

Political Parties and Rent-seeking through Connections*

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Abstract

Anti-corruption laws forbid selling nominations to public jobs. Even if bribing is ruled out, those interested in the nominations may invest in good relationships with the nominators. This provides a legal way to influence the decision. Such networking is costly, however. Thus, rent-seeking results in excessive networking. We argue that efficiency may be improved if political parties interfere with the nominations. Political parties may reduce wasteful networking, thanks to exclusive membership contracts. Parties can require that politicians belonging to the party promote the nomination of other party members, thus, reducing incentives to cultivate inter-party connections.

Keywords: Political parties, Political Nominations, Rent-seeking, Connections, Networks, Two-sided Platforms

JEL Codes: D72, D85, L14, H8

1 Introduction

Politicians have influence on a variety of nominations. Occasionally when a nomination is decided upon, a politician finds himself in a pivotal position. Anti-corruption laws forbid politicians to sell the nominations. Still, even though interested citizens

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can not buy a position, it pays off to be on good terms with the politician: favors are passed to friends and therefore the citizen needs a close connection to the nominating politician to be nominated. Keeping in touch is costly, however. It takes not only the citizen's time and effort but also that of the politician. Why should the politician bother spending time with a rent-seeker? He must be compensated for doing so. The rent-seekers spend time with the politicians by offering lunches and entertainment, and by taking part in campaigns and fund-raising events to be remembered when a nomination is made. In addition, if there are no restrictions on whom the politician can nominate, the rent-seekers gain by rubbing shoulders with several politicians. This is excessively time-consuming and results in wasteful networking¹. Here, political parties may provide valuable services.

Political parties are powerful gatekeepers in modern democracies. Citizens looking for spoils, and politicians allocating these, cannot belong to more than one party at a time. Moreover, parties can divide party members into groups around politicians. Examples of such subgroups include party associations for women, young people, students or pensioners. For the welfare consequences of rent-seeking through connections, it is crucial whether and to what extent parties are allowed to act as gate-keepers requiring their politician members to nominate other party members or members belonging to their group. If politicians are expected to favor only members belonging to their group, then party members outside this group, let alone members of other parties, have no incentive to lobby this politician. The parties can thus reduce rent-seeking.

This paper formalizes the argument presented above and shows that political parties may play this efficiency-improving role assuming that citizens are equally valuable when nominated. We compare rent-seeking through connections with and without the role of the political parties. We take as our starting point that political parties exist and that the politicians decide upon the allocation of non-ideological rents. We illustrate that allowing the political parties to play the gate-keeping role improves efficiency in the distribution of such rents.

Even if we find that parties' involvement in the nominations may increase welfare, this need not always hold. This is because there are additional costs of networking when the parties are present: the parties or the party leadership must also keep in touch with the politicians. Of course, this latter concern does not arise if the connections between party leadership and the politicians exist, whether or not the party is involved in political nominations. In this latter case the parties interference with nominations is unambiguously welfare enhancing.

Our model abstracts from the ideological considerations. This is not because we consider ideology unimportant. Rather, we abstract from the ideology to uncover the full potential of rent-seeking in explaining the role of political parties in non-ideological nominations. The effects of including ideological considerations are briefly discussed in the conclusion.

The paper is organized as follows. Section 2 summarizes related literature. Sec-

¹No efficiency issue arises, at least in a world of equally capable candidates who are equally valuable when nominated.

tion 3 presents the model when parties are not involved, and section 4 when they are. Section 5 presents a welfare analysis. Section 6 concludes.

2 Related Literature

Our analysis has common features with several strands of literature. First, our approach is related to the literature on rent-seeking and lobbying contests (Tullock 1967, 1980; Bernheim and Whinston, 1986; Baye, Kovenock and de Vries, 1993; Grossman and Helpman, 1994; Besley and Coate, 2001; Helpman and Persson, 2001) which gains important insights into how lobbying may affect policy making. These models are similar to our model in that citizens actively influence the politicians' decisions on how to distribute rents. Yet, there are major differences. In our model, links are endogenous, requiring mutual consent. Moreover, the links are costly not only for the lobbying side but also for the politicians. Payments are made in exchange for establishing links. In the rent-seeking and lobbying literature, the links are given at the outset. Second, only the citizens bear costs. Third, costs are bids in an auction or in a contest.

Throughout the analysis, we assume that anti-corruption laws work and thus the nominations cannot be auctioned or traded even implicitly². Therefore, we have especially in mind a modern democracy with a relatively low level of corruption such as EU 15 and especially Nordic countries³. Previous literature on contests has already extensively analyzed the case where the anti-corruption laws can be circumvented.

The only previous contribution that endogenizes the relationship between politicians and lobbyists is Felli and Merlo (2006). Our approach is complementary to theirs. Whereas they analyze ideological lobbying, we analyze lobbying on non-ideological spoils. Furthermore, Felli and Merlo (2006) assume that the links are costless whereas we assume that creating and maintaining links is costly.

Second, we suppose that for a citizen to receive a spoil from a politician, a connection must be established between the two. This relates the current paper to the literature on cooperative networks, pioneered by Jackson and Wolinsky (1996). However in our model, agents do not only make strategic linking decisions but, moreover, the politicians decide strategically upon the rewards that they charge for linking. There are few theoretical studies which consider connections as decisions made by economic agents and which, at the same time, model the economic interaction on an established network explicitly⁴.

Moreover, building upon the approach of Jackson and Wolinsky, we show in the appendix that in our setup the pair-wise stable cooperative network coincides with a network established by a Walrasian auctioneer. Thus, we show that a Walrasian approach can be used to simplify the analysis to a great extent. To our knowledge,

²The inability of politicians to sell or to auction off nominations when these arise could result from outside monitoring or from there being a fraction of honest citizens and politicians who would report asking or offering bribes, provided that punishments for corruption are sufficiently high.

³See the Transparency International Corruption Perceptions Index (2006).

⁴Jackson (2006) surveys network literature and classifies network formation models.

the current paper is the first to consider economic but non-strategic (Walrasian) network formation.

A related paper on bipartite networks is Kranton and Minehart (2001). They analyze strategic network formation followed by strategic trading on the thereby established platforms. They find that efficient networks are formed when highest valuation buyers pay the social opportunity cost for the good. In our paper, inefficiencies are due to the feature that nominators of political positions are prevented from charging the social opportunity cost due to the anti-corruption laws which prevent the nominator from selling the good. The implied high rents for the rent-seekers invite inefficiently large scale of networking. Our paper introduces parties as gate-keeping intermediaries to reduce this incentive for rent-seeking through connections. Intermediation is not analyzed by Kranton and Minehart. Moreover, in their model there is a constant cost of networking per each link whereas we assume convex linking costs to allow for increasing marginal opportunity cost of networking.

Third, our analysis is related to the middlemen literature (Rubinstein and Wolinsky, 1987) and the literature on two-sided markets (Rochet and Tirole, 2003, forthcoming; Armstrong, forthcoming). The previous literature has focused on situations in which the intermediary or the middleman facilitates search and matching. We analyze the case where the intermediary, the political party, plays a useful role by *restricting* activity between the two sides of its market.

Fourth and finally, our explanation complements previous efficiency rationales for the prominent role of political parties, like Alesina (1988), Alesina and Spear (1988) and Caillaud and Tirole (2002). These previous contributions leave a puzzle: Why political parties play a role also in cases where they do not reduce the time spent searching, provide additional information, or solve various commitment problems? It is questionable to what extent a political party would provide new information when filling the positions of trust or public jobs in a small municipality, for example. Yet, these positions and many other jobs are typically earmarked to different political parties. Our explanation for the role of a political party applies also in these cases.

3 Equilibrium without Political Parties

3.1 The Model

In this section, we assume that the political parties do not meddle in nominations. There are two types of agents. Type *A* is called a *politician* and type *B*, someone interested in being nominated, a *citizen*. Each politician makes a nomination with probability p . A nominated citizen receives surplus s where s is strictly positive. We define the expected rent as $\psi \doteq ps$.

There are n_A politicians and n_B citizens. The politicians are indexed with $i = 1, \dots, n_A$ and the citizens with $j = 1, \dots, n_B$. There are γ times more citizens than politicians, $n_B = \gamma n_A$, where γ is an integer strictly greater than one.⁵

⁵This simplification allows us to solve the model explicitly.

Whether politician i is connected with citizen j is captured by $m_{i,j}$. If i is connected with j then $m_{i,j} = 1$, if not then $m_{i,j} = 0$. A connection is established between a politician and a citizen if both are willing to do so. Politician i 's connections are described by $\mathbf{m}_i^A = (m_{i,1}, \dots, m_{i,n_B})$ and citizen j 's connections are described by $\mathbf{m}_j^B = (m_{1,j}, \dots, m_{n_A,j})$. Thus the network is characterized by the matrix

$$\begin{aligned}
M &= (\mathbf{m}_1^B, \dots, \mathbf{m}_{n_B}^B) \\
&= \begin{pmatrix} m_{1,1} & m_{1,2} & \cdots & \cdots & m_{1,n_B} \\ m_{2,1} & m_{2,2} & \cdots & \cdots & m_{2,n_B} \\ \vdots & \vdots & \ddots & & \vdots \\ \vdots & \vdots & & \ddots & \vdots \\ m_{n_A,1} & m_{n_A,2} & \cdots & \cdots & m_{n_A,n_B} \end{pmatrix} \\
&= (\mathbf{m}_1^A, \dots, \mathbf{m}_{n_A}^A)'
\end{aligned}$$

Let the number of connections that citizen j has to politicians be denoted by $m_{jA} \doteq \sum_{i=1}^{n_A} m_{i,j}$. The number of connections of politician i is denoted by $m_{iB} = \sum_{j=1}^{n_B} m_{i,j}$.

Maintaining a connection is costly. A decreasing marginal productivity in other activities, or a decreasing marginal utility of leisure, implies that the marginal cost of time spent on networking is strictly increasing. Thus, we adopt a simple quadratic cost for politician i of having a total number m_{iB} of connections, $\frac{c}{2}m_{iB}^2$. Similarly citizen i 's cost of networking is $\frac{c}{2}m_{iA}^2$. Here c is a positive networking cost parameter independent of the agent's type. Both must contribute time and effort to keep up the relationship. Thus any given connection induces costs for both.

We assume that, ex ante, each politician is indifferent as to whom to nominate and each citizen is indifferent as to who nominates him. However, we assume that in order for politician i to be able to nominate citizen j , there has to be a *direct* connection between them, $m_{i,j} = 1$, as opposed to an *indirect* connection where i knows a third agent who knows j . This assumption rules out favors being passed to a friend of a friend. While such indirect connections may indeed have some value, it is likely that, when the politician is ex ante indifferent as to whom to pass the favor, she is likely to favor a close rather than a distant friend. The restriction that only close friends can receive the favor serves as a simplifying assumption. Analogous assumptions are made in other network formation models of markets upon networks (Kranton and Minehart, 2001; Kakade et al 2004). A politician nominates each citizen connected to her with an equal probability. Moreover, we suppose that a citizen can accept several nominations. This is a simplifying assumption⁶.

⁶Assuming alternatively that each citizen can only receive one nomination would have two effects. First, the probability of being offered a nomination would depend positively on the number of connections that other citizens (linked to the politician) have to other politicians. Second, the

Our model of network formation is based on economic decisions as opposed to taking the network as given or as an outcome of an exogenous process⁷. Yet, the model is not strategic but rather it assumes a Walrasian market maker. A market maker announces a price for connections to politicians, the same price for every connection and for every politician. Each citizen then announces the number of connections he wishes to buy at that price and each politician announces the number of connections that she wishes to sell at that price. Each citizen (politician) correctly anticipates the politicians' (citizens') expected number of connections, in equilibrium, when deciding how many connections to demand (supply). In equilibrium, demand equals supply. The market maker is implicitly assumed to coordinate the demands and supplies so that an equilibrium network is established. In appendix B, we show that there is an equivalent pair-wise stable cooperative network (Jackson and Wolinsky, 1996) where the politicians set the rewards and where they are not exogenously restricted from price discriminating among the citizens⁸.

At a given price, each agent's optimal demand (supply) may not be unique but rather an agent may be indifferent between several quantities of connections. We assume that if an agent is indifferent, he or she will announce all optimal quantities to the market maker. Therefore, each announced demand (supply) may consist of several alternative quantities. When an agent is indifferent, any of amounts she or he announced may be allocated to her or him.

For a citizen, the probability that a connection to politician i results in a nomination, p_i , depends negatively on the expected number of connections that the politician has to other citizens: the more connections to other citizens, the less likely it is that the politician nominates the citizen. Politicians cannot commit not to sell additional connections. To reflect the fact that the citizens cannot monitor the politicians, we assume that the citizens cannot observe how many other connections each politician is providing, not even ex post. Thus, the politicians appear to the citizens as ex ante identical. Yet, the citizens correctly anticipate the distribution of politicians' equilibrium number of connections. Ex ante, the equilibrium number of connections of each politician, for instance, is a random variable. Let the probability that politician has k connections (or the fraction of politicians with k connections) be denoted by q_k^A . By construction, the probability that a connection to a politician results in a nomination is the same across politicians, for all i , $p_i = p_A \doteq \sum_k q_k^A \frac{p}{k}$. Similarly, the probability that citizen has k connections is denoted by q_k^B .

A citizen pays a politician a reward, r , for maintaining a connection. An equilibrium market reward r equates the supply of connections by the politicians and the demand by the citizens. While there are many rewards which clear the market,

gain from an additional connection would not be constant but rather decreasing as with more connections to politicians, the probability that only one nomination is offered is decreasing. The politician's incentives are unaffected by the alternative assumption, however, since she only cares about connections and rewards.

⁷As opposed to random or ex-ante given formation of the network. See Jackson (2006) for a classification of network formation models.

⁸For our specific needs, we augment their definition to allow us to consider the stability of the rewards charged by the politicians in addition to the stability of the connections formed.

the equilibrium connections are the same in all these equilibria. Therefore, the main focus of the paper, the social surplus, is unaffected by the choice of market clearing reward. To simplify and to reflect the relative market power of the politicians, we choose the equilibrium market reward which maximizes the politicians' profits.

Note that r is a gross price, and it has to compensate the politician for her marginal cost of linking. As will be formally shown below, competition between politicians on the supply side and between citizens on the demand side determines a unique (politicians' profit maximizing) equilibrium reward that is approximately equal to the marginal linking costs and that equilibrates politicians' supply and citizens' demand for connections.

This unique equilibrium turns out to be symmetric⁹: all citizens demand the same numbers and all politicians offer the same numbers of connections. However, in case of indifference, the number of connections of two politicians, for instance, need not be the same ex-post¹⁰. Consequently, more than one value of q_k^B may be strictly positive.

In addition to paying the politicians r for maintaining the connections, the citizens have to pay their own linking costs. The expected payoff of citizen j when network M prevails with reward r reads¹¹

$$\mathbb{E}\pi_j(M, r) = m_{jA}p_{AS} - m_{jA}r - \frac{c}{2}(m_{jA})^2 \quad (1)$$

and the payoff of politician i in the same network reads

$$\pi_i(M, r) = m_{iB}r - \frac{c}{2}(m_{iB})^2. \quad (2)$$

Politician i 's maximization problem¹² is

$$\max_{m_{iB}} \{m_{iB}r - \frac{c}{2}(m_{iB})^2\}.$$

Due to the strict concavity of the payoffs in the number of connections, there can be at most two optimal connection quantities for each agent and these must be consecutive. It turns out that the optima are the same for all agents of a given

⁹Symmetry is a property of any equilibrium. It is not exogenously assumed. The equilibrium would be symmetric even if we chose a market clearing r which does not maximize the politicians' profits.

¹⁰In Jackson and Wolinsky (1996), the links are observable. In our model, however, links are private information. Thus, citizens are not willing to change the number of links once the network is formed.

¹¹This formulation relates to Tullock (1980). Yet, here we consider a dichotomic decision whether to connect with a politician or not and all citizens who are connected have an equal probability of being nominated. Moreover, we differ from Tullock in that the cost of networking is not linear but convex in the number of connections.

¹²For simplicity, we assume that the electoral strength of politicians does not depend on the number of citizens connected to them. All the results could be generalized to allow politicians to receive some direct benefit from networking with citizens, as long as the time cost exceeds the benefit for politicians at the margin. Furthermore, all the results would remain the same also if the politician would receive a surplus, in case a nomination is made.

type. Thus, we simplify and denote the total equilibrium number of connections of a politician (to citizens) by m_{AB}^N and by m_{BA}^N the total equilibrium number of connections of a citizen (to politicians). If politicians have two optima, there may exist numbers m_{AB}^N and $m_{AB}^N + 1$ such that each politician has m_{AB}^N connections for sure and some have an additional $m_{AB}^N + 1$:th connection with a probability smaller than one (respectively numbers m_{BA}^N and $m_{BA}^N + 1$ such that each citizen has m_{BA}^N connections for sure and some have an additional $m_{BA}^N + 1$:th connection with a probability smaller than one)¹³. Furthermore, we denote by r^N the equilibrium reward.

In equilibrium, given rewards, increasing or decreasing the number of connections must not strictly pay off. Thus, we have the following equilibrium condition for politicians

$$\frac{c}{2}(2m_{AB}^N - 1) \leq r^N \leq \frac{c}{2}(2m_{AB}^N + 1). \quad (3)$$

Each citizen takes as given the reward, r , and correctly anticipates the expected probability of being nominated, p_A . The citizen maximizes

$$\max_{m_{jA}} \{m_{jA} p_A r - m_{jA} r - \frac{c}{2}(m_{jA})^2\}.$$

Again, in equilibrium, all citizens behave identically and, given rewards, increasing or decreasing the number of connections must not strictly pay off:

$$p_A r - \frac{c}{2}(2m_{BA}^N + 1) \leq r^N \leq p_A r - \frac{c}{2}(2m_{BA}^N - 1). \quad (4)$$

In equilibrium, the politicians demand the highest reward that the citizens are willing to pay given the politician's (expected) equilibrium connections. Thus, one of the upper bounds of r^N in (3) and in (4) must be binding. An equilibrium exists if there exists such a market clearing price.

3.2 Equilibrium Regimes

As anticipated in the previous section, the equilibrium number of connections is unique. However depending on the parameters, there are four structures of the equilibrium network. These four equilibrium regimes as described below.

- (i) All citizens have an identical number of connections and all politicians have an identical number of connections. The reward keeps the citizens indifferent between their equilibrium connections and having one connection less. The equilibrium reward is increasing in ψ .
- (ii) All citizens have an identical number of connections and all politicians have an identical number of connections. The reward keeps the politicians indifferent between their equilibrium connections and having one connection more. The reward does not adjust to small changes in ψ .

¹³These equilibrium probabilities are coordinated by the Walrasian auctioneer.

- (iii) Some citizens have a connection more than others and some politicians have a connection more than others. The reward does not adjust to small changes in ψ .
- (iv) Some citizens have a connection more than others and all politicians have an equal number of connections. The equilibrium reward is increasing in ψ .

The network structure and the equilibrium reward are driven by the incentive constraints (3) and (4). The politicians supply connections at the highest reward that the citizens are willing to pay. However, the citizens correctly anticipate how many connections the politicians have in equilibrium, which affects their demand and willingness to pay. In regime (i), the network structure does not change as ψ increases and, thus, the citizens' willingness to pay for each connection increases. Therefore, the politicians are able to capitalize on increases in ψ in the market value of connections, r^N .

Eventually the reward, r^N , becomes so high that the politicians do not mind supplying an additional connection and, if it is raised further, the politicians would strictly prefer to provide an additional connection. This would lead to an oversupply of connections. Moreover, the citizens would anticipate that if the politicians sold more connections, each individual connection would be associated with a lower expected probability of nomination. This would further imbalance the supply and the demand. Thus, in regime (ii) we say that a *reward cap* binds. As ψ increases, the reward cap regime persists until the connections become sufficiently more attractive so that the citizens do not mind demanding an additional connection and the equilibrium shifts to regime (iii) where both are indifferent between two consecutive connection quantities.

In regime (i) and in regime (ii), citizens have m_{BA}^N connections and politicians have $m_{AB}^N = \gamma m_{BA}^N$ connections. As ψ increases, the equilibrium shifts to regime (iii) where there are politicians with γm_{BA}^N connections and others with $\gamma m_{BA}^N + 1$ connections, and there are citizens with m_{BA}^N connections and others with $m_{BA}^N + 1$ connections. From regime (iii), we enter regime (iv) when there is sufficient demand for all politicians to provide eventually $\gamma m_{BA}^N + 1$ connections whereas the citizens keep on having either m_{BA}^N or $m_{BA}^N + 1$ connections. As ψ increases even further, we enter regime (iii) again, but now while some citizens have m_{BA}^N connections and others have $m_{BA}^N + 1$ connections, some politicians have $\gamma m_{BA}^N + 1$ and others have $\gamma m_{BA}^N + 2$ connections. Regimes of types (iii) and (iv) alternate until eventually all citizens strictly prefer to demand an additional connection and we move from regime (iii) to regime (i), now with $m_{BA}^N + 1$ and $\gamma(m_{BA}^N + 1)$ connections for citizens and politicians, respectively.

We formally derive the order of equilibrium regimes in the appendix. Figure 1 illustrates this. We fix $\gamma = 2$ and let the expected rent of the nomination increase when moving from the left to the right. The number of connections increases and we move from one regime to another as shown in figure 1.

Regime:	(i)	(ii)	(iii)	(iv)	(iii)	(i)	ψ
Citizen's number of connections:	m	m	m or m+1	m or m+1	m or m+1	m+1	
Politician's number of connections:	2m	2m	2m or 2m+1	2m + 1	2m+1 or 2(m+1)	2(m+1)	

Figure 1: Equilibrium regimes, $\gamma = 2$.

Figure 2 illustrates the network structure for two values of ψ both of which lie in an interval where regime (i) prevails. On the left, ψ is small and therefore the number of links is also small. On the right, ψ is larger and therefore the number of connections is also larger.

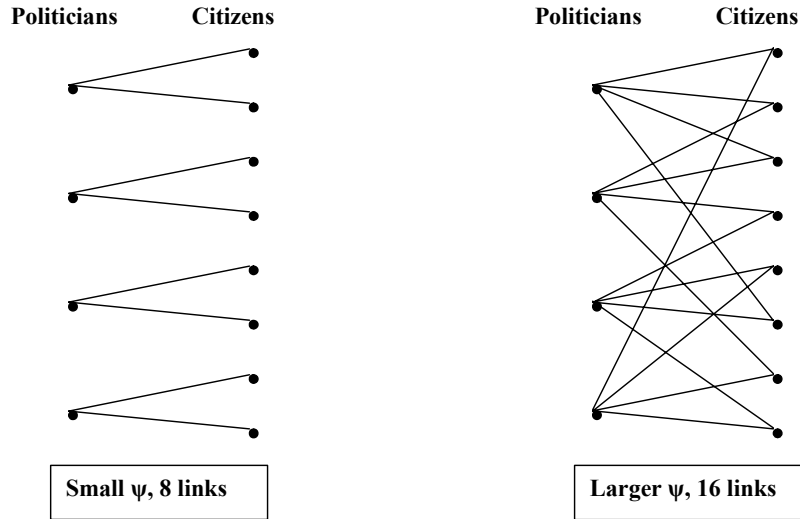


Figure 2: The number of connections increases in ψ , $n_A = 4$, $\gamma = 2$.

We denote the expected equilibrium payoffs by π_A^N, π_B^N . The costs of networking are defined as $TC^N \doteq n_A \frac{c}{2} (q_{m_{AB}^N}^A (m_{AB}^N)^2 + (1 - q_{m_{AB}^N}^A) (m_{AB}^N + 1)^2) + n_B \frac{c}{2} (q_{m_{BA}^N}^B (m_{BA}^N)^2 + (1 - q_{m_{BA}^N}^B) (m_{BA}^N + 1)^2)$ where $q_{m_{AB}^N}^A$ and $q_{m_{BA}^N}^B$ are the equilibrium probabilities that a politician has m_{AB}^N connections and a citizen has m_{BA}^N connections, respectively. The sum of payoffs is defined by $W^N \doteq n_A \pi_A^N + n_B \pi_B^N$. The main results can be summarized as follows:

Proposition 1

- There is a unique no-party equilibrium, provided that $\psi \geq c\gamma^2$. It is symmetric.
- The equilibrium numbers of connections, $m_{AB}^N(\psi, c, \gamma)$ and $m_{BA}^N(\psi, c, \gamma)$, are increasing in ψ and decreasing in c and in γ .
- The equilibrium payoffs, π_A^N, π_B^N , the costs of networking, TC^N , and the sum of payoffs, W^N , are continuous and increasing in ψ but not strictly increasing. For all parameter values, either the payoffs of the citizens remain constant or the payoffs of the politicians remain constant as ψ increases or both.

The payoffs are all continuous and increasing in the expected value of the nomination. Intuitively, the citizens are willing to demand more connections when the rents are higher. The politicians can charge higher rewards not only for these added connections but also for the inframarginal connections in all regimes, except for regime (ii) where the reward cap binds and the citizens reap the gains from small increases in the rents, ψ . The higher rewards charged by the politicians are offset by higher networking costs in regime (iii) and neither the politicians nor the citizens gain. In regimes (i) and (iv), the gains of the higher rents accrue to the politicians.

The payoff functions are illustrated in figure 3 for the special case $n_A = 2$, $\gamma = 2$ and $c = 1$. As a function of ψ , the citizen's equilibrium payoff is the curve on the bottom, the politician's payoff is the second curve from the bottom and the aggregate surplus for two politicians and four citizens is the third curve from the bottom.

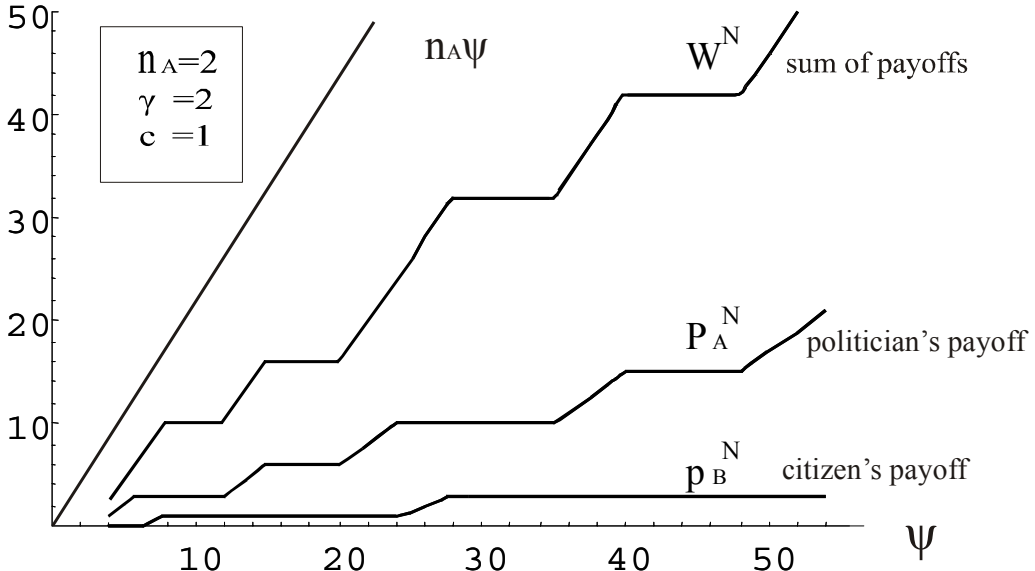


Figure 3: Payoffs in no-party equilibrium.

The total expected value of nominations is $n_A\psi$. In figure 3, this is illustrated by the line starting from the origin with a slope equal to two. Notice, that the sum of payoffs falls short of this total expected value and the distance between these two increases in ψ . The distance coincides with the total costs of networking.

4 Equilibrium with Political Parties

4.1 The Model

In this section, we introduce political parties or *party bosses* as intermediaries between politicians and citizens. Party bosses are denoted by C . The party bosses face the same networking costs as the politicians and the citizens. If the party boss has $m_{kA} + m_{kB}$ connections to the politicians and the citizens respectively, then her cost of networking equals $\frac{c}{2}(m_{kA} + m_{kB})^2$. The bosses play an active role, making take-it-or-leave-it offers to the politicians and to the citizens. There must be a direct connection between the politician and the citizen who is nominated by the politician. A party boss receives the right to control and design the network of all the politicians and the citizens connected with her on the condition that the party bears all the networking costs.¹⁴ However, the party bosses cannot commit not to sign contracts with additional politicians and citizens. Each politician and each citizen can join only one party at a time. The party boss maximizes the party's payoff.¹⁵

We take the identities of the party bosses as exogenous. To guarantee explicit solutions, we also assume that there are ω politicians per each party boss, where $\omega \in \{2, 3, \dots\}$. Therefore, $n_A = \omega n_C$ and as $n_B = \gamma n_A$ (by section 3), $n_B = \gamma \omega n_C$. The party bosses are indexed by $k = 1, \dots, n_C$. The party boss first recruits politician members and then the citizen members. When the citizens make their networking decisions, they know how many politicians belong to each party.¹⁶

To reflect the empirical fact that politicians and their party bosses interact in various ways, we assume that the politicians require having a direct connection with their party boss. However, the party bosses need not interact directly with the citizens belonging to the party, but they may delegate the member-contacts to the politicians representing the party. There is an indirect connection between party k and citizen j , when there is a politician i to whom both k and j are connected. We indicate an indirect connection between k and j by $\mu_{k,j}$. If there is an indirect connection then $\mu_{k,j} = 1$, if not, then $\mu_{k,j} = 0$.

The service that the parties provide turns out to be the exclusivity of connections. Parties can divide party members into groups around politicians: those belonging

¹⁴If the party would not bear the networking costs, then the party boss would have an incentive to require politicians to build more connections *ex post* than they have agreed on *ex ante*.

¹⁵We do not take a stance whether party bosses would keep the payoff, or part of it, for private consumption, or if they use the surplus for ideological purposes.

¹⁶This timing would arise endogenously in a richer model in which party bosses decide the timing. If party bosses would not recruit politicians before selling connections to citizens, they might have an incentive to recruit fewer politicians *ex post*. Thus, citizens would favor parties that have already secured connections to politicians.

to the same constituency or demographic subgroup such as party associations for women, young people, students or pensioners, for instance. If politicians are expected to nominate only members belonging to their group, then party members outside this group, let alone members of other parties, have no incentive to lobby this politician. This reduces wasteful excessive networking to each politician. Yet, there are costs to this as well since each politician must now have a connection to the party boss in addition to the citizens. There will be no direct payments between the politicians and the citizens since the party regulates all connections.¹⁷

4.2 Properties of Party Equilibrium

We focus on an equilibrium where all politicians and citizens are party members. We establish below conditions under which this is the case. For notational simplicity, the number of connections that an agent of type t has to t' types is set equal over the agents of the same type and denoted by the same variable for all agents of the same type. This is restrictive in general but we show in the appendix that this is a property of any equilibrium¹⁸: all agents of the same type have an equal number of connections and pay and receive equal payments. We denote the reward that each citizen pays to the party boss by r_{BC} and the reward that each politician receives from the party boss by r_{CA} . A payment is made whether the connection is direct or indirect, but the cost of a connection is born only from direct connections. We also require that the equilibrium generates a non-negative payoff for all agents. We call these the constraints of political participation. It turns out that when these constraints are satisfied then both r_{BC} and r_{CA} are positive.

The party's payoff is

$$\begin{aligned} \pi_C = & m_{CB}[r_{BC} - \frac{c}{2}(m_{BA} + m_{BC})^2] \\ & + \mu_{CB}[r_{BC} - \frac{c}{2}(m_{BA})^2] \\ & - m_{CA}[r_{CA} + \frac{c}{2}(m_{AB} + m_{AC})^2] \\ & - \frac{c}{2}(m_{CA} + m_{CB})^2. \end{aligned}$$

The first row is the sum of rewards paid by the citizens who are directly connected to the party net of the citizens' networking costs paid by the party. The second row comprises the citizens who are indirectly connected to the party.¹⁹ The third row subtracts the rewards to the politicians and their networking costs paid by the party. The fourth row consists of the party's own networking costs.

Equally, the citizen's expected payoff is

$$\pi_B = \frac{\psi}{m_{AB}}m_{BA} - r_{BC}.$$

¹⁷Note that citizens often pay the party in the form of volunteer work. Our framework could be generalized to allow for this, without changing the qualitative results.

¹⁸This is essentially driven by the convexity of the networking cost function.

¹⁹Only one of the first two terms can differ from zero since, in equilibrium, all citizens behave identically.

Finally, a politician connected to a party receives a reward from the party (in addition to the compensation for networking costs). Thus her payoff equals $\pi_A = r_{CA}$.

The equilibrium network structure is based on two principles. First, the party is forced to build direct connections between the citizens and the politicians. This being the case, it is less costly for the party boss to establish her own connections to the citizens via a politician rather than directly. Moreover, allocating an equal number of citizens to each politician minimizes the cost of networking.

Second, competition drives the benefit from an additional connection equal to its marginal cost. Having a unique market reward and an unequal number of connections across the agents of one type would violate the condition of zero marginal net benefit. The one with fewer connections could apply the cheapest network structure described above and obtain the same reward with a lower marginal cost. Hence, the number of connections of any two agents of the same kind must be the same. The rewards are such that the parties are indifferent between supplying an additional connection to a citizen, or demanding an additional connection to a politician, and sticking to the equilibrium number of connections.

The following proposition characterizes the network structure in the *party equilibrium* and establishes the existence conditions.

Proposition 2

- There is a party equilibrium with $\pi_A^P \geq 0$ and $\pi_B^P \geq 0$ where each citizen and each politician is connected to a unique party if and only if

$$\frac{\psi}{c} \geq \gamma(\gamma + 2) \geq 2\omega + 2 + \gamma. \tag{5}$$

- In this equilibrium, each party boss is connected to ω politicians and $\omega\gamma$ citizens. The numbers of direct connections are given by $m_{AB}^P = \gamma$, $m_{BA}^P = 1$, $m_{AC}^P = 1$, $m_{CA}^P = \omega$, $m_{BC}^P = 0 = m_{CB}^P$.

Proof. See the appendix. ■

Figure 4 illustrates the network structure in the party equilibrium. Notice that the structure does not depend on the expected rent, ψ .

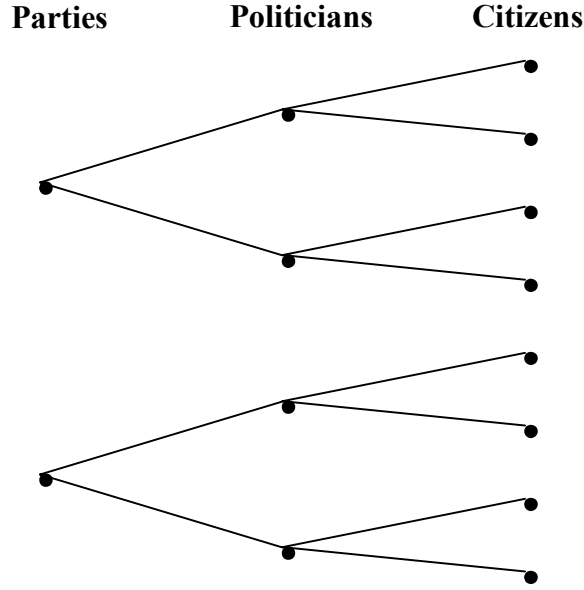


Figure 4: Connections in the party equilibrium, $n_C = \phi = \gamma = 2$.

According to (5), a party equilibrium exists if and only if the number of citizens per politician is not too small or too large, the networking cost and the number of politicians per party boss is sufficiently small and the expected rent from the nomination is sufficiently large. Using the network structure specified in proposition 2, we can establish the payments made by the party bosses to the politicians and the membership fees collected from the citizens²⁰.

5 Welfare

In this section, we compare welfare in the two equilibria - one without the involvement of the parties and the other when the parties are present. We use the aggregate surplus - the sum of the payoffs of those involved - as our welfare indicator. The sum of payoffs in the no-party equilibrium, $W^N(\cdot)$, is defined in section 3.2. The sum of payoffs in the party equilibrium is $W^P \doteq n_A \pi_A^P + n_B \pi_B^P + n_C \pi_C^P$. Notice that, in the no-party equilibrium, the expected rent, ψ , appears also on the cost side where it enters through the equilibrium number of connections²¹ $m_{BA}^N(\psi, c, \gamma)$. However, in the party equilibrium, the expected rent does not appear on the cost side. Our main finding is the following:

²⁰Reported explicitly in the appendix.

²¹If there is mixing in the equilibrium, then this is the smaller of the two consecutive amounts demanded in the equilibrium with a positive probability.

Theorem 1

- If the no-party equilibrium is characterized by

$$m_{BA}^N(\psi, c, \gamma) \leq \sqrt{\frac{(\gamma + 1)^2 + \gamma + \omega}{\gamma(\gamma + 1)}} - 1$$

then the no-party equilibrium results in higher welfare than the party equilibrium.

- If

$$m_{BA}^N(\psi, c, \gamma) \geq \sqrt{\frac{(\gamma + 1)^2 + \gamma + \omega}{\gamma(\gamma + 1)}}$$

then the party equilibrium results in higher welfare than the no-party equilibrium.

- There are parameter values for which the party equilibrium generates higher welfare than the no-party equilibrium and parameter values for which the reverse holds.

Theorem 1 is illustrated in figure 5 where $\gamma = 2$, $\omega = 2$ and $c = 1$ and the sum of equilibrium payoffs for the party and its members is given as a function of the expected rent ψ .

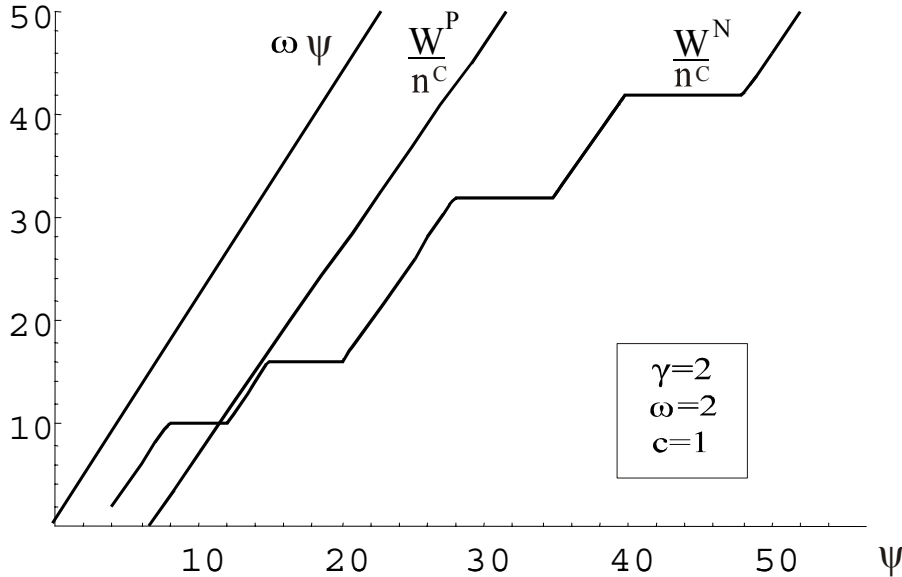


Figure 5: Comparison of welfare associated with 2 politicians and 4 citizens in a no-party and a party equilibrium.

Given that there are ω politicians for each party, $\omega\psi$ is the aggregate expected value of nominations within a party. In figure 5, $\omega\psi$ is the leftmost straight line of

slope equal to two (since figure 5 assumes two politicians per party). Some of this value is lost in networking. Thus, the sums of payoffs in the party and the no-party equilibrium, respectively W^P and W^N , lie below $\omega\psi$, the difference indicating the total networking costs. The network structure is controlled by the party and thus unaffected by ψ in the party equilibrium. Thus, the distance between $\omega\psi$ and W^P is constant. However, in the no-party equilibrium, the costs of networking are increasing in ψ and, therefore, the distance between $\omega\psi$ and W^N increases in ψ . Whereas for a small ψ , the number of connections is small and the no-party equilibrium generates smaller costs of networking, eventually as ψ increases the networking costs of the no-party equilibrium will exceed those of the party equilibrium, and the latter will generate a higher welfare than the former.²²

Proposition 1 and theorem 1 allow us to show how the social desirability of the party equilibrium, $W^P - W^N$, depends on the expected rent, ψ , and on the networking costs, c :

Proposition 3 *An increase (a decrease) in the expected rent ψ or a decrease (an increase) in the network cost parameter c weakly increases (decreases) the difference in the aggregate surplus between the party equilibrium and the no-party equilibrium.*

We find that the involvement of the party in the nominations is bound to result in a relatively higher social welfare, if the value of the rent increases and if the cost of networking decreases.

6 Conclusion

In this paper, we analyze the welfare implications of political parties taking a role in the distribution of nominations for non-ideological jobs and positions of trusts. We take as our starting point that there are anti-corruption laws which prevent political nominations from being sold. These laws still allow rent-seeking citizens to invest in good connections to nominating politicians. They spend time with the politicians by taking part in fund-raising events, volunteering their time in campaigns and by offering lunches and entertainment. Competition for the politicians' attention results in wasteful networking. As the party can require its politicians to only nominate from a subgroup of the party members, the political parties can improve efficiency by restricting the incentives to rent-seeking through connections.

It should be highlighted that the anti-corruption laws also restrict the activities of political parties. They are not allowed to sell the nominations either, but only to receive membership payments and allocate funds to politicians' campaigns. Even political parties are unable to fully eliminate wasteful networking, as they

²²Theorem 1 still leaves some parameter values undetermined where the number of connections in the no-party equilibrium is such that it is not a priori certain which equilibrium results in higher welfare. The exact welfare ranking can be solved numerically for each combination of parameter values.

cannot commit to restricting the number of members.²³ Social desirability of the involvement of the political parties in the non-ideological nominations increases as the costs of networking decrease and as the expected value of the nominations increase. This suggests a novel welfare motivation for the role of political parties in such nominations.

Our framework raises several topics for further research. First, we could endogenize the identity of the politicians in the citizen-candidate tradition pioneered by Osborne and Slivinski (1996) and Besley and Coate (1997). Second, we could endogenize the identity of the party bosses by presenting an overlapping-generations framework in which the party bosses arise from senior politicians. Third, Persson and Tabellini (2003) show that electoral rules have significant consequences on the organization of political parties and on economic policy. To what extent do these differences arise from the role that political parties play in network formation?

Fourth, we could allow for citizens to differ in their skills and preferences. In that case, politicians have an incentive to be connected with the citizens both in order to search for a competent one and to cash in the citizens' desire for nomination. Our main insight should remain: politicians would like to sell more connections than would be optimal from the efficiency perspective. Political parties could still improve efficiency by limiting the extent of connections when rents are sufficiently high.

Fifth, we could allow for different networking costs inside and outside the political parties and we could allow for the agents to partly control these costs. According to our model, the political parties could benefit from limiting the use of the new opportunities that communication technology provides, like political participation via the internet. At the same time, the citizens and the politicians may find it attractive to try to build connections outside the political parties. Such a divergence in networking costs could result in a reduced role of the parties and, therefore, in an alienation from the party membership.

Finally, we abstract from the role of ideological considerations. Some politicians and citizens might join the parties purely for ideological reasons. In a richer model, the citizens would differ in their ideology, and the politicians and the political parties would differ in their candidate valuations. In that case, the political parties could face a choice between the ideologically more appealing candidates and those willing to pay more for gaining access. Such trade-offs and heterogeneity in the ideological importance of positions could help to explain why some positions are typically filled by ideological party members, while others are used as rewards for contributors. For example in the United States, Presidents have nominated campaign contributors as Ambassadors while the Justices of the Supreme Court are chosen according to other criteria.

²³ Allowing political parties to pre-commit to not admit additional members would disenfranchise those citizens not belonging to the selected few from fully participating in the political life.

7 Appendix A

7.1 Lemma 1

Lemma 1 lists the parameter values for which each equilibrium regime exists given numbers of connections in equilibrium.

Lemma 1 *Given c and γ and that $\psi \geq c\gamma^2$, one and only one of the regimes prevails for each ψ .*

- *Equilibrium regime (i) where citizens are connected with m_{BA}^N politicians and politicians are connected with γm_{BA}^N citizens prevails iff*

$$c(m_{BA}^N)^2\gamma(\gamma + 1) - cm_{BA}^N\gamma \leq \psi \leq c\gamma(\gamma + 1)(m_{BA}^N)^2.$$

If ψ is increased above the upper bound, one enters an interval belonging to regime (ii) with each citizen having m_{BA}^N connections.

- *Equilibrium regime (ii) where citizens are connected with m_{BA}^N politicians and politicians are connected with γm_{BA}^N citizens prevails iff*

$$c\gamma(\gamma + 1)(m_{BA}^N)^2 < \psi \leq c\gamma m_{BA}^N(m_{BA}^N(\gamma + 1) + 1).$$

If ψ is increased above the upper bound, one enters an interval belonging to regime (iii) with each citizen having m_{BA}^N or $m_{BA}^N + 1$ connections.

- *Equilibrium regime (iii) where citizens have m_{BA}^N or $m_{BA}^N + 1$ connections whereas politicians have m_{AB}^N or $m_{AB}^N + 1$ connections where $\gamma m_{BA}^N \leq m_{AB}^N < \gamma(m_{BA}^N + 1)$ prevails iff*

$$cm_{AB}^N(m_{AB}^N + m_{BA}^N + 1) < \psi < c(m_{AB}^N + 1)(m_{AB}^N + m_{BA}^N + 1).$$

If ψ is increased above the upper bound and

- *if $m_{AB}^N < \gamma(m_{BA}^N + 1) - 1$, one enters an interval belonging to regime (iv) with $m_{AB}^N + 1$ connections for politicians.*
- *if $m_{AB}^N = \gamma(m_{BA}^N + 1) - 1$, one enters an interval belonging to regime (i) with $m_{BA}^N + 1$ connections for citizens.*
- *Equilibrium regime (iv) where citizens have m_{BA}^N or $m_{BA}^N + 1$ connections whereas politicians have m_{AB}^N connections where $\gamma m_{BA}^N + 1 \leq m_{AB}^N < \gamma(m_{BA}^N + 1)$ prevails iff*

$$cm_{AB}^N(m_{AB}^N + m_{BA}^N) \leq \psi \leq cm_{AB}^N(m_{AB}^N + m_{BA}^N + 1).$$

If ψ is increased above the upper bound, one enters an interval belonging to regime (iii) with politicians mixing between m_{AB}^N and $m_{AB}^N + 1$ connections.

7.2 Lemma 2

Lemma 2 *Equilibrium payoffs and the sum of payoffs are non-negative and given by*

$$\begin{aligned}\pi_A^N &= \psi - \frac{c}{2}\gamma m_{BA}^N(\gamma m_{BA}^N + 2m_{BA}^N - 1) \\ \pi_B^N &= \frac{c}{2}m_{BA}^N(m_{BA}^N - 1) \\ W^N &= [\psi - \frac{c}{2}\gamma(m_{BA}^N)^2(\gamma + 1)]n_A\end{aligned}$$

in regime (i);

$$\begin{aligned}\pi_A^N &= \frac{c}{2}\gamma m_{BA}^N(\gamma m_{BA}^N + 1) \\ \pi_B^N &= \frac{\psi}{\gamma} - m_{BA}^N \frac{c}{2}(2\gamma m_{BA}^N + 1 + m_{BA}^N) \\ W^N &= [\psi - \frac{c}{2}\gamma m_{BA}^N(\gamma m_{BA}^N + m_{BA}^N)]n_A\end{aligned}$$

in regime (ii);

$$\begin{aligned}\pi_A^N &= \frac{c}{2}m_{AB}^N(m_{AB}^N + 1) \\ \pi_B^N &= \frac{c}{2}m_{BA}^N(m_{BA}^N + 1) \\ W^N &= [\frac{c}{2}m_{AB}^N(m_{AB}^N + 1) + \frac{c}{2}\gamma m_{BA}^N(m_{BA}^N + 1)]n_A\end{aligned}$$

in regime (iii); and

$$\begin{aligned}\pi_A^N &= \psi - \frac{c}{2}m_{AB}^N(2m_{BA}^N + m_{AB}^N + 1) \\ \pi_B^N &= \frac{c}{2}m_{BA}^N(m_{BA}^N + 1) \\ W^N &= [\psi + \frac{c}{2}\gamma m_{BA}^N(m_{BA}^N + 1) - \frac{c}{2}m_{AB}^N(2m_{BA}^N + m_{AB}^N + 1)]n_A\end{aligned}$$

in regime (iv).

7.3 Proof of lemma 1

Proof. We will first show that each equilibrium regime exists in each of its intervals of ψ in the claim. For each regime, the proof proceeds regime by regime using a market clearing condition and the two optimality conditions (4) and (3) where either one or the other must be equal to one of its bounds. The market clearing condition is given by $\sum_{m_{AB}} q_{m_{AB}}^A m_{AB} = \sum_{m_{BA}} q_{m_{BA}}^B m_{BA}$ where $q_{m_{AB}}^A$ and $q_{m_{BA}}^B$ are the probabilities that a politician has m_{AB} connections and a citizen has m_{BA} connections, respectively. Below, we will illustrate how the bounds are derived for regime (i).

Supplementary material provides an extended version of the proof including the details of the proof for each regime.

Bounds of regime (i). In equilibrium, the supply of connections by politicians has to equal the demand by citizens and thus $m_{AB}^N = \gamma m_{BA}^N$. We consider the equilibrium reward which maximizes the politicians' payoffs. Thus, the latter inequality of (4) is satisfied as an equality, and solving for r^N gives

$$r^N = \frac{\psi}{\gamma m_{BA}^N} - \frac{c}{2}(2m_{BA}^N - 1). \quad (6)$$

Now (3) must be satisfied yielding

$$c\gamma(m_{BA}^N)^2(\gamma + 1) - c\gamma m_{BA}^N \leq \psi \leq c\gamma(m_{BA}^N)^2(\gamma + 1).$$

Thus, if and only if these conditions hold, we have a regime (i) equilibrium with citizens having m_{BA}^N connections.

It is easy to verify that, for each pair c and γ , the regime intervals are ordered as in the statement of lemma 1. When $m_{BA}^N = 1$, for example, the lower bound of (i) equals $c\gamma^2$. The uniqueness and the existence and the order of regime intervals follow since the intervals form a partition of $[c\gamma^2, \infty)$. ■

7.4 Proof of lemma 2

Proof. From the proof of lemma 1, we obtain the equilibrium payoffs and welfare in various regimes by substituting in the expected equilibrium connection quantities and the equilibrium rewards. Using the boundaries of the existence condition of the regime in lemma 1, it is easy to verify that the equilibrium payoffs of the politician, the citizen and the politician in regimes (i), (ii), (iii) and (iv) respectively are non-negative. ■

7.5 Proof of proposition 1

Proof. We first show that there can be no other equilibria but those which belong to regimes (i)-(iv). The claim then follows from lemma 1.

The payoff of the politician is strictly concave in the number of connections, $rm_{AB} - \frac{c}{2}(m_{AB})^2$. Moreover, if each politician's expected number of connections is the same, then a citizen's gross expected return from a connection is equal across her connections. Thus, also the citizen's payoff is strictly concave in the number of connections. A strictly concave function has at most two maximizers which are moreover consecutive.

There is no symmetric equilibrium where all citizens have an equal number of connections but politicians are indifferent and fraction $q_{m_{AB}}^A$ have m_{AB} and fraction $1 - q_{m_{AB}}^A$ have $m_{AB} + 1$ connections since then demand for connections would not equal the supply. Moreover, given that the politicians can be indifferent between connection quantities that differ at most by one, market would not clear if

quantity $m_{AB} \notin \{\gamma m_{BA}^N, \dots, \gamma(m_{BA}^N + 1)\}$ maximizes the politicians' payoff (where m_{BA}^N is the smallest equilibrium connection quantities of the citizens).²⁴

We have ruled out any other type of equilibrium regime but (i)-(iv). By lemma 1, one and only one of these regimes prevails and, by the transformation rule of the regimes, the (minimum) equilibrium quantities, $m_{AB}^N(\psi, c, \gamma)$ and $m_{BA}^N(\psi, c, \gamma)$ are increasing in ψ . Moreover by lemma 1, the bounds of each regime with given equilibrium quantities are increasing in c and in γ . Thus, by the transformation rule, the equilibrium quantities are decreasing in c and in γ .

The last claim follows from noticing that the equilibrium payoff functions and the sum of payoffs in lemma 2 are continuous increasing functions in ψ . To see this, notice that by lemma 1, the regimes constitute a partition of $[c\gamma^2, \infty)$ and it is easy to check that the equilibrium payoff functions and the sum of payoffs in lemma 2 are continuous at the regime shift values of ψ . That TC^N is increasing in ψ follows from the fact that $m_{AB}^N(\psi, c, \gamma)$ and $m_{BA}^N(\psi, c, \gamma)$ are increasing in ψ . ■

7.6 Proof of proposition 2

Proof. 1) Let us first assume that each party has γ citizens for each politician connected to it, that is $\mu_{CB} = \gamma m_{CA}$. The equilibrium reward must be such that the party is indifferent on whether to have an additional connection or not. An additional connection to a citizen would increase the networking costs of the politician to whom the citizen would be connected from $\frac{c}{2}(\gamma+1)^2$ to $\frac{c}{2}(\gamma+2)^2$. In addition, the party would have to pay $\frac{c}{2}$ for the new citizen's networking cost as the party bears all networking costs. The marginal increase in the networking costs then equals $\frac{c}{2}(2\gamma+4) = c(\gamma+2)$. For any party, the net gain from supplying a connection to one more citizen cannot be positive in equilibrium. Hence, $r_{BC}^P \leq c(\gamma+2)$. On the other hand, it is not possible that the net gain is negative either, $r_{BC}^P < c(\gamma+2)$, since then each party could increase the reward that a citizen has to pay up to $c(\gamma+2)$. The citizen remains with his party even with the higher reward since, for every party $r_{BC}^P \leq c(\gamma+2)$, and hence no party strictly prefers offering a connection to an additional citizen. Thus,

$$r_{BC}^P = c(\gamma+2). \quad (7)$$

2) Given that each party has m_{CA} politicians, the equilibrium number of citizens per party is $m_{CA}\gamma$. To see this, suppose that there are two political parties, C' and C'' and that the number of citizens connected to the two political parties are such that $\frac{\mu_{CB}''}{m_{CA}''} < \frac{\mu_{CB}'}{m_{CA}'}$. Then, since all citizens and politicians are connected and $n_B = \gamma n_A = \gamma \omega n_C$, we can choose two political parties so that $\frac{\mu_{CB}''}{m_{CA}''} < \gamma < \frac{\mu_{CB}'}{m_{CA}'}$. However, then using the cheapest structure described in point (1) of the proof, every politician connected to C'' must have $\gamma+1$ connections or less. Denote the largest number of connections of a politician in party C'' by m'' . For the party C' , on the other hand, there must be a politician for whom the number of connections m' is

²⁴By the same arguments, there can be no two agents of the same type whose payoff maximizing link quantities differ by more than one.

strictly greater than $\gamma + 1$. Hence,

$$\frac{c}{2}(m'' + 1) \leq \frac{c}{2}(\gamma + 1) < \frac{c}{2}(m' + 1). \quad (8)$$

The reward r'_{BC} of the party C' must be higher than or equal to $(2m' + 2)$. Otherwise, the last additional connection does not provide positive profit. However, for C'' the marginal cost is lower and therefore,

$$r'_{BC} \geq c(m' + 2) > c(m'' + 2).$$

Thus, party C'' makes a profit by providing a cheaper additional connection to a customer of C' and the customer has a higher or equal probability of receiving the nomination with C'' than with C' and this cannot be an equilibrium. This is a contradiction. Hence, $\frac{\mu'_{CB}}{m'_{CA}} = \frac{\mu'_{CB}}{m_{CA}} = \gamma$.

3) Let us now show that the equilibrium reward r_{CA}^P satisfies

$$r_{CA}^P = \frac{c(\gamma^2 + \gamma - 1)}{2} - \frac{c}{2}(2m_{CA}^P + 1). \quad (9)$$

The benefits to the party are the payments from all citizens connected to the politicians,

$$m_{CA}^P \gamma r_{BC}^P.$$

The costs include the payment made to the politicians $m_{CA}^P r_{CA}^P$, the networking costs of politicians paid by political parties, $m_{CA}^P \frac{c}{2}(\gamma + 1)^2$, the networking costs of the citizens connected to the politicians of the party, $m_{CA}^P \gamma \frac{c}{2}$, and the party's own networking costs to the politicians $\frac{c}{2}(m_{CA}^P)^2$. In equilibrium, the marginal benefit from connections to politicians must equal its marginal cost, that is

$$\gamma r_{BC}^P = \frac{c}{2}\gamma + r_{CA}^P + \frac{c}{2}(\gamma + 1)^2 + \frac{c(2m_{CA}^P + 1)}{2}. \quad (10)$$

Substituting from (7), the payment r_{CA}^P is given by (9).

4) Let us now show that any network structure where for some party's amount of connections, m_{CA} , differs from ω cannot be an equilibrium. If there is such a party then, since all politicians are connected to a party, there must be parties C'' and C' with $m'_{CA} < \omega < m''_{CA}$ and thus $m''_{CA} \geq m'_{CA} + 2$. The party C'' is not willing to pay more than $r''_{CA} = \frac{c(\gamma^2 + \gamma - 1)}{2} - \frac{c}{2}(2m''_{CA} + 1)$ to the politicians connected to it. Otherwise, the last additional politician would deteriorate the payoff of C'' . However, C' can recruit a politician connected to C'' with a positive profit, since

$$r_{C''A}^P \leq \frac{c(\gamma^2 + \gamma - 1)}{2} - \frac{c}{2}(2m''_{CA} + 1) < \frac{c(\gamma^2 + \gamma - 1)}{2} - \frac{c}{2}(2m'_{CA} + 1)$$

and C' can afford paying $r_{C''A}^P + \varepsilon$ for a sufficiently small $\varepsilon > 0$. Hence, $m_{CA} \neq \omega$ cannot be an equilibrium.

The equilibrium reward r_{BC}^P is given by equation (7) in part 1) of the proof. The equilibrium reward,

$$r_{CA}^P = \frac{c}{2}(\gamma^2 + \gamma - 2\omega - 2), \quad (11)$$

now follows from substituting r_{BC}^P and $m_{CA}^P = \omega$ into (10) and rearranging. Thus, $\pi_A^P \geq 0$ and $\pi_B^P \geq 0$ if and only if

$$\frac{\psi}{c} \geq \gamma(\gamma + 2) \geq 2\omega + 2 + \gamma. \quad (12)$$

■

7.7 Proof of theorem 1

Proof. In regime (i) and in regime (ii), we find that $W^{N-P} \geq 0$ iff

$$m_{BA}^N \leq \sqrt{\frac{(\gamma + 1)^2 + \gamma + \omega}{\gamma(\gamma + 1)}}. \quad (13)$$

This follows by substituting in the values of W^N and W^P and rearranging.

If the parameter values are such that regime (i) or (ii) prevails, then the claim follows directly from (13). If the prevailing regime is (iii) or (iv), we proceed as follows: we hypothetically increase or decrease ψ as little as possible but so that a nearby regime (i) or regime (ii) interval is reached, respectively. This can be done by the alternation rule of equilibrium regimes pointed out in lemma 1. We check whether (13) holds at that hypothetical situation and since both $m_{BA}^N(\psi, c, \gamma)$ and $W^{N-P}(\psi, c, \gamma, \omega)$ are monotone in ψ , we are able to make a claim about $W^{N-P}(\psi, c, \gamma, \omega)$ with the original ψ .

Remember that if regime (iii) or (iv) with $m_{BA}^N(\psi, c, \gamma)$ prevails, then some citizens have $m_{BA}^N(\psi, c, \gamma)$ connections whereas some others have $m_{BA}^N(\psi, c, \gamma) + 1$ connections. On the other hand, if regime (i) or (ii) with $m_{BA}^N(\psi, c, \gamma)$ prevails, then all citizens have $m_{BA}^N(\psi, c, \gamma)$ connections.

Denote the prevailing expected rent by $\tilde{\psi}$. Consider $\psi' < \tilde{\psi}$ where ψ' is the largest ψ such that regime (ii) with $m_{BA}^N(\tilde{\psi}, c, \gamma)$ connections prevails (by the alternation rule of the equilibrium regimes in lemma 1, equilibrium regime (ii) with $m_{BA}^N(\tilde{\psi}, c, \gamma)$ prevails for an interval of values of ψ smaller than $\tilde{\psi}$). Thus, $m_{BA}^N(\tilde{\psi}, c, \gamma) = m_{BA}^N(\psi', c, \gamma)$. Now if $m_{BA}^N(\psi', c, \gamma) > \sqrt{\frac{(\gamma+1)^2 + \gamma + \omega}{\gamma(\gamma+1)}}$ then $W^{N-P}(\psi', c, \gamma, \omega) < 0$ and since $W^{N-P}(\psi, c, \gamma, \omega)$ is decreasing in ψ and $\psi' < \tilde{\psi}$, $W^{N-P}(\tilde{\psi}, c, \gamma, \omega) < 0$.

Consider now $\psi' > \tilde{\psi}$ where ψ' is the smallest ψ such that regime (i) prevails with $m_{BA}^N(\tilde{\psi}, c, \gamma) + 1$ connections (by the alternation rule of the equilibrium regimes in lemma 1, equilibrium regime (i) with $m_{BA}^N(\tilde{\psi}, c, \gamma) + 1$ prevails for an interval of values of ψ greater than $\tilde{\psi}$). Thus $m_{BA}^N(\psi', c, \gamma) = m_{BA}^N(\tilde{\psi}, c, \gamma) + 1$. Now if

$$m_{BA}^N(\psi', c, \gamma) \leq \sqrt{\frac{(\gamma + 1)^2 + \gamma + \omega}{\gamma(\gamma + 1)}}, \quad (14)$$

then $W^{N-P}(\psi', c, \gamma, \omega) \geq 0$ and since $W^{N-P}(\psi, c, \gamma, \omega)$ is decreasing in ψ and $\psi' > \tilde{\psi}$,

$W^{N-P}(\tilde{\psi}, c, \gamma, \omega) \geq 0$. However, (14) is equivalent to

$$m_{BA}^N(\tilde{\psi}, c, \gamma) \leq \sqrt{\frac{(\gamma + 1)^2 + \gamma + \omega}{\gamma(\gamma + 1)}} - 1$$

where $\tilde{\psi}$ is the original value since $m_{BA}^N(\tilde{\psi}, c, \gamma) + 1 = m_{BA}^N(\psi', c, \gamma)$. This completes the proof of the theorem. ■

8 Appendix B

8.1 Cooperative Network Approach

The approach in section 3 implicitly assumes a Walrasian auctioneer who sets the price and coordinates the demand and the supply of connections. In this appendix, we adopt a game theoretical cooperative networks approach building upon Jackson and Wolinsky (JW, 1996) and leading to the same conclusion as the Walrasian approach.

Remember that a network is characterized by a matrix M of zeros and ones on which the restriction $m_{i,j} = m_{j,i}$ is imposed. Network $M - ij$ is one where the connection between i and j present in m is abolished. Network $M + ij$ is one where the connection ij not present in M is created. Network $M \pm ij$ is any such network where a connection in M is abolished and a new connection is created between i and j .

We implicitly assume that politicians play an active role, making take-it-or-leave-it offers to citizens. A priori they can discriminate across citizens by charging them different payments. The reward that politician i charges from citizen j is denoted $r_{i,j}$ and her profile of rewards is denoted by $\mathbf{r}_i = (r_{i,1}, \dots, r_{i,n_B})$.²⁵ The matrix of reward profiles is denoted by $\mathbf{R} = (\mathbf{r}_1, \dots, \mathbf{r}_{n_A})'$. A network is stable if, first with given rewards, no politician or citizen would gain by refraining from establishing any of the specified connections or by replacing a connection; and second, it does not pay off for the politicians to change their rewards. The formal statement is given in the two definitions below. Define $q_{i,j}$ as the probability that there is a connection between i and j . For a given \mathbf{R} let \mathbf{R}^o satisfy $r_i^o = (r_{i,1}, \dots, r_{i,j-1}, r_{i,j}^o, r_{i,j+1}, \dots, r_{i,n_B})$ where $r_{i,j}^o \neq r_{i,j}$ and $r_k^o = r_k$ for $k \neq i$. (In \mathbf{R}^o there is only one politician whose reward scheme is different from that in \mathbf{R} and only one reward offer of that politician is different from the offers in \mathbf{R} .)

Definition 1 *Given \mathbf{R} , the network m is pair-wise stable, provided that*

- (1) *if $q_{i,j} > 0$, then $\pi_i(M, \mathbf{R}) \geq \pi_i(M - ij, \mathbf{R})$ and $E\pi_j(M, \mathbf{R}) \geq E\pi_j(M - ij, \mathbf{R})$*

²⁵These would appear in equations (1) and (2) in the subsection 3.1 and r would be replaced by $r_{i,j}$.

(2) if $q_{i,j} = 0$, then

$$\pi_i(M, \mathbf{R}) < \pi_i(M + ij, \mathbf{R}) \text{ implies } \mathbb{E}\pi_j(M, \mathbf{R}) > \mathbb{E}\pi_j(M + ij, \mathbf{R})$$

For every $M \pm ij$, $\pi_i(M, \mathbf{R}) < \pi_i(M \pm ij, \mathbf{R})$ implies $\mathbb{E}\pi_j(M, \mathbf{R}) > \mathbb{E}\pi_j(M \pm ij, \mathbf{R})$

$$\mathbb{E}\pi_j(M, \mathbf{R}) < \mathbb{E}\pi_j(M + ij, \mathbf{R}) \text{ implies } \pi_i(M, \mathbf{R}) > \pi_i(M + ij, \mathbf{R})$$

For every $M \pm ij$, $\mathbb{E}\pi_j(M, \mathbf{R}) < \mathbb{E}\pi_j(M \pm ij, \mathbf{R})$ implies $\pi_i(M, \mathbf{R}) > \pi_i(M \pm ij, \mathbf{R})$.

Definition 2 \mathbf{R} is stable if there does not exist \mathbf{R}^o (as defined above) such that $\pi_i(M, \mathbf{R}^o) > \pi_i(M, \mathbf{R})$ where M given \mathbf{R}^o is pair-wise stable.

The first definition lists essentially the pair-wise stability conditions of JW. Pair-wise stability is stronger than the Nash equilibrium concept since it allows for pair-wise deviations if they are profitable. Our approach differs from JW in two aspects. First, we allow for pair-wise deviations where two players form a connection and at the same time each of them abandons one of their connections. Second, we suppose that the politicians make take-it-or-leave-it reward-offers to citizens. This obviously endogenizes the value of any given network²⁶ and we need to say something about the stability of the rewards. We consider the rewards stable if no politician can benefit by charging different rewards without destabilizing her network. This is captured by definition 2.

The first pair of inequalities of condition 2 of definition 1 implies that if i strictly prefers to deviate and form a connection with j whereas j is indifferent, then the connection between them will be formed with a positive probability. The second pair of inequalities of condition 2 includes the case where replacing some connection of politician i and some connection of citizen j by a connection between i and j would benefit politician i but harm citizen j . The third and the fourth pairs of inequalities have the corresponding cases where the citizen would gain and the politician would lose. Notice that the pair-wise stability conditions (1) and (2) do not say whether there is a positive or a zero probability of forming a connection if both are indifferent.

This cooperative network approach leads to exactly the same outcome as the Walrasian approach of section 3. As in the Walrasian approach, there may exist several equilibrium reward profiles with equal rewards for all politicians which sustain the same network constellation. We choose to consider the one where politicians' payoffs are the highest. These stable networks and reward profiles coincide with the Walrasian equilibria. The intuition behind this result is the following. The expected numbers of connections must be the same, since if they are not, then a citizen connected to a politician with more connections and a politician with less connections can pair-wise deviate and replace their existing connections so that the citizen strictly benefits and the politician is indifferent. The equilibrium rewards must be the same since if they are not, then a citizen connected with a politician with a higher reward and a politician with a lower reward can pair-wise deviate. However, if the equilibrium quantities of connections of agents of the same type are

²⁶The value of the network and the allocation rule are determined by the extent of linking and the rewards.

equal and the rewards are equal to the marginal costs or benefits of all citizens or all politicians, then no deviation will strictly benefit one party without harming the other.

8.2 Proof of proposition 1, cooperative networks approach

Proof. Before proceeding to the proof of proposition 1 itself, we first need to reconsider the proof of lemma 1. In all regimes, the Walrasian proof above verifies that the supply of connections equals their demand. It also verifies that in all regimes, by (3) and (4), neither citizens nor politicians are willing to increase or reduce their number of connections. But if, first, all politicians set equal rewards for all citizens, and second, if politicians and citizens have connection quantities which satisfy (3) and (4), then conditions (1) and (2) in definition 1 (the stability of the network) are satisfied. Thus given \mathbf{R} , the network is stable. In regime (i), decreasing any $r_{i,j}$ would not increase profits, since the politician is not willing to be connected with more citizens due to the fact that reward is below the marginal cost of an added connection. Increasing any $r_{i,j}$ would render citizen j willing to replace his connection with that politician with a connection to another politician and this latter would be indifferent between replacing and not replacing the connection. Thus, such an \mathbf{R}' is not stable. In regime (ii), it does not pay off for the politician to reduce her reward, since this would reduce her payoff for each current customer and the reward would be lower than the marginal networking cost to an added citizen. If a politician charges a reward higher than the reward cap, there exists a pair-wise replacement deviation where one of her customers replaces the connection with the politician with a connection with a politician whose reward equals the reward cap. Thus, the rewards are stable. In regime (iii), it does not pay off for the politician to reduce her reward, since this would reduce her payoff for each current customer and the reward would be lower than the marginal networking cost to an added citizen. If a politician charges a higher reward, there exists a pair-wise replacement deviation where one of her customers replaces the connection with the politician with a connection with a politician whose reward equals the original reward. Thus, the rewards are stable. In regime (iv), by the same arguments as in the previous case the network is stable given \mathbf{R} and, on the other hand, \mathbf{R} is stable.

Now we move to the core of the proof of the proposition. In proving the uniqueness (under the restriction that the rewards are the most favorable for politicians given a network structure, and up to permutations) in the cooperative network approach, in addition to what is done in the Walrasian proof, we need to verify that there is no price discrimination across citizens in equilibrium or that the rewards of two politicians cannot differ.

If there are two politicians whose expected supplied quantities differ say $m'_{AB} < m''_{AB}$ then the marginal networking costs (MC) satisfy $MC' < MC''$ and $p'_A > p''_A$. Moreover, $MC' < MC'' \leq r''$. However, now the one with less connections can slightly undercut r'' and provide an additional connection to the citizen who is offered r'' and this citizen is willing to take the offer since $m'_{AB} < m''_{AB}$ and thus the

probability of being nominated when connecting to this other politician is at least p''_A with the original politician. Thus all politicians must have an equal number of connections.

Suppose now that all politicians have an equal number of connections and there are two politicians whose rewards at two implemented connections differ (notice that any network where a single politician price discriminates against her citizens implies this). Now obviously, the politician with a lower offer can abolish this low reward connection and slightly undercut the offer made to the citizen to which the politician with the higher offer is connected. This pays off to both the lower offer politician and the higher offer citizen. Thus, all politicians must be connected to an equal number of citizens in expected terms and the offers must be equal. ■

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