get the license, through the regular way or bribing, is $n_{\max} = (g - C)/p$.

Individuals' net gain from acquiring the license, aggregated for all individuals, is shown in panel C.[17] In this panel, the aggregate net gain in the case of

[17] An important remark at this point is that we study how a rent-seeking/corrupt bureaucracy affects individuals and have therefore chosen to work with individuals' net gain from the license as the main outcome of interest. This would be equivalent to a welfare measure if bribes and fees to intermediaries (in excess of $C + np$) were a social waste. If bribes and fees to intermediaries were instead considered transfers without any welfare impact per se (i.e. if we had no distributional concerns), the total value of time spent in queueing + transport constitutes an alternative welfare measure.

no corruption has been included as well (lower lying curve). The graph shows a result that holds generally: individuals are better off when the possibility to bribe exists. The following lemma states this point:

Lemma 1: For any combination of the exogenous parameters g, C, p, k, t and n, no individual is worse off when the possibility to bribe exists, compared to the case when there is only the regular bureaucracy, and some individuals are better off.

The lemma follows directly from the fact that individuals now have one more choice of how to acquire the license, and the regular way of acquiring the license still exists. No individual can thus be worse off. All individuals that bribe - and there will be some such individuals due to bureaucrats' profit maximization - will be better off than they were when the option to bribe did not exist. In fact, the higher productivity an individual has, the larger is the gain from bribing (because bureaucrats cannot price discriminate).[18]

Lemma 1 thus states that corruption is good: the possibility to pay "speed money" means that (some) individuals can get the license at a lower total cost.[19] It is a formalization of the "grease the wheels" view of corruption, see e.g. Bardhan (1997) and Svensson (2005) for a discussion and early references.[20]

It is important to note at this stage that we have treated all parameters as exogenous. If bureaucrats can control for instance k or n, i.e. if bureaucrats can in some way manipulate queueing times at the bureaucracy - and thereby extract a higher surplus from individuals, then lemma 1 no longer applies.

Related to the discussion in the preceding paragraph, Panel D shows total bureaucracy bribe profits. It shows that total bribe profits are higher for higher n, but only up until a certain point. For large n, the remaining time costs $A^i nt$ become too high, few individuals will acquire the license, and profits fall. Profits are maximal in the intermediate n-range. We postpone a discussion of bureaucrats controlling n - as well as further discussion of lemma 1 - until intermediaries have been introduced.

[18] See appendix 6.2 for a formal statement of the difference in individuals' aggregate net gain from the license between the "regular bureaucracy case" from section 3.1 and the "corruption case" from section 3.2.

[19] In addition, for $n > n^*$, more individuals will get the license than in the case with the regular bureaucracy only (this comparison with the regular bureaucracy case is not shown in figure 1B).

[20] In the paper by Lui (1985), individuals with higher value of time pay higher bribes and get more favorable positions in the queue at the one bureaucrat, i.e. a form of welfare improving "speed money".

3.3 A corrupt bureaucracy and intermediaries

We now add to the model the third alternative available to individuals to get the license, intermediaries. Individuals pay intermediaries a fee, and obtain the license. There are no time costs involved for the individual, and the time saving obtained by this alternative constitutes a surplus from which bureaucrats and intermediaries can profit.[21]

As documented in section 2, intermediaries have access to a better technology in acquiring the license from the government bureaucracy. We model this as intermediaries having no cost, other than what bureaucrats charge, in acquiring the license.[22] We assume all intermediaries are identical. Importantly, and as also assumed for the interaction between bureaucrats and individuals, intermediaries cannot price discriminate between individuals and hence charge the same fee to all individuals.

Bureaucrats charge intermediaries a profit maximizing price for the license. We continue to assume that bureaucrats take one centralized decision, and then split the revenue between them.

Events proceed as follows. Bureaucrats choose two bribe levels, $B = nb$ and $B_d = nb_d$, that individuals that bribe and intermediaries, respectively, will face when acquiring the license. These levels are taken as given by individuals and intermediaries. Second, all intermediaries simultaneously choose a license fee, d, that individuals using intermediaries will pay (the license fee is equal between intermediaries due to symmetry). Third, individuals choose if and through which means to acquire the license.

We start with the assumption that there is perfect competition between intermediaries. This will be modified later, allowing both for oligopolistic competition between intermediaries as well as a brief discussion of collusion between bureaucrats and a monopolist intermediary. Although modeling the intermediaries' sector explicitly is one of the novelties of this paper, the alternative specifications explored do not affect the main results presented in this section, and is therefore postponed.

With no other cost than what bureaucrats charge, and with perfect competition between intermediaries, each intermediary simply sets a price $d = B_d$, i.e. the total cost for the intermediary of acquiring the license from the corrupt bureaucracy.

Individuals that go to an intermediary avoid time costs altogether, and get a net gain from the license of $g - d = g - B_d$. Individuals therefore choose to use the intermediary, rather than bribe, if the following condition is satisfied:

$$g - d > g - B - A^i nt \qquad A^i > \tfrac{d-B}{nt} \left(= \tfrac{B_d - B}{nt}\right). \tag{7}$$

[21] Adding a small time cost for individuals at the intermediary would not change the qualitative results and is therefore omitted.

[22] Adding a small time cost for intermediaries at the bureaucracy would not change the qualitative results and is therefore omitted.

As before, individuals with productivity higher than $\frac{B-(C+np)}{nk}$ bribe rather than use the regular bureaucracy (expression 3). Corrupt bureaucrats choose the two bribe levels, B and B_d, in order to maximize profits. Intuitively, as individuals save more time from using the intermediary than from bribing, and as there is no mark-up in the intermediaries' sector, the joint surplus between individuals and bureaucrats is larger when intermediaries are used. Formally, the corrupt bureaucrats' profits are the sum of "direct" and "indirect" bribe profits. As before, the total cost of completing the license is $C + np$, and bureaucrats solve the following problem:

$$\begin{array}{l}\text{Choose } (B, B_d) \text{ to} \\ \text{Max } \pi_B = (B - (C + np)) \left(\frac{B_d - B}{nt} - \frac{B-(C+np)}{nk} \right) + (B_d - (C + np)) \left(1 - \frac{B_d - B}{nt}\right) \\ \text{subject to } B_d \leq g \end{array} \quad (8)$$

where the first term in π_B is "direct" profits from individuals bribing to avoid the queueing cost $A^i nk$ and the second term is "indirect" profits coming from individuals using intermediaries. The constraint comes from the fact that the price of intermediaries, d, cannot become larger than g.

The solution, derived in appendix 6.3, is:

$$B^* = (C + np) + \tfrac{nk}{2},\ B_d^* = B^* + \tfrac{nt}{2},\ d^* = B_d^* \ \text{ if } \ 0 \leq n \leq \tfrac{g-C}{p+(k+t)/2} \quad (9A)$$

$$B^* = (C + np) + \tfrac{g-(C+np)}{1+t/k},\ B_d^* = d^* = g \ \text{ if } \ \tfrac{g-C}{p+(k+t)/2} \leq n \leq \tfrac{g-C}{p} \quad (9B)$$

The four panels of figure 2 display the solution to the problem, as a function of n, for the same parametrization as was used in figure 1.[23] Panel A shows the optimal bribe levels B^* and B_d^* (which is larger) as functions of n. Panel B shows, for each value of n, the range of individuals that use intermediaries (light shaded area) and the range of individuals that get the license the regular way (below the shaded area).

The first thing to note about the solution, as hypothesized above, is that no individual will bribe. The bureaucrats optimally set B^* and B_d^* such that individuals choose to use intermediaries rather than bribe.[24] Although the focus here is not on anti-corruption policies, it is interesting to note that all corruption proceeds gets channeled through intermediaries. From panel B, we can also infer that all individuals, irrespective of the value of n, will always get a license, this is due to the removal of time costs and is different from the corruption-only case.

[23] As in the corruption only-problem, the general properties of the solution, displayed in the graphs and discussed below, do not depend on the parametrization of the problem.

[24] By plugging in the optimal B and B_d into the threshold between the regular bureaucracy and bribing, $\dfrac{B - (C + np)}{nk}$, on the one hand, and the threshold between bribing and using intermediary, $\dfrac{B_d - B}{nt}$, on the other hand, we see that in the optimum these thresholds are equal, i.e. nobody bribes. This holds for both expressions 9A and 9B.

For small values of n (expression 9A), the direct bribe is set as in the corruption-only case. The indirect bribe, which is always larger than B^* (panel A), becomes $B_d^* = (C + np) + \frac{nk+nt}{2}$, i.e. has a mark-up of $\frac{nk+nt}{2}$. This markup is proportional to the time saving individuals get when going to the intermediary. Individuals with productivity above $A^i = 1/2$ will get the license through intermediaries, individuals with lower A^i get it through the regular bureaucracy (displayed in panel B). Similar to the corruption only case, note that the n-range for which bureaucrats optimally choose an indirect bribe with a markup $\frac{nk+nt}{2}$ over cost extends up to $n = \frac{g-C}{p+(k+t)/2}$, i.e. beyond the maximum value of n for which all individuals would acquire a license, absent corruption (expression 2).

For larger values of n, the optimal B_d^* becomes bounded by the fact that the intermediary price d cannot exceed the gain of the license g. The optimal direct bribe level B^* is set higher than in the corruption-only case (expression 9B vs. expression 6C), which makes direct bribing less attractive than in the corruption-only case. All individuals with productivity higher than $A^i = \frac{g-(C+np)}{nk+nt}$, the downward-sloping curve in panel B, get the license through intermediaries. Individuals with lower productivity get the license through the regular bureaucracy.

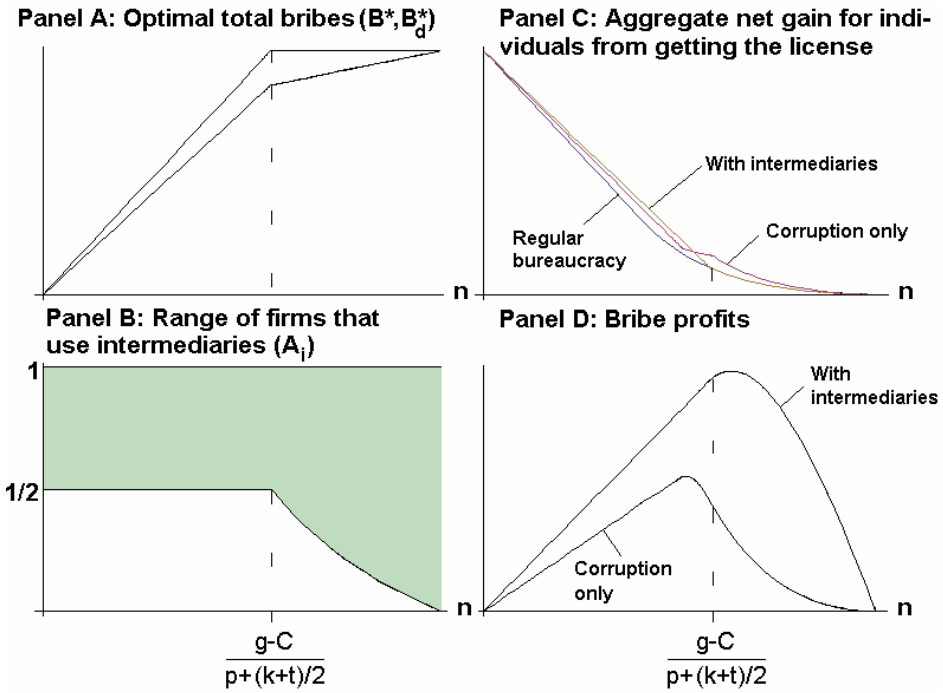

Figure 2. The solution to the license allocation problem with corruption and intermediaries: optimal bribes, range of firms that use intermediaries, individuals' aggregate net gain from acquiring the license and bribe profits.

In panel C of figure 2, the aggregate net gain of individuals from acquiring the license in the model with intermediaries is shown. The regular bureaucracy and corruption-only curves (from figure 1) are displayed as well. The graph displays a general result, formalized in the following proposition:

Proposition 1: A) For any combination of the exogenous parameters g, C, p, k, t and n, no individual is worse off when the possibility to use the intermediary exists, compared to the case when there is only the regular bureaucracy. For small values of n, some individuals are better off and individuals' aggregate net gain of the license is thus higher with intermediaries. **B)** For small values of n, individuals' aggregate net gain is higher with intermediaries than with direct corruption only, for large values of n the opposite holds.

Proposition 1A follows from a reasoning similar to the reasoning after lemma 1: given that individuals can always go to the regular bureaucracy, an additional choice cannot make them worse off. For small n, individuals that use intermediaries get a share of the joint surplus related to time saving (which is proportional to $nk + nt$). The presence of intermediaries and corruption thus "greases the wheels", and individuals are better off than with the regular procedure only.

Proposition 1B follows, for small n, from the fact that individuals are better off using intermediaries (to avoid $A^i nk + A^i nt$) than bribing (to avoid $A^i nk$): the surplus to be divided between bureaucrats and individuals is larger. For large n, bureaucrats set B high enough such that noone bribes directly, and set B_d such that individuals pay $d = g$ to intermediaries. Bureaucrats therefore extract the entire surplus. In the direct corruption case, individuals pay a lower bribe than their valuation of the license, and bureaucrats can not extract the entire surplus.[25]

The main message from proposition 1 (and lemma 1) thus is that, for an exogenously determined license procedure, the existence of "speed money" and intermediaries makes individuals better off.

Panel D reveals two important properties of corrupt bureaucrats' profits. First, profits are higher when there are intermediaries. The total surplus available from individuals' time saving is larger when intermediaries can be used to avoid not only the time cost of queueing but also the transport time cost. Second, when there are intermediaries, bureaucrats profits peak at a larger n. We now turn to a formal analysis of these statements, and their implications on individuals' gain from the license.

[25] See appendix 6.4 for a formal statement of the difference in individuals' aggregate net gain from the license, comparing the case with intermediaries with the previous two cases.

3.4 Incentives to create red tape

Thus far, we have considered the problem that bureaucrats face when maximizing revenue from "speed money", *given* a license procedure. That is, the implementation of the license procedure, i.e. the exact number of checks and controls, documents to be filled in, stamps to be obtained etc., represented by n, has been exogenously determined.

However, if the corrupt bureaucrats can affect the way in which the license procedure is implemented, the analysis changes significantly. In actual license procedures, it is not uncommon that the same bureaucrat has to be visited several times, that application documents have to be certified/authenticated several times, that the individual herself has to deliver and pick up papers at an office on different days and times with varying opening hours, and so on (Rosenn, 1971; de Soto, 1989). As motivated in the introduction, we take the view that corrupt bureaucrats, while still obeying all rules and facing the cost C - i.e. performing all relevant checks related to awarding the licenses, are free to choose how the procedure is implemented. That is, bureaucrats choose the number of steps n of the procedure. We define as red tape the difference between the n that maximizes profits, and n^* from section 3.1, i.e. the maximum license procedure length for which all individuals would acquire the license, absent corruption and intermediaries.

In choosing n, corrupt bureaucrats face the costs of making the procedure longer, i.e. np. The profit maximization problems (5) of section 3.2 and (8) of section 3.3 do not change per se, the only difference is that n is now a choice variable. We get

Corruption only:
Choose (B, n) to Max $\pi_B = (B - (C + np)) \left(\text{Min} \left\{ 1, \frac{g-B}{nt} \right\} - \frac{B-(C+np)}{nk} \right)$

With intermediaries:
Choose (B, B_d, n) to
Max $\pi_B = (B - (C + np)) \left(\frac{B_d - B}{nt} - \frac{B-(C+np)}{nk} \right) + (B_d - (C + np)) \left(1 - \frac{B_d - B}{nt} \right)$
subject to $B_d \leq g$. (10)

The problems are solved in appendix 6.5. The maximal profit, as can be guessed from the graphs above, pertains to the middle-n region (from 6B) in the case without intermediaries, and in the large-n region (from 9B) in the case with intermediaries. We are primarily interested in the optimal n for each of the two problems. The main result is summarized in proposition 2, in which we compare the solution of the model with intermediaries (n_{i}^*) to the solution when there is direct corruption only (n_{c}^*). In addition, we relate to the threshold n^* from section 3.1, i.e. the maximum length of the procedure for which all individuals will acquire a license, absent corruption and intermediaries.

Proposition 2: A) The profits of corrupt bureaucrats peak at a larger n when there are intermediaries, i.e. $n_{\text{i}}^* > n_{\text{c}}^*$. **B)** The maximal profits of corrupt bureaucrats are larger when there are intermediaries. **C**) Individuals' net gain from the license is lower when there are intermediaries (at n_{i}^*) than with direct corrupt only (at n_{c}^*), which is in turn lower than the net gain when there is only the regular procedure of length n^*.

As shown in appendix 6.5, the optimal n-values are $n_{\text{c}}^* = \frac{g-C}{\sqrt{(p+t)(p+k+t)}}$ and $n_{\text{i}}^* = \frac{g-C}{\sqrt{p(p+k+t)}}$. The latter is larger as long as $t > 0$. That is, we get more red tape when there are intermediaries. The intuition behind this result is as follows: In both cases, bureaucrats face increased costs np as n increases. In choosing the optimal n, the marginal cost increase is compared to the marginal revenue increase. With intermediaries, the increase in individuals' transport time costs from increases in n is a source of revenue not present in the direct corruption case. For any n, the marginal revenue from increasing n will then be larger when there are intermediaries, and thus the optimal n larger. The existence of t also explains why maximal profits are higher in the case of intermediaries.[26]

What proposition 2A-2B tells us is that there is an additional incentive to "add steps", i.e. create red tape, to the license procedure when there are intermediaries. While panel D of our figure 1 indicates a result similar to that of Lui (1985)[27], i.e. that bureaucrats maximize revenue by choosing an optimal number of steps (here) or an optimal speed of service (Lui), here we say something more. We show that time-related costs that cannot be directly affected by the bureaucrat will further strengthen, through the presence of intermediaries, the incentive to complicate/slow down/add red tape. Bureaucrats find it optimal to create more red tape when there are intermediaries.

Proposition 2C says that such additional red tape hurts individuals. In the corruption only case, at n_{c}^*, all individuals get the license and are left with some surplus. With intermediaries, at n_{i}^*, individuals using the service pay exactly their valuation of the license, hence only individuals that use the regular bureaucracy are left with some surplus. That the aggregate net gain is lower is shown to be unambiguously true in appendix 6.5.

Proposition 2C says something more however: If there were no corruption possibilities, and if the procedure was just as complex so that all individuals could afford it (n^*, condition 2), individuals would still be better off than at n_{c}^* in the direct corruption case.[28] The addition of red tape to the procedure thus more than offsets the gain from paying speed money.[29] Corruption hurts, corruption and intermediaries hurts more.

[26] Again, see appendix 6.5 for a formal statement of profit levels and a comparison of the two cases.

[27] Figure 2, page 773 of Lui (1985).

[28] Hence also better off than at n_{i}^* in the model with intermediaries.

[29] This result, which also is formally proven in appendix 6.5, can be further explained as follows. Compare the smallest n, with and without corruption, in which the highest productivity individual is just indifferent between getting a license and not getting it. That is, compare a

4 Extensions

Above, we have assumed perfect competition between intermediaries, resulting in no mark-up from the sector itself. Hasker and Okten (2008) motivate the same assumption, reasoning that "since the market for intermediaries is informal, generally without government license or even recognition, and without high fixed costs, we assume that this market is competitive" (p 105). Whereas in some countries and settings this seems the most plausible starting assumption, it need not be the typical case. In general, there are some entry costs into learning license procedures, getting to know the bureaucrats, setting up an office, building a clientele, etc. In section 4.1, we study the implications on individuals' net gain and bureaucrats' red tape incentives when there is imperfect competition between intermediaries.

Another assumption from above is that all bureaucrats are corrupt. Although we have ruled out extortion, it is perhaps unrealistic that all bureaucrats accept "speed money". In section 4.2, we discuss what happens when not all bureaucrats accept speed money. This adds additional insight with respect to corrupt bureaucrats' rent extraction possibilities. Finally, in section 4.3, we briefly speculate on an alternative setting of bureacrat-intermediary interaction, collusion.

4.1 Oligopolistic competition between intermediaries

Assume the intermediation sector is characterized by Cournot competition. This makes it possible to study the effects of a mark-up in a simple way. Assume there are x intermediaries. The sequence of decisions between bureaucrats, intermediaries and individuals is as before, but we need to detail the choice of d within the intermediary sector. As is standard in Cournot competition, each intermediary simultaneously makes a quantity choice of how many licenses to handle, taking the quantity choices of the $x-1$ other intermediaries as given. This, in turn, results in a mark-up from the intermediary sector, over B_d, which is a decreasing function of x. The formulation and solution to this problem is

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briber's net gain at $n_1 = \frac{g-C}{p+t+k/2}$ with the net gain of an individual that, absent corruption, faces a license procedure of length $n^* = \frac{g-C}{p+t+k}$. To simplify, assume that t is very small, i.e. we have $n_1 \approx \frac{g-C}{p+k/2}$ and $n^* \approx \frac{g-C}{p+k}$. We know from above that the optimal bribe in 6A is $B^* = (C+np)+\frac{nk}{2}$. At n_1, any briber's net gain, $g-B^*-A^i nt$, after plugging in n_1 and simplifying, would be (almost) zero. Due to the removal of queueing time costs, the bureaucrat can extract a larger surplus from each individual. In the regular bureaucracy case at n^*, any individual $A^i < 1$ is left with a larger surplus. The intuition remains the same for a positive t - the removal of some time costs allows the bureaucrat, when free to choose n, to extract a larger part of each individuals' surplus.

straightforward - the main change being the introduction of an additional vertical markup (or a vertical externality) that reduces demand for intermediaries.[30] The solution is

$$B^* = C + np + \frac{nk}{2},\ B_d^* = B^* + \frac{nt}{2},\ d^* = B_d^* + \frac{nt}{2+2x} \quad \text{if} \quad 0 \leq n \leq \frac{g-C}{p+\frac{k+t}{2}+\sqrt{\frac{t(k+t)}{4(1+x)}}}$$

$$B^* = C+np+\frac{g-(C+np)}{1+t/k},\ B_d^* = d^* = g \text{ if } \frac{g-C}{p+\frac{k+t}{2}+\sqrt{\frac{t(k+t)}{4(1+x)}}} \leq n \leq \frac{g-C}{p} \quad \text{(11A-11B)}$$

For small n, the price of intermediaries is higher than before. As a result, the productivity threshold above which individuals use intermediaries shifts up and the same individuals will instead bribe.[31] As bureaucrats gain less corruption profits from a briber than they would do if the individual would instead use an intermediary, total bureaucracy profits go down for small n. This in turn makes it profitable for bureaucrats to shift to $B_d^* = g$ at a lower n than previously, which explains the new n-threshold. Above the threshold, noone bribes. Note that expressions 11A-11B converge to 9A-9B as $x \to \infty$.

Although there is now a mark-up in the intermediary sector, proposition 1 still holds. It continues to be true that the additional choice of intermediaries cannot make individuals worse off, proposition 1A thus holds. For small sizes of n, individuals still gain more from using intermediaries than from bribing, hence proposition 1B also holds.[32] As a result of higher prices at intermediaries however, the aggregate net gain for individuals, is lower the lower is the degree of competition between intermediaries. It is formally proven to hold in appendix 6.6 and summarized in corollary 1:

Corollary 1: Individuals are always (at least weakly) better off the larger is the degree of competition between intermediaries (i.e. the larger is x).

This result is intuitive. It follows from the fact that intermediaries perform a function that is beneficial for individuals (it removes time costs), and the more competition between intermediaries the less individuals have to pay for the time saving. In models where intermediaries have functions different than here, such as facilitating rule-breaking (Hasker and Okten, 2008; Bose and Gangopadhyay, 2009), competition between intermediaries is likely detrimental.

In addition, because the solution in 11B is identical to 9B, and knowing that profits peak in this large-n region, endogenizing n gives the same result as in proposition 2. That is, bureaucrats' incentive to add red tape has not changed from the introduction of intermediaries.

[30] See appendix 6.6 for a formal statement of the profit maximization problems.

[31] For instance, for small n, with $x = 1$, we get a bribe-bureaucracy threshold $\frac{B^*-(C+np)}{nk} = \frac{1}{2}$, while the intermediary-bribe threshold becomes $\frac{d^*-B^*}{nt} = \frac{2+x}{2+2x} = \frac{3}{4}$, such that individuals between $\frac{1}{2} \leq A^i \leq \frac{3}{4}$ now bribe, and individuals $\frac{3}{4} \leq A^i \leq 1$ use intermediaries.

[32] See appendix 6.6.

4.2 Some bureaucrats are honest

In the models above, we assumed that there is a constant number of bureaucrats, all of which are corrupt. Consider first the model without intermediaries. The corrupt bureaucrats accept speed money for letting individuals skip lines, and, the more lines, the higher the revenue (up to n_c^*). Importantly, however, revenue would not increase if the additional step of the procedure was associated with a new honest bureaucrat that did not accept speed money. There would simply be no additional source of rents.

Now think of the case with intermediaries. The same corrupt bureaucrats, through intermediaries, accept speed money for letting individuals skip lines *and* transport costs, and, the more lines and transports, the higher the revenue (up to n_i^*). Differently from above, revenue would increase if the additional step of the procedure was associated with a new, honest bureaucrat. This is due to the fact that the time costs associated with the counter can be avoided by using an intermediary, and hence constitutes a source of surplus for corrupt bureaucrats.[33]

With the addition of "honest steps", the incentives to create red tape thus differ somewhat between a setting with- and a setting without intermediaries. With intermediaries, corrupt bureaucrats can gain additional revenue even if such honest steps, at which individuals cannot bribe to skip lines, are added to the procedure. For corrupt bureaucrats, any addition to the bureaucratic procedure that adds transport time costs is a source of potential revenue, channeled through intermediaries.

4.3 Collusion between bureaucrats and intermediaries

The upstream-downstream relationship between bureaucrats and intermediaries explored so far is certainly not the only possible form of interaction between these two actors. It is beyond the scope of this paper to explicitly model alternative arrangements and little is known empirically about the bureaucrat-intermediary interaction (the study of Bertrand et al, 2008, being an exception).

An alternative to the model above however, with at least anecdotal support, is to think of an intermediary as an entity with very close ties to the bureaucracy, perhaps it is a government employee/bureaucrat that doubles in the intermediation market, or a former bureaucrat.[34] Such arrangements indicate some form of collusion in the bureaucrat-intermediary interaction.

[33] We have assumed that also honest bureaucrats handle applications from intermediaries. We can think of the intermediary as paying $C/n + p$ for completing an honest step. The reasons outlined in section 2 for why the intermediary has a lower cost of acquiring the license still apply when the bureaucrat is honest. Handling 20 applications at the same time and knowing how the procedure works are two reasons why intermediaries have a lower cost also when having to go through honest steps.

[34] See Fjeldstad (2003) for an account of how former employees of the bureaucracy in Tanzania, having lost their job on corruption charges, started working as intermediaries instead.

In the model in section 4.1, a low x and hence a high mark-up from intermediaries perhaps arises from high entry costs to become an intermediary (think of a license procedure that requires detailed expert knowledge). It can easily be shown, for the range of n in expression 11A, that the sum of intermediaries' and bureaucrats' profits decreases the less competition there is, with the lowest profits when there is a monopolist intermediary. In such a setting, both the nature of the entry requirements (a former bureaucrat is appropriate for the intermediary job) and the fact that a joint price setting would eliminate the double marginalization of section 4.1 and hence increase total profits, point in the direction of collusion as an alternative modeling choice.

A joint price setting by bureaucrats and intermediaries (perhaps followed by bargaining between the two over how to split profits) would replicate the results of section 3, which is the set-up that maximizes the joint bureaucracy-intermediary surplus.

5 Conclusion

To the best of our knowledge, this paper is the first to study what impact bureaucracy intermediaries have on the emergence of red tape. We show that when corrupt bureaucrats are free to choose the level of red tape, there is more red tape and individuals are unambiguously worse off in a setting with intermediaries than when there is "direct" corruption only. With bureaucracy intermediaries common throughout most of the developing world, this constitutes a potential explanation why license procedures tend to be very long and tedious in many countries.

However, it should also be underlined that, given an amount of regulation, bureaucracy intermediaries may constitute a "second best". In societies where the government can do little to reform its bureaucracy, allowing intermediaries may be a way to give citizens a better de facto access to the bureaucracy, it "greases the wheels". This may explain why, in a country such as Brazil, bureaucracy intermediaries ("despachantes") are typically neither illegal nor informal, but instead legalized entities.

We also show in the paper that competition between intermediaries increases individuals' gain from licenses.

Beyond anecdotal evidence, there is little detailed knowledge about the bureaucracy-intermediary relation. How the contractual relationships between bureaucrats and intermediaries look, and under what conditions collusion comes about, is an interesting question for future work. The same goes for empirical work studying welfare impacts of the intermediary sector.

Similarly, Ankarcrona (2005) reports anecdotal evidence that Russian customs intermediaries are typically former employees of the customs bureaucracy.

6 Appendix

6.1 Bureaucrats' profit maximization problem (corruption only)

Case 1: Assume $\text{Min}\left\{1, \frac{g-B}{nt}\right\} = 1$. The problem in expression 5 becomes:
Choose B to Max $\pi_B = (B - (C + np)) \left(1 - \frac{B-(C+np)}{nk}\right)$
Taking the first order condition with respect to B and solving, we get $B^* = (C + np) + \frac{nk}{2}$

We need to check that $\frac{g-B^*}{nt}$ indeed is larger than 1, from which we get the condition that $n \leq n_1 \equiv \frac{g-C}{p+t+k/2}$. For larger values of n, high productivity individuals would choose to not get the license, i.e. the upper threshold can then not be "1", i.e. the solution is not valid.

Case 2: Assume $\text{Min}\left\{1, \frac{g-B}{nt}\right\} = \frac{g-B}{nt}$. The problem in expression 5 becomes:
Choose B to Max $\pi_B = (B - (C + np)) \left(\frac{g-B}{nt} - \frac{B-(C+np)}{nk}\right)$
The solution is $B^* = (C + np) + \frac{g-(C+np)}{2(1+t/k)}$

We need to check that $\frac{g-B^*}{nt}$ indeed is smaller than 1, from which we get the condition that $n \geq n_2 \equiv \frac{g-C}{p+t+k/(2+k/t)}$. For smaller values of n, all individuals would choose to get the license, i.e. the upper threshold can then not be $\frac{g-B}{nt}$, i.e. the solution is not valid.

We see that n_2 is always larger than n_1 (as long as $k > 0$). We must thus have a middle region, in which we always have $\frac{g-B}{nt} = 1$.

Case 3: $\frac{g-B}{nt} = 1$
The solution is $B^* = g - nt$

6.2 Proof of lemma 1

In the case of the regular bureaucracy (section 3.1), the aggregate net gain for individuals from getting the license, NG_{b}, is

$$NG_{\text{b}} = \int_0^{A^i_{\text{bur}}} \left(g - (C + np) - A^i \left(nk + nt\right)\right) dA^i,$$

where A^i_{bur}, the highest productivity-individual that goes through the regular bureaucracy, is "1" for $n \leq n^* = \frac{g-C}{p+k+t}$, otherwise $\frac{g-(C+np)}{nk+nt}$. In the case of

corruption (section 3.2), the aggregate net gain for all individuals, i.e. the net gain for the individuals that use the regular bureaucracy plus those that bribe, NG_{c}, is

$$NG_{\mathrm{c}} = \int_0^{A^i_{\mathrm{bur,\ c}}} \left(g - (C+np) - A^i\left(nk+nt\right)\right) dA^i + \int_{A^i_{\mathrm{bur,c}}}^{A^i_{\mathrm{bribe}}} \left(g - B^* - A^i nt\right) dA^i,$$

where B^* is given in expression 6 and where the limits in the integrals are derived from plugging in B^* in the thresholds in expressions 3 and 4 (as visualized in figure 1B). $A^i_{\mathrm{bur,c}}$ is the highest productivity-individual that goes through the regular bureaucracy and A^i_{bribe} is the highest productivity-individual that bribes. With $n_1 = \frac{g-C}{p+t+k/2}$, $n_2 = \frac{g-C}{p+t+k/(2+k/t)}$ and $n_{\max} = \frac{g-C}{p}$, we get $A^i_{\mathrm{bur,c}} = \frac{1}{2}$, $A^i_{\mathrm{bribe}} = 1$ if $0 \leq n \leq n_1$; $A^i_{\mathrm{bur,c}} = \frac{g-nt-(C+np)}{nk}$, $A^i_{\mathrm{bribe}} = 1$ if $n_1 \leq n \leq n_2$ and $A^i_{\mathrm{bur,c}} = \frac{g-(C+np)}{2(nk+nt)}$, $A^i_{\mathrm{bribe}} = \frac{k+2t}{2k+2t}\frac{g-(C+np)}{nt}$ if $n_2 \leq n \leq n_{\max}$. The difference in aggregate net gain between the case when there is corruption and when there is not, becomes

$$\begin{aligned}
&NG_{\mathrm{c}} - NG_{\mathrm{b}} = \tfrac{1}{8}nk \ \text{ if } \ 0 \leq n \leq n^* \\
&NG_{\mathrm{c}} - NG_{\mathrm{b}} > \tfrac{k(g-(C+np)-\frac{nk+nt}{2})^2}{2n(k+t)^2} \ \text{ if } \ n^* \leq n \leq n_1 \\
&NG_{\mathrm{c}} - NG_{\mathrm{b}} = \tfrac{t(g-(C+np)-nk-nt)^2}{2nk(k+t)} \ \text{ if } \ n_1 \leq n \leq n_2 \\
&NG_{\mathrm{c}} - NG_{\mathrm{b}} = \tfrac{k(g-(C+np))^2}{8nt(k+t)} \ \text{ if } \ n_2 \leq n \leq n_{\max}
\end{aligned}$$

All differences are positive. This completes the proof.[35]

6.3 Bureaucrats' profit maximization problem (with intermediaries)

Case 1: Assume $B_d \leq g$. The problem in expression 8 becomes:
Choose (B, B_d) to
Max $\pi_B = (B-(C+np))\left(\frac{B_d-B}{nt} - \frac{B-(C+np)}{nk}\right) + (B_d-(C+np))\left(1-\frac{B_d-B}{nt}\right)$
The solution is $B^* = (C+np) + \frac{nk}{2}$, $B^*_d = d^* = (C+np) + \frac{nk+nt}{2}$

We need to check that B_d indeed is smaller than g, from which we get the condition that $n \leq \frac{g-C}{p+(k+t)/2}$. For larger values of n, the cost of using an

[35] In the second case we have integrated NG_{c} only up to $A^i_{\mathrm{bur,c}}$ in order to simplify the algebra. For individuals between $A^i_{\mathrm{bur,c}}$ and "1" there is a positive net gain in the case of bribing and zero gain in the regular bureaucracy case (because these individuals do not get the license at all). The expression given is thus smaller than the actual difference in net gain.

intermediary would outweigh the benefits, i.e. the solution would no longer apply.[36]

Case 2: Assume $B_d = g$. The problem in expression 8 becomes:
Choose B to
Max $\pi_B = (B - (C + np)) \left(\frac{g-B}{nt} - \frac{B-(C+np)}{nk} \right) + (g - (C + np)) \left(1 - \frac{g-B}{nt} \right)$
The solution is $B^* = (C + np) + \frac{g-(C+np)}{1+t/k}$, $B_d^* = d^* = g$

This solution holds for $n \geq \frac{g-C}{p+(k+t)/2}$. As before, the largest number of steps for which any licenses at all would be awarded is $n_{\max} = \frac{g-C}{p}$.

6.4 Proof of proposition 1

In the case of intermediaries (section 3.3), the aggregate net gain for all individuals, i.e. the net gain for the individuals that use the regular bureaucracy plus those that use intermediaries, NG_{i}, is

$$NG_{\mathrm{i}} = \int_0^{A^i_{\mathrm{bur,\ i}}} \left(g - (C + np) - A^i (nk + nt) \right) dA^i + \int_{A^i_{\mathrm{bur,\ i}}}^1 (g - d^*)\, dA^i,$$

where d^* is given in expression 9 and where $A^i_{\mathrm{bur,i}}$ becomes $\frac{1}{2}$ for $n \leq \frac{g-C}{p+(k+t)/2}$, otherwise $\frac{g-(C+np)}{nk+nt}$. The threshold $A^i_{\mathrm{bur,i}}$ is the highest productivity-individual that goes through the regular bureaucracy. The upper threshold for using intermediaries is always "1" (as visualized in figure 2B).[37] Comparing NG_{i} to the case with the regular bureaucracy, we get

$$NG_{\mathrm{i}} - NG_{\mathrm{b}} = \tfrac{1}{8}(nk + nt) \ \text{ if } \ 0 \leq n \leq \tfrac{g-C}{p+k+t}$$
$$NG_{\mathrm{i}} - NG_{\mathrm{b}} > \tfrac{(g-(C+np)-(nk+nt)/2)^2}{2n(k+t)} \ \text{ if } \ \tfrac{g-C}{p+k+t} \leq n \leq \tfrac{g-C}{p+(k+t)/2}$$
$$NG_{\mathrm{i}} - NG_{\mathrm{b}} = 0 \ \text{ if } \ \tfrac{g-C}{p+(k+t)/2} \leq n \leq n_{\max}$$

These expressions prove proposition 1A.[38] For proposition 1B, we limit the proof to the n-range below the lowest threshold, and above the highest threshold, respectively. We get

[36] A property of the solution in case 1 is that bureaucrats set the same bribe B^* as in the "small-n" case without intermediaries (expression 6A). This is because individuals, as in the case without intermediaries, can still choose to use the regular bureaucracy. The bureaucrats therefore face the same profit trade-off with respect to changes in B as in the case without intermediaries. (The same property was pointed out by Hasker and Okten, 2008, studying the effects of anti-corruption policies in a model with intermediaries).

[37] In writing these expressions we have used the fact that -in the optimum - noone bribes, otherwise there would have been a third term in NG_i (as there will be in section 4.1, when we introduce a mark-up in the intermediary sector).

[38] In the intermediate-n range we have integrated NG_{i} only up to $A^i_{\mathrm{bur,i}}$ in order to simplify the algebra. The difference in net gain is thus larger than stated. For large n, i.e. for values of n above $\frac{g-C}{p+(k+t)/2}$, individuals with productivity below $A^i_{\mathrm{bur,i}} = \frac{g-(C+np)}{nk+nt}$ acquire the license

$NG_{\rm i} - NG_{\rm c} = \frac{1}{8}nt$ if $0 \leq n \leq \frac{g-C}{p+k+t}$
$NG_{\rm i} - NG_{\rm c} = -\frac{k(g-(C+np))^2}{8nt(k+t)}$ if $\text{Max}\left\{n_2, \frac{g-C}{p+(k+t)/2}\right\} \leq n \leq n_{\max}$

These expressions, with the first difference being positive and the second negative, prove proposition 1B. The intuition is given in the main text.

6.5 Proof of proposition 2

Solving for the optimal n.
The order of differentiation when solving a multidimensional optimization problem does not matter. That is, we can solve for the bribe levels first (as in appendices 6.1 and 6.3), then solve for the optimal n.

In the corruption only case, plugging in the optimal B for the small-n (large-n) case of 6A (6C) give profits that are strictly increasing (decreasing) in n. Given the continuity of the optimal bribe (and hence profits), we thus look for the optimal n in the middle-n region. By plugging in $B^* = g - nt$ in the profit function and solving for the n that maximizes revenue, we get

$$n_{\rm c}^* = \frac{g-C}{\sqrt{(p+t)(p+k+t)}} \qquad \pi_{\rm c}^* = (g-C)\left(1 + \frac{p+t-\sqrt{(p+t)(p+k+t)}}{k/2}\right)$$
$$B_{\rm c}^* = g - n_{\rm c}^* t.$$

Similarly, with intermediaries, profits increase linearly in n for the small-n case of expression 9A, and we look for optimal profits in the large-n region of expression 9B. By plugging in $B^* = C + np + \frac{g-(C+np)}{1+t/k}$, $B_d^* = g$ in the profit function and solving for the n that maximizes revenue, we get

$$n_{\rm i}^* = \frac{g-C}{\sqrt{p(p+k+t)}} \qquad \pi_{\rm i}^* = (g-C)\left(1 + \frac{p-\sqrt{p(p+k+t)}}{(k+t)/2}\right)$$
$$B_{\rm i}^* = C + n_{\rm i}^* p + \frac{g-(C+n_{\rm i}^* p)}{1+t/k} \qquad B_{d,{\rm i}}^* = d^* = g.$$

Proof that bureaucrats' profits are higher when there are intermediaries.
Solving $\pi_{\rm i}^* = \pi_{\rm c}^*$ with respect to t gives, after some algebraic steps to eliminate the square roots and then simplifying the expressions, that the only solution to this equation is $t = 0$. It then suffices to show that, for some positive t, we have $\pi_{\rm i}^* > \pi_{\rm c}^*$. Take $t = k$ as an example, this gives $\pi_{\rm i}^* - \pi_{\rm c}^*$

from the regular bureaucracy, this is exactly the same threshold as in section 3.1, and these individuals are thus equally well off between the two cases. For individuals with productivity above $\frac{g-(C+np)}{nk+nt}$ the net gain of the license is exactly zero (because $d = g$), which is the same as in the regular bureaucracy case (when the same individuals did not get the license at all). Hence all individuals are indifferent.

$= \frac{(g-C)\sqrt{p+2k}}{k}\left(\left(\sqrt{p+k}-\sqrt{p}\right)-\left(\sqrt{p+2k}-\sqrt{p+k}\right)\right)$, which is always positive (due to concavity of the square root). This completes the proof that $\pi_{\mathrm{i}}^* \geq \pi_{\mathrm{c}}^*$.

Proof that the aggregate net gain is lower when there are intermediaries, compared to direct corruption only.
The direct way of comparison is to compare the expressions for net gain, similar to appendices 6.2 and 6.4. We take a shortcut however. Knowing that $n_{\mathrm{i}}^* > n_{\mathrm{c}}^*$, we know that going through the regular bureaucracy is more costly when there are intermediaries. If we can show that the number of individuals that use the regular bureaucracy is smaller when there are intermediaries, we have then proven that the aggregate net gain is lower in the case of intermediaries.[39]

By plugging in n_{c}^* in $A_{\mathrm{bur,c}}^i$ from appendix 6.2, and n_{i}^* in $A_{\mathrm{bur,i}}^i$ from appendix 6.4, we get the following thresholds below which individuals use the regular bureaucracy:

Corruption only:
$A_{\mathrm{bur,c}}^{i,\,*} = \frac{1}{1+\sqrt{(p+k+t)/(p+t)}}$
With intermediaries:
$A_{\mathrm{bur,i}}^{i,\,*} = \frac{1}{1+\sqrt{(p+k+t)/p}}$

These are also the fractions of individuals that use the regular bureaucracy in each case. Because $A_{\mathrm{bur,i}}^{i,\,*} < A_{\mathrm{bur,c}}^{i,\,*}$ as long as $t > 0$, we have thus shown that the aggregate net gain is lower in the model with intermediaries.

Proof that the aggregate net gain is lower when there is direct corruption, at n_{c}^*, compared to the no-corruption case at n^*.
If we can prove that the net gain of individuals in the corruption-case is lower at $n = n_1$ than in the regular bureaucracy case at n^*, we´re done (because $n_1 < n_{\mathrm{c}}^*$).

In the regular bureaucracy case, at n^*, the net gain is
$NG_{\mathrm{b}} = \int_0^1 \left(g - C - n^*p - A^i\left(n^*k + n^*t\right)\right) dA^i = \frac{(g-C)(k+t)}{2(p+k+t)}$.
In the direct corruption case, at n_1, the net gain is
$NG_{\mathrm{c}} = \int_0^{\frac{1}{2}} \left(g - C - n_1p - A^i\left(n_1k + n_1t\right)\right) dA^i + \int_{\frac{1}{2}}^1 \left(g - B^* - A^in_1t\right) dA^i = \frac{(g-C)(k+4t)}{4(k+2(p+t))}$
The latter can be shown to always be smaller than the former (as long as $k > 0$).

[39] That is: fewer individuals use the regular bureaucracy and each such individual is worse off. Combined with the fact that individuals using intermediaries, for this region of n, have zero net gain, the aggregate net gain in the case of intermediaries must then also be lower.

6.6 Oligopolistic competition between intermediaries

Profit maximization problem of intermediaries and bureaucrats
The solution is obtained by backward induction, i.e. we first solve the problem of intermediaries, then bureaucrats' profit maximization. In order to solve the profit maximization problem of intermediaries, we first need to find intermediaries' inverse demand function. Knowing that the threshold for the choice between bribing directly and using an intermediary, from (7), is $\frac{d-B}{nt}$, we get the total demand for intermediaries as $Q \equiv 1 - \frac{d-B}{nt}$. Rewriting $Q = q + (x-1)\tilde{q}$ and solving for d we get the following inverse demand function

$$d(q) = B + nt(1 - (q + (x-1)\tilde{q})).$$

Here, we have written one intermediary's quantity as q, indicating that he will take the quantity of all other intermediaries, $(x-1)\tilde{q}$, as given. Facing costs for the license of B_d, each intermediary chooses a quantity that maximizes profits:

Choose q to maximize $q(d(q) - B_d)$

After taking the first-order condition with respect to q, applying symmetry between all intermediaries ($\tilde{q} = q$), solving for q and plugging the optimal quantities back into $d(q)$, we get the following optimal intermediary price response:

$$d_{\text{response}} = \frac{xB_d}{1+x} + \frac{B_c + nt}{1+x}$$

The response function captures the standard feature of Cournot competition, that is, a mark-up over cost (B_d) that gradually declines as the number of intermediaries, x, grows.

Bureaucrats solve the following problem:

Choose (B, B_d) to
Max $\pi_B = (B - C - np)\left(\frac{d_{\text{response}} - B}{nt} - \frac{B-(C+np)}{nk}\right) + (B_d - C - np)\left(1 - \frac{d_{\text{response}} - B}{nt}\right)$
subject to $d_{\text{response}} \leq g$

The only difference to (8) is that $d = B_d$ has been replaced by d_{response}. The solution is given by expressions 11A and 11B. As pointed out in the main text, the threshold $(g - C)/(p + \frac{k+t}{2} + \sqrt{\frac{t(k+t)}{4(1+x)}})$, which is lower than the corresponding threshold in 9A-9B, comes from bureaucrats' comparison of profits for the two different solutions.

Proof of proposition 1 in the case of imperfect competition between intermediaries

In order to prove proposition 1, the method from appendix 6.4 is followed, but with NG_{i} replaced by $NG_{\text{i,x}}$ (defined below) and the threshold $\frac{g-C}{p+(k+t)/2}$ replaced by $\frac{g-C}{p+\frac{k+t}{2}+\sqrt{\frac{t(k+t)}{4(1+x)}}}$.

Proof of corollary 1
For $0 \leq n \leq \frac{g-C}{p+\frac{k+t}{2}+\sqrt{\frac{t(k+t)}{4(1+x)}}}$, in the model with imperfect competition, the aggregate net gain of individuals from the license is the sum of three terms. This corresponds to the individuals that use the bureaucracy, those that bribe, and those that use intermediaries:[40]

$$NG_{\text{i,x}} = \int_0^{A^i_{\text{bur,i}}} \left(g - C - np - A^i\left(nk + nt\right)\right) dA^i + \int_{A^i_{\text{bur,i}}}^{A^i_{\text{bribe,i}}} \left(g - B^* - A^i nt\right) dA^i + \int_{A^i_{\text{bribe,i}}}^{1} \left(g - d^*\right) dA^i$$

with $A^i_{\text{bur,i}} = \frac{1}{2}$, $A^i_{\text{bribe,i}} = \frac{2+x}{2+2x}$. The threshold $A^i_{\text{bur,i}}$ is the highest productivity-individual that goes through the regular bureaucracy and $A^i_{\text{bribe,i}}$ is the highest productivity-individual that bribes. The first integral is independent of x and it can be shown that the sum of the second two integrals increases in x, i.e. individuals are better off the more competition there is. Because the solution in 9A-9B is a special case of 11A-11B, i.e. when $x \to \infty$, we have shown that the net gain is highest in the case with perfect competition.

For $\frac{g-C}{p+\frac{k+t}{2}+\sqrt{\frac{t(k+t)}{4(1+x)}}} \leq n \leq \frac{g-C}{p+\frac{k+t}{2}}$, the aggregate net gain in the case with perfect competition, NG_{i}, is given in appendix 6.4. The aggregate net gain with imperfect competition, where the bureaucrat charges $B^*_d = d^* = g$ and hence using the intermediary means zero gain, is instead

$NG_{\text{i,x}} = \int_0^{A^i_{\text{bur,i}}} \left(g - (C + np) - A^i\left(nk + nt\right)\right) dA^i$, with $A^i_{\text{bur,i}} = \frac{g-(C+np)}{nk+nt}$.

After integration and simplification, we get $NG_{\text{i}} - NG_{\text{i,x}} = g - C - np - \frac{3}{8}(nk + nt) - \frac{(g-(C+np))^2}{2n(k+t)}$, which can be shown to be positive over the n-range we consider.

For $\frac{g-C}{p+\frac{k+t}{2}} \leq n \leq \frac{g-C}{p}$ we have the same solution in the two cases, i.e. the same net gain. This completes the proof of corollary 1.

[40] $NG_{\text{i,x}}$ refers to the net gain in the model with intermediaries and imperfect competition. NG_{i}, from appendix 4, refers to the net gain in the model with perfect competition.

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