Technical and Data Appendix to "Experiments with Network Formation"

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Abstract

This appendix provides proofs and the entire set of data used in Corbae and Duffy [1]. In particular we show that for the environment laid out in our Corbae and Duffy [1], a marriage network is not only the ex-ante efficient network, but also stable in the sense of being immune to unilateral deviations.

This separate technical (Section 1) and data appendix (Section 2) is provided as a supplement to our paper and is not intended for publication

1 Proofs

The crucial part of the analysis of perfect Bayesian play in the stag-hunt stage is to try to infer ones' neighbors' type. To this end, we introduce the following notation. Let ω^i denote player i's type, and denote the action taken by player i in round t by $a_t^i \in A^i\left(\omega^i\right) \subset \{X, Y\}$. Write $a^{i,t-1} := \left(a_1^i, a_2^i, ..., a_{t-1}^i\right)$ for the history of player i's actions prior to round t. It will be convenient to use identical notation for the functions describing a generic behavioral strategy for the player. For example, if player i has two neighbors, say j and k, in some network, then the action prescribed by a pure strategy for player i in round t is a function of his own type and the actions taken by his neighbors prior to round t; that is, $a_t^i = a_t^i\left(\omega^i, a^{j,t-1}, a^{k,t-1}\right)$.[1]

The next lemma is useful in establishing results for the case of neighborhoods of one or two players. It follows from $b > \frac{a+c}{2}$ that if an agent knows that one of his neighbors has the shock (and must play Y), he should play Y in subsequent rounds if his neighborhood has one or two neighbors.

Lemma 1 *Suppose shocks are permanent. Following any history in which some player with two or fewer neighbors knows that one of his neighbors has the shock, any strategy which calls for that player to play X in a subsequent round is strictly dominated by a strategy that is otherwise identical, except that the player plays Y for the remainder of the game from this history.*

Proof. If an agent plays X in a state in which he knows one of his neighbors has the shock, he gets at most $\frac{a+c}{2}$ for the round. By committing instead to play Y in each round subsequent to the discovery that a neighbor has the shock, this player guarantees himself a sure payoff of b in each round. Since $b > \frac{a+c}{2}$, this change represents a strict improvement over a strategy which calls for play of X in this case, and is otherwise identical. ■

The next lemma shows that despite the fact that the shocked agent is certainly in one's neighborhood in a UM network, it is possible to support X play by unshocked players since $\frac{2a+c}{3} > b$. With this strategy, there is no "contagious" Y play in a UM network.

Lemma 2 *When the network is given by UM, there is an ex-ante payoff dominant, pure strategy PBE in which each unshocked agent plays X in every round.*

Proof. Consider the following strategy. Each unshocked agent plays X in the first round and thereafter plays X in each round in which at least three agents play X in the previous round, and plays Y otherwise. First note that play of Y by each player constitutes an equilibrium continuation following any deviation. To see that the stated strategies are a PBE, it suffices to note that the payoff of a player who has not received the shock is $\frac{2a+c}{3}$ in each period, which is greater than the one period payoff from playing Y. Moreover, by deviating a player ensures that she will receive this lesser amount in every subsequent period as well. Thus, the prescribed strategies are mutual best responses. The ex-ante payoff is the average of the payoff received by the three players who do not receive the shock and the shocked player; that is $\frac{3}{4} \cdot \frac{2a+c}{3}\tau + \frac{1}{4}b\tau = \frac{2a+b+c}{4}\tau$.

To see that the equilibrium constructed is ex-ante payoff dominant, it suffices to show that the ex-post payoffs of each player in each round is as large as it can be. That this is so for the shocked player is true by definition. Now consider an unshocked player. The four possible payoffs for any given period are $\frac{2a+c}{3} > b > \frac{a+2c}{3} > c$ if 2 unshocked neighbors play X (the equilibrium path), if the agent chooses Y, if 1 unshocked neighbors plays X, and if no unshocked neighbors play X, respectively. Playing the above strategy thus yields the highest in each period. ■

[1] Allowing for dependence on the player's own past actions is redundant under pure strategies; this can be seen as follows. Suppose that we were to write $a_t^i = f_t\left(\omega^i, a^{i,t-1}, a^{j,t-1}, a^{k,t-1}\right)$ in the example above. Then clearly we could write

$$\begin{aligned} a_t^i &= f_t\left(\omega^i, f_{t-1}\left(\omega^i, a^{i,t-2}, a^{j,t-2}, a^{k,t-2}\right), a^{j,t-1}, a^{k,t-1}\right) \\ &=: h_t\left(\omega^i, a^{i,t-2}, a^{j,t-1}, a^{k,t-1}\right). \end{aligned}$$

By recursion, it is clear that we can always reduce the function to the form presented in the text.

The next result, which follows from $b > \frac{a+c}{2}$, shows that a strategy where unshocked agents in an LI network play X in the first round until the shocked agent is discovered is an equilibrium (though obviously not unique). Using that strategy, the position of the shocked player can be inferred after one round. The agent who is diagonally across from the shocked agent anticipates that his unshocked neighbors will play Y by lemma 1 and hence plays Y. Notice that this result would be very different if we were using a solution concept like naive best response. Thus, the "contagious" Y play spreads very quickly in our application, but would take another round with naive players.

Lemma 3 *When the network is given by LI, there is an ex-ante payoff dominant, pure strategy PBE in which all unshocked agents play X in the first round, then all agents play Y in subsequent rounds.*

Proof. Consider the following strategy. Each unshocked agent plays X in the first round and plays Y in subsequent rounds. Since play of Y is an equilibrium of the one period game, play of Y in rounds 2 through τ is an equilibrium continuation following any mode of play for date 1; therefore, to show that the play described is an equilibrium, it suffices to show that play of X in the first round is a mutual best response. In the first round, conditional on not receiving the shock, an agent's prior that one of her neighbors has the shock is $\frac{2}{3}$ and that neither has it is $\frac{1}{3}$. Thus, the expected payoff for playing X in the first round is given by $\frac{2}{3}\left(\frac{(a+c)}{2}\right)+\frac{1}{3}(a)=\frac{2a+c}{3}$ while the payoff to playing Y in the first round is b, which is less by Assumption 1. Thus, playing X is a mutual best response in round 1 when each continuation is independent of first round play. This shows that the stated strategy constitutes a PBE. Payoffs for an agent who is shocked are given by $b\tau$, for an agent whose neighborhood contains the shocked player is $\frac{a+c}{2}+b(\tau-1)$, and for an agent whose neighborhood does not contain the shocked player is $a+b(\tau-1)$. Thus, ex-ante payoffs are given by $\frac{2a+b+c}{4}+b(\tau-1)$.

Next we show that play of X by three players can occur at most once in any pure equilibrium in an LI network, and that such a round can only be followed by play of Y in every subsequent round. For concreteness, suppose that players are linked as $1-2-3-4-1$ in Figure 1 and suppose that after some history of shocks and actions $\left(\omega^i, a^{i,t-1}\right)_{i=1}^{4}$, players' strategies call for play of X at t by players $1-3$ and Y by player 4. Then state ω is known to at least two players after such an occurrence: player 4, who has the shock; and player 2 who played X and is situated between two other players who did likewise. (Player 2 knows her own type and those of two others, and so she can infer the type of player 4 whose play she cannot observe directly.) On the other hand, players 1 and 3 see play of one X and one Y but cannot see whether each other is playing Y and so cannot necessarily infer whether 4 is shocked or just playing Y. Thus while players 2 and 4 are informed, players 1 and 3 are uninformed. However, the uninformed player 1 knows that agent 2 is informed. To see this, it is common knowledge that player 2 knows that if $\omega^3=0$, player 2's action history were $a^{2,t-1}$, and player 4's action history were $\{Y,Y,...,Y\}$, then player 3 would play X by the above supposition (i.e. $a_t^3(0,a^{2,t-1},\{Y,Y,...,Y\})=X$). Therefore, if there was another history with $\widetilde{\omega}^3$ and $\widetilde{a}^{4,t-1}$ but the same $a^{2,t-1}$with $a_t^3(\widetilde{\omega}^3,a^{2,t-1},\widetilde{a}^{4,t-1})=Y$, then player 1 knows that if agent 2 had observed play of Y by agent 3, player 2 could infer player 3's type. That is, either $\widetilde{a}^{4,t-1}\neq\{Y,Y,...,Y\}$ in conjunction with $\omega^1=\omega^2=0$ or $\widetilde{\omega}^3\neq 0$ implies $\widetilde{\omega}^3=1$.

To finish the proof that play of X by three players can occur at most once and that such a round can only be followed by play of Y in every subsequent round, first note that subsequent play of X by an LI agent who knows that at least one neighbor has the permanent shock is strictly dominated by Lemma 1. Next consider the problem faced by a neighbor of the informed players considered above. Player 1, say, knows that one of two things is true: either her neighbor who played Y (player 4) actually has the shock, or player 3 has the shock and player 2 knows it. In either case, player 1 has at least one neighbor who will play Y in each subsequent round. Therefore, she must play Y herself in any equilibrium continuation. It follows that each player must do likewise. Since any situation in which three players play X in equilibrium is isomorphic to that described above, this result holds generally, as claimed.

To see that this equilibrium is ex-ante payoff dominant among symmetric equilibria, first note that the all-Y equilibrium, which yields ex-ante payoff b in each round is dominated since $\frac{2a+b+c}{4}>b$ by Assumption 1. By symmetry, the first time anyone plays X, all three unshocked agents must play X, which we know from above must be followed by all-Y. Since we have shown that three Xs can occur at most once, no pure symmetric PBE can deliver a higher ex ante payoff than the one constructed, Q.E.D. ■

The next result establishes that a network where two agents have two neighbors while two agents have three neighbors (i.e. a mixture of UM and LI) has properties similar to that of either a UM or LI network depending on who gets the shock.

Lemma 4 *When the network is given by UM-LI, there is an ex-ante payoff dominant, pure strategy PBE in which all unshocked agents play X in the first round, all agents play Y in subsequent rounds if a UM agent is shocked and all agents play X in subsequent rounds if an LI agent is shocked.*

Proof. Consider the following strategy. All unshocked agents play X in the first round, an LI agent continues to play X if both his neighbors have played X in all previous rounds, a UM agent continues to play X if his UM and one LI neighbor play X in all previous rounds, and agents play Y otherwise. To show that the strategies described constitute an equilibrium, first notice that play of Y in each round by each player is clearly an equilibrium continuation for any history, since a player gets $c < b$ by a unilateral deviation. Next, a deviation by any unshocked player in round 1 gets him at most $b\tau$ which is strictly dominated by expected payoffs to each player under the equilibrium: an unshocked UM player expects to receive $\frac{1}{3}\left[\frac{2a+c}{3} + b(\tau-1)\right] + \frac{2}{3}\left[\frac{2a+c}{3}\right]\tau$ and an unshocked LI player expects $\frac{2}{3}\left[\frac{a+c}{2} + b(\tau-1)\right] + \frac{1}{3}a\tau$, both of which are greater than $b\tau$. Finally, we must consider deviations from prescribed play after the first round. We have already established there are no profitable deviations if the UM player is shocked (and all agents play Y as prescribed). In the case where it has been revealed that an LI player has the shock, note that this player constitutes only $\frac{1}{3}$ of the neighbors of each of the UM players, so that they each earn $\frac{2a+c}{3} > b$ by playing X when each of the other players does so. Furthermore, the other LI player gets a payoff of a in this situation, so that play of X is a mutual best response following a shock to an LI player. Thus we conclude that the stated strategies constitute a PBE by the one-shot deviation property.

To see that the strategy is ex-ante payoff dominant, we must establish that the UM and LI players each receive the highest expected payoff among symmetric equilibria. There are four possible cases. First, that the UM players get the highest possible payoff when an LI agent is shocked follows from the proof of Lemma 2. Second, to show that an unshocked UM player gets the highest possible equilibrium payoff when the other UM neighbor is shocked we consider two cases: one where the UM agent always plays Y and one where he plays X at least once. In the second case, we know that the location of the shock is revealed to everyone after the first play of X by a UM player in a symmetric equilibrium which results in Y play for the remainder of the game by the LI agents by Lemma 1 and therefore the best he can get afterwards is b in each period under symmetric strategies. In the first case he receives $b\tau$ while in the second case he receives at most $\frac{2a+c}{3} + b(\tau-1)$,which is what he gets in the proposed equilibrium. Since in both the first and second cases we have shown the UM agent receives the highest payoff ex-post, we know he receives it ex-ante. Third, to show that an unshocked LI player gets the highest possible equilibrium payoff when the other LI agent is shocked follows since he receives $a\tau$. Fourth, we must consider the case of an LI player when a UM agent is shocked. Ex-post, in this continuation, the only way for the LI player to do better is to play Y in every round. Any symmetric equilibrium with this property must have the LI agent play Y in the first round. In that case, the highest ex-ante payoff is $b + \frac{2}{3}b(\tau-1) + \frac{1}{3}a(\tau-1)$. But this is dominated by the expected payoff under the above mentioned strategy. Since in the third case we showed the LI agent receives the highest payoff ex-post and in the fourth case that any symmetric equilibrium with a higher ex-post payoff actually has a lower ex-ante payoff, we know he receives the highest payoffs ex-ante relative to any symmetric equilibrium. ■

The next result establishes that a network where three neighbors are linked to each other while one is in autarky (i.e. a mixture of LI and A) has similar properties to that of a UM network provided the agent in autarky has the shock while it has properties similar to an LI network otherwise.

Lemma 5 *When the network is given by LI-A, there is an ex-ante payoff dominant, pure strategy PBE in which all unshocked linked agents play X in the first round, and each plays X in the subsequent rounds if the autarkic player received the shock, and play Y otherwise.*

Proof. Consider the following strategy for linked agents. All unshocked agents play X in the first round, each plays X in the subsequent rounds if the others did, and plays Y otherwise. An unshocked autarkic player's strategy can be any arbitrary sequence of actions. It is easy to see that the strategies described constitute an equilibrium. That the equilibrium is payoff dominant among symmetric equilibria is easy to see in light of Lemma 1. ■

The next set of results shows that X play in all periods by a pair of unshocked players in a marriage is a PBE which yields the highest possible payoff a in each round. Since agents are ex-ante more likely to be in an unshocked marriage and Y play may invoke an Y response, in the first round it is optimal to play X until one knows whether one's partner is the shocked player, in which case it is optimal to play Y since $b > c$.

Lemma 6 *When the network is given by M, there is an ex-ante payoff dominant, pure strategy PBE in which all unshocked agents play X in the first round, partners in the unshocked marriage play X in each subsequent round, and partners in the other marriage play Y in each subsequent round.*

Proof. Consider the following strategy. All unshocked agents play X in the first round, players who have played X in each previous round continue to do so if their partner has played X in each previous round, and any player who has herself played Y or whose partner has played Y in some round plays Y in each subsequent round. First note that play of Y by each of a pair of linked players is a mutual best response for the two, so that the play prescribed following play of Y by either of them constitutes a PBE for the continuation. Now, in equilibrium, an unshocked agent plays X in the first round, and continues to play X if her partner has not been shocked (that is, if her partner is observed to play X in round 1); the payoff to this player in this case is $a\tau$. If her partner has been shocked, she will observe Y by that player, and she will then play Y herself for the remainder of the game; the payoff to this player in this case is $c + b(\tau - 1)$. Since a player who has not been shocked perceives the probability that her partner has the shock as $\frac{1}{3}$, her expected payoff from playing according to the equilibrium is

$$\frac{2}{3}a\tau + \frac{1}{3}\left[c + b(\tau - 1)\right] = \frac{2a + c}{3} + \frac{2a + b}{3}(\tau - 1) > b\tau.$$

Thus, (by the one deviation property) playing X in round 1 is a best response when others are expected to play according to the equilibrium. Moreover, it is easy to see that continuing to play X in each period is also a best response in subsequent rounds when one's partner is expected to do so. In the PBE described, the shocked player gets $b\tau$, the two partners who have not been shocked receive $a\tau$, and the other player gets the payoff $c + b(\tau - 1)$. Ex-ante payoffs are then $\frac{2a+b+c}{4} + \frac{a+b}{2}(\tau - 1)$.

To see that the PBE is ex ante payoff dominant, it is sufficient to note that the ex-ante payoff obtained in the equilibrium is the largest expected payoff achievable by any single player in the M network without knowing the type of the player to whom she is matched. That is, a larger payoff can be obtained by a player only by knowing the type of her neighbor ex ante, but this is impossible. Since each player achieves this maximum feasible expected payoff, there can be no other PBE which gives a higher payoff to the players. ■

A related result for a marriage follows directly for the M-A network.

Lemma 7 *When the network is given by M-A, there is an ex-ante payoff dominant, pure strategy PBE in which each unshocked agent in a marriage plays X in the first round, partners in an unshocked marriage play X in each subsequent round, and partners in a shocked marriage play Y in each subsequent round.*

Proof. Consider the following strategy for linked agents: each unshocked agent plays X in the first round, continues to play X if her partner has done so in the past, and plays Y thereafter. The actions of unshocked agents in autarky may be chosen arbitrarily. The fact that this is a payoff-dominant equilibrium follows from Lemma 6. ■

The next result establishes that a network where two agents have two neighbors while two agents have one neighbor (i.e. a mixture of LI and M) has similar properties to that of an LI network since the shocked player will be in some LI player's 2 person neighborhood.

Lemma 8 *When the network is given by LI-M, there is an ex-ante payoff dominant, pure strategy PBE in which all unshocked agents play X in the first round and then all agents play Y in subsequent rounds.*

Proof. Consider the following strategy. All unshocked agents play X in the first round, then all agents play Y in the subsequent rounds. Since play of Y is an equilibrium of the one period game, play of Y in rounds 2 through τ is an equilibrium continuation following any mode of play for date 1; therefore, to show that the play described is an equilibrium, it suffices to show that play of X in the first round is a mutual best response. Now conditional on not receiving the shock, an LI player's prior that one of her neighbors has the shock is $\frac{2}{3}$ and that neither has it is $\frac{1}{3}$. Thus, the expected payoff of such a player for playing X in the first round is given by $\frac{2}{3}\left(\frac{(a+c)}{2}\right) + \frac{1}{3}(a) = \frac{2a+c}{3}$ while the payoff to playing Y in the first round is b, which is less by Assumption 1. Furthermore, conditional on not receiving the shock, an M player's prior that her neighbor has the shock is $\frac{1}{3}$ and that she does not have it is $\frac{2}{3}$. Thus the expected payoff to such a player from playing X in the first round is $\frac{2}{3}a + \frac{1}{3}c$, while the payoff to playing Y is b. Thus play of X by each non-shocked player is a mutual best response, and the stated strategies constituted a PBE, as claimed. In equilibrium, the expected payoff of an LI player is $\frac{2}{3}\left(\frac{a+c}{2}\right) + \frac{1}{3}a + b(\tau - 1)$ and that of an M player is $\frac{1}{3}c + \frac{2}{3}a + b(\tau - 1)$.

To see that the strategy is ex-ante payoff dominant for both the LI and M players, we first need three results, which we establish here. For concreteness, suppose the LI-M network is as depicted in Figure 1. Result 1 is that in the LI-M network in play of pure strategies, at each history which occurs with positive probability, each LI player knows whether the other LI player knows the type of the M player to whom the second is linked. To see this, we can write the behavioral strategy of an M player, say player 2, in round t as a function of only that player's type ω^2 and the history of her neighbor's, say player 1's, actions $a^{1,t-1}$; that is $a_t^2 = a_t^2\left(\omega^2, a^{1,t-1}\right)$. Next suppose that we have that $a_t^2\left(\omega^2, a^{1,t-1}\right) \neq a_t^2\left(\widetilde{\omega}^2, a^{1,t-1}\right)$ for $\omega^2 \neq \widetilde{\omega}^2$, so that player 2's type is revealed through her actions to player 1 after this history. Then it can be seen that, since the other LI player, say player 4, can observe the actions of player 1 (and players know the strategies of the other players), player 4 knows when $a_t^2\left(\omega^2, a^{1,t-1}\right)$ is different from $a_t^2\left(\widetilde{\omega}^2, a^{1,t-1}\right)$; i.e., she knows when player 2 has revealed her type to player 1, proving the first result. Result 2 is that in the LI-M network, if an LI player knows that the other LI player knows the type of the M player to whom the second is linked, then the first LI player must play Y in each subsequent round in equilibrium. To see this, note that if the first LI player, say agent 1, has the shock herself, then the result is trivial. Suppose agent 1 does not have the shock. In this case, the other LI player, agent 4, will play X in a subsequent round only if her M neighbor (player 3) was revealed not to have the shock. But if this is the case, then agent 4 plays X only if she knows that agent 1's M neighbor (player 2) has the shock. Thus in every case in equilibrium, at least one of agent 1's neighbors must subsequently play Y in each round. The second result then follows from lemma 1. Result 3 is that whenever three agents play X, at least one of the LI players learns the type of her M neighbor, the proof of which is obvious.

Taken together, these three results imply that X play by three players can occur at most once in any pure strategy PBE: that is, by result 3, play of three Xs causes at least one LI player to know the type of her M neighbor; by result 1, the other LI player knows that the first one knows this; then by result 2 and iterated elimination of dominated strategies, both of the LI players must play Y in each round subsequent to play of X by three players.

Furthermore, these results imply that if no one has played X previously, then any strategy that calls for unshocked M agents to play X must be followed by Y play by all agents thereafter. To see this, it is obvious that the LI agents learn the types of their M neighbors; by result 1, each LI player knows that the other LI player knows the type of the M player to which he is linked; by result 2, those LI agents play Y thereafter; by lemma 1 all agents play Y thereafter. Thus, there is no symmetric equilibrium in which only the two M agents play X in the first round in which X is played because the M agents receive at most $c + b(\tau - 1)$, which is dominated by all-Y.

Finally, we need to show that if no one has played X previously, then there is no symmetric equilibrium in which only the unshocked LI agents play X. To see this, first note that an LI agent who discovers one of his neighbors is shocked, plays Y thereafter by lemma 1. Therefore, an unshocked M agent assigns probability $\frac{1}{2}$ to the event that his LI partner plays Y forever after. Furthermore, by results 1 and 2, the M agent can only receive a payoff of a once. Thus, his maximum expected payoff from playing X in the period after his LI partner first plays X in this case is at most $\frac{a+c}{2} + b(\tau - 1)$, which is less than the payoff he receives from playing Y in all periods. It follows from this reasoning that an M agent will never play X unless he sees his LI partner play X a second time. This would signal that neither his partner nor his partner's partner (the other LI agent) has the shock; at best this signal affords the LI agent one round with payoff a. The expected payoff for an unshocked LI player in this case is at most

$$\frac{1}{3}\left[3\left(\frac{a+c}{2}\right) + b(\tau - 3)\right] + \frac{1}{3}\left(c + b(\tau - 1)\right) + \frac{1}{3}\left[2\left(\frac{a+c}{2}\right) + a + b(\tau - 3)\right]$$

which can be shown to be less than what he receives by playing all-Y which is $b\tau$. Thus, no such signaling strategy can be part of a symmetric equilibrium. Further, it is possible to show that more than two rounds of X play by LI agents to signal their type results in a lower expected payoff than $b\tau$.

To see that this equilibrium is ex-ante payoff dominant, note that the all-Y equilibrium, which yields ex-ante payoff b is dominated since both the LI and M agents expect payoff $\frac{2a+b+c}{4} + b(\tau - 1)$ by Assumption 1. Since there is no symmetric equilibrium where only one type of LI or M agent plays X the first time anyone plays X

and we have shown that play of X by both types gives at most a payoff equal to our proposed equilibrium, the result follows. ■

The next result shows that a star network where one agent has three neighbors while three agents have one neighbor (i.e. a mixture of UM and M) has similar properties to that of a UM network provided the middleman is not shocked and properties of a shocked marriage otherwise.

Lemma 9 *When the network is given by UM-M, there is an ex-ante payoff dominant, pure strategy PBE in which all unshocked agents play X in the first round, then they play X in the subsequent rounds if the UM player is not shocked and play Y otherwise.*

Proof. Consider the following strategies. All unshocked agents play X in the first round, then they play X in the subsequent rounds if the UM player did, and play Y otherwise. It is easy to see that these strategies constitute an equilibrium. To see that it is a payoff dominant equilibrium, note that we can restrict attention to strategies in which some player plays X if she is able in the first round. This is because given any equilibrium strategies which call for play of Y by all players in round 1 independent of the shock, and play of X in some states in round 2, we can construct a payoff equivalent equilibrium strategy in which first play of X may occur in round 1.

First, consider an unshocked M agent. We claim that there is no action profile for the agents in which this agent's play in round 1 is independent of the shocks of the other agents that is as good for this player. To see this, note that, conditional on the location of the shock, the proposed strategies offer the highest possible payoff in each round after the first for this agent. Moreover, given her information in round 1, the expected first round payoff of this player is as good as it can be. Therefore, there can be no other strategy profile that is feasible under the information structure which gives a better payoff for this agent.

Now consider the UM agent. It is easy to see that this player's *ex post* payoff is maximal conditional on the location of the shock in each equilibrium outcome. Therefore there can be no other strategy profile which does better for this agent. ■

The LI-M-A network presents the first case where there is no ex-ante payoff dominant equilibrium for all types. There is one equilibrium that yields the highest ex-ante equilibrium payoff for the LI player and another equilibrium that yields the highest ex-ante equilibrium payoff for the M types. Each equilibrium makes at least one type of agent strictly worse off relative to the other equilibrium. Like the M network, the shocked agent may lie outside one's direct or indirect neighborhood (in this case it may reside with the A agent) and this leads to an inference problem which raises the possibility of signaling. In particular, strategies are such that in the equilibrium where the LI agent is best off, information about who is shocked is resolved only after the second round so that there are states of the world where the M agent could be made better off (i.e. when one of the M agents is playing X in round 2 while the network is heading to all-Y because he doesn't know the other M agent has the shock). This information is made available in the equilibrium where the M agents are best off; in particular, in that equilibrium the LI agent provides a costly signal in the second round in the event that both M agents don't have the shock.

Lemma 10 *When the network is given by LI-M-A, if τ is large, the ex-ante payoff dominant equilibrium for the LI type is strictly worse for the M players than the ex-ante payoff dominant equilibrium for the M types (and vice versa). Provided $\tau \geq 3$, play in the ex-ante payoff dominant equilibrium for the LI type is given by: in round 1, each unshocked linked agent plays X; thereafter, all linked agents play X provided the shock was not revealed to have been to one of them, and play Y otherwise. Provided τ is sufficiently large, the ex-ante payoff dominant (signaling) equilibrium for the M type is given by: in round 1, each unshocked linked agent plays X; in round 2, the M agents play Y and the LI agent plays X if both of her neighbors did so in round 1 (i.e. he provides a costly signal as to whether one of the M players is shocked which is revealed by round 1 play) and plays Y otherwise; from round 3 on, the three linked agents play X if the shock is outside of their network (i.e. if the A agent has the shock) and each plays Y otherwise.*

Proof. The proof proceeds by showing that, if τ is large enough, one strategy is payoff dominant for the M agents, while a distinct strategy is payoff dominant for the LI agent. Consider first the following LI-optimal strategy profile. In each round, each linked agent plays X if she has not previously played Y and has not witnessed another agent play Y, and she plays Y otherwise. It is straightforward to show that these strategies constitute an equilibrium whenever $\tau \geq 3$, and that they give a highest payoff to the LI agent.

Now consider the following M-optimal strategy profile. In round 1, each unshocked linked agent plays X. In round 2, the M agents play Y and the LI agent plays X if both of her neighbors did so in round 1; otherwise she plays Y. From round 3 on, the three linked agents play X if each agent's neighbors has signaled that they do not have the shock, and each plays Y otherwise. We will show that this strategy gives the best possible payoff for the M players, and that it is an equilibrium if τ is large. (Note that it is symmetric in type.) To see this, we begin by stating several obvious facts:

(1) It is clear that a payoff dominant equilibrium for the M players must have the LI agent playing X in some states.

(2) It is clear that a (symmetric) payoff dominant equilibrium for the M players will have the M agents play X in some states. Thus, they will reveal their types to the LI player (simultaneously, by symmetry) in some period.

(3) Lemma 1 shows that, after learning the types of the M players, the LI player will subsequently play X only if both of the M players are revealed unshocked.

(4) In the round immediately after the M agents have first revealed their types to the LI agents, the subjective probability assigned by an unshocked M player to the possibility that the LI player will play Y in every subsequent round is at least $\frac{1}{2}$. (It is $\frac{1}{2}$ if the LI player has already revealed to the M players that she is unshocked herself, and it is $\frac{2}{3}$ otherwise.) It follows that an unshocked M agent's subjective expected continuation payoff in the period immediately following the first play of X by unshocked M agents (at round t) is no greater than

$$x_\tau(t) := \frac{b}{2}(\tau - t) + \frac{1}{2}\left[b + a(\tau - t - 1)\right]. \tag{1}$$

(This calculation reflects play of Y by the M player in the current round followed by earning the maximum possible payoff in each subsequent period conditional on the location of the shock.) In particular, any equilibrium continuation in which the M player plays X in the current round must earn a worse (subjective expected) continuation payoff.

(5) The subjective expected period payoff of an unshocked M agent in the period in which the LI player first reveals herself is no greater than $(2a + c)/3$. (This follows from the fact that no information about the other players can be gleaned without this information; i.e., the type of the LI agent must be the first information that the unshocked M agent learns about the types of the other players.) This payoff can obviously be obtained only if the unshocked M player simultaneously plays X.

(6) In the period t that the M players first reveal their types, the best continuation payoff they can expect is

$$a + x_\tau(t),$$

but then only if the LI player has revealed previously, so that the M players are sure of her type.

It can be seen that there are 3 possible itineraries: the M agents reveal first, the LI agent reveals first, or all linked players reveal simultaneously. (Without loss of generality, we assume that one of these events occurs in round 1.) In the first case, the payoff of an unshocked M agent is at most

$$c + x_\tau(1).$$

In the second case, the unshocked M agent gets at most

$$\frac{1}{3}b\tau + \frac{2}{3}\left[b + a + x_\tau(2)\right].$$

In the third case, the unshocked M agent gets at most

$$\frac{2a + c}{3} + x_\tau(1).$$

Of these three payoff bounds, it is straightforward to show that the last is the greatest. Moreover, this payoff is attained in by the proposed strategies; thus, the proposed strategies offer the highest possible payoff for the M agents among all strategies which respect the result of Lemma 1.

It remains to show that this is acceptable to an unshocked LI agent. The unshocked LI agent's payoff under this scheme is

$$\frac{2a + c}{3} + \frac{2}{3}b(\tau - 1) + \frac{1}{3}\left[c + a(\tau - 2)\right].$$

It is clear that this is better than any possible deviation if τ is large enough. Thus we have shown that the proposed strategies give the best feasible payoff to the M agents, and that they constitute an equilibrium if τ is large enough.

Thus, there is no equilibrium which is payoff dominant for all of the players. ■

The last (asymmetric) network we consider is UM-LI-M, which provides another example where there is no equilibrium which is ex-ante payoff dominant for all types. There is one equilibrium that yields the highest ex-ante equilibrium payoff for the UM and LI players and another equilibrium that yields the highest ex-ante equilibrium payoff for the M player. Each equilibrium makes at least one type of agent strictly worse off relative to the other equilibrium. This network has properties similar to that of LI if either the UM or LI agents are shocked and properties similar to that of UM if the M agent is shocked. Unlike the previous case (LI-M-A), in the equilibrium which is best for the UM and LI players, there is no inference problem after the first round (i.e. after the first round, all agents either directly observe an Y play by a neighbor or can infer that someone out of their neighborhood has received the shock). However, if τ is sufficiently large, there is another equilibrium where information about shocks is actually revealed slowly which results in higher ex-ante payoffs for the M agent. Each equilibrium makes at least one type of agent strictly worse off relative to the other equilibrium.

Lemma 11 *When the network is given by UM-LI-M, if τ is large, the ex-ante payoff dominant equilibrium for the UM and LI types is strictly worse for the M players than the ex-ante payoff dominant equilibrium for the M types (and vice versa). Play in the ex-ante payoff dominant equilibrium for the UM and LI types is given by: in round 1, all unshocked agents play X; if the M agent is shocked, all unshocked agents continue to play X and play Y otherwise. Provided τ is sufficiently large, the ex-ante payoff dominant equilibrium for the M types is given by: in round 1, an unshocked UM agent plays X and other players play Y; in round 2, if the UM agent previously played X, then the UM player and an unshocked M player play X while the other players play Y, and everyone plays Y otherwise; in the third round, if the UM player has played X in the first two rounds, then all unshocked agents play X and play Y otherwise; after the third round, agents continue to play X if the M agent played X in the second round, and they play Y otherwise.*

Proof. Consider the following strategies for the $UM-LI$-optimal equilibrium. In round 1, all unshocked agents play X. If the M agent is revealed to have the shock, then all of the other agents continue to play X as long as each of them has always played X in the past. In all other continuations, all agents play Y. It is straightforward to show that this is an equilibrium and that it is the unique ex-ante payoff dominant equilibrium for both the UM and LI agents.

If τ is sufficiently large, then the following strategies constitute the M-optimal pure-strategy symmetric equilibrium for the M player. In round 1, the UM agent plays X if he is able and other agents play Y. If the UM agent played Y in round 1, all agents play Y subsequently. If the UM agent played X, then in round 2, the UM agent and the M agent (if she's able) play X, and the other agents play Y. If the UM agent has played X in the first two rounds, then all agents who are able play X in round 3. After round 3, agents continue to play X if they have observed two neighbors play X all rounds after round 2, and they play Y otherwise.

To see that this is the best possible equilibrium for the M player, consider each of the four possible states. When either the M player himself or the UM player gets the shock, then this equilibrium delivers the highest possible payoff $b\tau$ to this agent. I claim that the UM player will play X at most once in any equilibrium after learning that the M player is unshocked. To see this, note that the only period payoff better than b for this player comes in a round when 2 of his neighbors play X. By symmetry, the LI players must learn whenever this occurs. Thus if the state is such that one of the LI players has the shock, Helpful Lemma implies that neither of them will ever play X again. Thus the UM player will not play X after the LI players learn that one of them has the shock, proving the claim. Thus it can be seen that the M player can not earn a higher payoff in any equilibrium. ■

Now we move on to predicting which networks we expect to be stable in the above game. The idea is to endow agents with beliefs that play in a network that results from a unilateral deviation from a given network will follow the ex-ante payoff dominant perfect Bayesian equilibrium strategies discussed in the above lemmas in the subgame following that deviation. We consider proposal strategies that implement a given network with a minimum number of link (i.e. $\{1\}$) proposals. In this case, we needn't consider a unilateral deviation where a given player sends $\{1\}$ instead of $\{0\}$ since unreciprocated proposals yield no change in payoffs. One could consider other proposal strategies that implement a given network with more $\{1\}$ proposals. In many cases, such a proposal strategy would lead to a lower ex-ante payoff. For example, if players are following an M proposal strategy with two {1} proposals (i.e. player 1 sends {1} to player 2 and 3, player 2 sends {1} to player 1 and 4, player 3 sends {1} to player 4 and 2, player 4 sends {1} to player 3 and 1, thereby implementing an M network where 1 is linked to 2 and 3 is linked to 4), then if player 1 deviates and sends a {1} to 4 as well, an LI-M network is formed, which yields lower ex-ante payoff than an M network. On the other hand, there are cases where a proposal profile that contains more than the minimal number of link proposals to implement a given network can admit profitable unilateral deviations. For example, consider a candidate (asymmetric) LI proposal profile where player 1 sends {1} proposals to all three other players, while 2 sends {1} to player 1 and 4, player 3 sends {1} to player 4 and 2, player 4 sends {1} to player 3 and 1, an LI network would be implemented. However, if player 3 deviates from the prescribed strategy and sends a {1} to 1 as well, an UM-LI network is formed, which yields higher ex-ante payoff than an LI network. Given the possibility of these other equilibria, our focus on equilibria with minimal proposal strategies is something that will be tested in the experimental section.

The first result, that an M network is an equilibrium in the sense that it is (strictly) immune to unilateral deviations, follows simply from lemmas 6 and 7 (trivially). In particular, a unilateral deviation from sending a {1} proposal to one's partner results in autarky, where payoff $d\tau$ is strictly less under Assumption 1 than the ex-ante payoff associated with M given by $\frac{2a+c}{3} + \frac{2a+b}{3}(\tau - 1)$.

Lemma 12 *An M network is a (strict) equilibrium outcome under the assumption that players always play according to a PBE continuation which is ex-ante payoff dominant among all pure PBE continuations in the stag-hunt stage.*

Proof. Consider a proposal strategy that implements an M network with the minimum number of {1} proposals. Now the only unilateral deviations for the proposal stage which can affect a player's payoff are to propose zero links. This deviation is clearly worse for the player, since she receives a payoff of d in any continuation. This shows that these link proposals are an equilibrium with the prescribed mode of continuation play. ■

Corollary 13 *An M-A network is a (strict) equilibrium outcome under the assumption that players always play according to a PBE continuation which is ex-ante payoff dominant among all pure PBE continuations in the stag-hunt stage.*

Proof. Since the deviation we are considering is for an M type agent that lands him in autarky, the same reasoning as in lemma 12 holds in an M-A network. ■

The next result uses lemmas 3 and 8 to establish that LI is an equilibrium. It shows that an LI network in which all agents send two proposals is stable in the sense that there is no strictly profitable unilateral deviation that brings about LI-M. To understand the result, suppose agent 2 deviates and chooses not to send a proposal to agent 3, while all other agents send two proposals associated with the original LI network. As we saw in lemma 8 the equilibrium play in LI-M is identical to equilibrium play in LI since the M player, if he is unshocked, knows that one of the two LI players is linked to a shocked player after the first round, thereby altering his beliefs and best responding with Y play in the subsequent rounds as in lemma 3. Since equilibrium play is the same, ex-ante payoffs are identical so that the deviation is not strictly profitable. There is an important sense, however, in which LI is not stable which corresponds informally to an evolutionary stability type argument. That is, a best response to agent 2's single proposal to agent 1 is for agent 1 to send a single proposal to agent 2. As above, agent 2 does no worse sending one proposal and both do better getting into a marriage. This type of proposal strategy would displace LI as an equilibrium.

Lemma 14 *An LI network is a (weak) equilibrium outcome under the assumption that players always play according to a PBE continuation which is ex-ante payoff dominant among all pure PBE continuations in the stag-hunt stage.*

Proof. Consider a proposal strategy that implements an LI network with the minimum number of {1} proposals. The only unilateral deviations for the proposal stage which can materially affect a player's payoff are to propose zero or only one link instead of the prescribed two. The affect of proposing zero links is that the deviating player becomes an A player in a LI-M-A network. This deviation is clearly worse for the player, since she receives a payoff of d in any continuation. By proposing only one link, the deviating player becomes an M player in a LI-M network. Using the result above about the equilibrium followed in the stag-hunt stage of the LI-M network, it can be seen that such a player earns a payoff identical to what he would earn by playing according to the prescribed equilibrium. Thus, no player can have a profitable deviation. ■

The next result uses lemmas 5 and 10. It shows that an LI-A network where three agents send out two proposals to each other is stable in the sense that there is no profitable unilateral deviation that brings about LI-M-A. To understand the result, suppose the LI-A network is as depicted in Corbae and Duffy [1] Figure 1, where agent 3 is the sole A player, and the other 3 players are LI players. Suppose that agent 2 deviates and chooses not to send a proposal to agent 4, while agents 1 and 4 continue to send two proposals that would have resulted in LI-A. To show that 2's deviation is not profitable, it is sufficient to assign beliefs to the deviator that play in LI-M-A will be payoff dominant for the M type.[2] The deviation does nothing to insulate agent 2 from the shock and in the case that the shocked player is A, actually leads to a lower payoff. We also note that this equilibrium is stable in a sense that LI is not; an LI player in LI-A would do worse to accept a proposed link by the A player. This is in contrast to what is the case for the LI network, where a player does better to accept a proposed link by a player to whom he is not linked.

Lemma 15 *An LI-A network is a (strict) equilibrium outcome under the assumption that players always play according to a PBE continuation which is ex-ante payoff dominant among all pure PBE continuations in the stag-hunt stage.*

Proof. Consider a proposal strategy that implements an LI-A network with the minimum number of $\{1\}$ proposals. We need only contemplate the outcome where an LI player drops one or more of his links. By doing so unilaterally, this player can become either an M player in an LI-M-A network, or an A player in an M-A network. In the payoff dominant equilibrium for the LI-A network considered in lemma (5), an LI player gets

$$\frac{a\tau}{4}+\frac{b\tau}{4}+\frac{1}{2}\left[\frac{a+c}{2}+b\left(\tau-1\right)\right].$$

In the equilibrium that is payoff dominant for the M type in the LI-M-A network from lemma (10), an M player gets

$$\frac{1}{4}\left[b+a\left(\tau-1\right)\right]+\frac{b\tau}{4}+\frac{1}{4}\left[c+b\left(\tau-1\right)\right]+\frac{1}{4}\left[a+b\left(\tau-1\right)\right].$$

Subtracting the latter expression from the former gives $a-b$, so that an LI player in the LI-A network cannot improve his payoff by deviating unilaterally to effect an LI-M-A network under our assumptions. Since it is easy to see that the player does worse as an A player in a M-A network, LI-A can be seen to be an equilibrium network, as claimed. ■

The next result uses lemmas 2 and 4. It shows that a UM network in which all agents send three proposals is not stable in the sense that there is a profitable unilateral deviation that brings about UM-LI. To understand the result, suppose agent 1 deviates and chooses not to send a proposal to agent 3, while all other agents send proposals to all other agents. The resulting UM-LI network (as shown in Corbae and Duffy [1] Figure 1) means that agent $1'$s two neighbors (agents 2 and 4) "provide insurance" to agent 1 (continue to play X) in the event that agent 3 gets the shock. In that event, agent 1 receives payoff a while in the UM network he would receive $(2a+c)/3<a$. Thus, the resulting instability of the UM network is similar to a free-rider problem. That is, each agent has an incentive to enjoy the benefits of insurance against payoff shocks (the public good) provided by others while providing it insufficiently herself.

Lemma 16 *A UM network is* not *an equilibrium outcome under the assumption that players always play according to a PBE continuation which is ex-ante payoff dominant among all pure PBE continuations in the stag-hunt stage.*

Proof. By deviating unilaterally from the prescription that all players propose links to all of the other players, the deviator finds herself as an LI player in a UM-LI network. Given lemma 4 above guiding play in the UM-LI network, the LI player can expect to receive

$$\frac{1}{4}b\tau+\frac{1}{4}a\tau+\frac{1}{2}\left(\frac{a+c}{2}+b\left(\tau-1\right)\right).$$

[2] If this is dominated, then payoffs for the M player associated with the payoff dominant equilibrium for LI types would even be lower.

This is greater than

$$\frac{1}{4}b\tau + \frac{3}{4}\left(\frac{2a+c}{3}\tau\right),$$

the expected payoff for a player in a UM network following the strategy outlined in lemma (2).[3] Since there is a profitable deviation from any strategies which result in a UM network when play continues as we've assumed, such a network cannot occur in equilibrium. ■

A star network is considered in many papers. The next result uses lemmas 7 and 9. The UM player could unilaterally deviate and send only one proposal, resulting in his own marriage. His ex-ante payoffs $\frac{2a+b+c}{4} + \frac{a+b}{2}(\tau - 1)$ from being in a marriage are strictly higher than the expected payoffs by being the middleman $\frac{2a+b+c}{4}\tau$ since in the event that he is unshocked, he provides insurance against the shock with probability one each period.

Lemma 17 *A star (M-UM) network is* not *an equilibrium outcome under the assumption that players always play according to a PBE continuation which is ex-ante payoff dominant among all pure PBE continuations in the stag-hunt stage.*

Proof. Consider a proposal strategy that implements an M-UM network with the minimum number of $\{1\}$ proposals. Then by deviating from a proposal strategy which would cause her to be the UM player in an M-UM network, a player can become an M player in an M-A network. By lemma 7, it is easy to show that this player then earns an ex ante expected payoff of $\frac{2a+b+c}{4} + \frac{a+b}{2}(\tau - 1)$ in the payoff dominant continuation. This is greater than $\frac{2a+b+c}{4}\tau$, the ex ante expected payoff of the UM player in an M-UM network in any payoff dominant continuation established in lemma 9. ■

The following result uses lemmas 4 and 9 to show that UM-LI network is not an equilibrium since a UM player can deviate unilaterally to become an M player in a UM-M network. Provided the middleman in the resulting UM-M network does not receive the shock, this deviation generates the benefits of an unshocked marriage to the deviator and yields a strict improvement over having to provide insurance in the UM-LI network as above.

Lemma 18 *A UM-LI network is not an equilibrium outcome under the assumption that players always play according to a PBE continuation which is ex-ante payoff dominant among all pure PBE continuations in the stag-hunt stage.*

Proof. Consider a proposal strategy that implements a UM-LI network with the minimum number of $\{1\}$ proposals. A UM player in a UM-LI network can deviate unilaterally to become an M player in a UM-M network by dropping two links. Computing the payoff of the M player in the payoff dominant equilibrium described in lemma 9, it can be seen that the player gets

$$\frac{2a}{4} + \frac{b}{4} + \frac{c}{4} + \left(\frac{a}{2} + \frac{b}{2}\right)(\tau - 1).$$

This payoff is higher than

$$\frac{2a}{4} + \frac{b}{4} + \frac{c}{4} + \left(\frac{a}{3} + \frac{b}{2} + \frac{c}{6}\right)(\tau - 1),$$

which can seen from Lemma 4 to be the payoff of the UM player in a UM-LI network. ■

The next set of results establish that an LI-M or LI-M-A network is not an equilibrium since an LI player can deviate unilaterally and receive the strictly higher ex-ante payoff of an M or M-A network respectively.

Lemma 19 *An LI-M network is not an equilibrium outcome under the assumption that players always play according to a PBE continuation which is ex-ante payoff dominant among all pure PBE continuations in the stag-hunt stage.*

[3] To see this, note that

$$\frac{1}{4}a\tau + \frac{2}{4}\left(\frac{a+c}{2} + b(\tau - 1)\right) > \left(\frac{2a+c}{4}\tau\right)$$

since $\frac{a+c}{2} < b$ by Assumption 1.

Proof. Consider a proposal strategy that implements an LI-M network with the minimum number of {1} proposals. An LI player in that network can deviate unilaterally to become an M player in an M network. As established in lemma 6, the latter player earns

$$\frac{a}{2}+\frac{b}{4}+\frac{c}{4}+\left(\frac{a}{2}+\frac{b}{2}\right)(\tau-1),$$

whereas it can be computed from Lemma 8 that the payoff of the LI player in the LI-M network is

$$\frac{a}{2}+\frac{b}{4}+\frac{c}{4}+b(\tau-1),$$

which is lower. ■

Lemma 20 *Provided τ is sufficiently large, an LI-M-A network is not an equilibrium outcome under the assumption that players always play according to a PBE continuation which is ex-ante payoff dominant for at least one type among all pure PBE continuations in the stag-hunt stage.*

Proof. Consider a proposal strategy that implements an LI-M-A network with the minimum number of {1} proposals. By deviating unilaterally from this network, the LI player can become an M player in an M-A network. From lemma 7, it is easily seen that the latter player does better than if he remains an LI player by lemma 10. ■

The next result is based upon the same idea but now it is the UM type in a UM-LI-M network who can deviate by sending only one proposal to be linked with one neighbor resulting in strictly higher ex-ante payoffs associated with an M network.

Lemma 21 *Provided τ is sufficiently large, a UM-LI-M network is not an equilibrium outcome under the assumption that players always play according to a PBE continuation which is ex-ante payoff dominant for at least one type among all pure PBE continuations in the stag-hunt stage.*

Proof. Consider a proposal strategy that implements a UM-LI-M network with the minimum number of {1} proposals. By deviating from this network, the UM player can become an M player in an M network. From lemma 6, it is easy to see by lemma 11 that the latter player receives a higher payoff than the former in either continuation game ■

The previous results are summarized in the proposition.

Proposition 22 *When τ is sufficiently large, and we restrict play in the second stage continuation game to satisfy ex-ante payoff dominance for at least one type, the set of weak PBE networks are LI, M, LI-A, M-A. Those which are strict PBE networks are M, M-A, and LI-A. The ex-ante efficient, strict PBE network is M.*

Proof. The only remaining thing to establish is efficiency of M, which follows from comparison of ex-ante payoffs provided in lemma 2 to lemma 11. ■

2 Data

On the following pages we present all data collected from all experimental sessions we conducted. These data are summarized using a variety of aggregate statistics within the text of our paper, Corbae and Duffy [1] but we thought it would be of value to provide a disaggregated view of our experimental dataset as well.

Figures M5, LI5, and UM5 collect together the data from the four, 5–game sessions where in the first game alone, players were constrained to form marriage networks (M5) local interaction networks (LI5) or uniform matching networks (UM5), respectively. The data from three of the four sessions of each of these treatments also appears in Corbae and Duffy [1] as Figures 7–9. Figures M9.a–M9.d show data for four 9-game sessions where, in the first game alone, players were constrained to form marriage networks. Figures LI9.a–LI9.d and UM9.a–UM9.d do the same for 9–game sessions where players were initially instructed to form local interaction or uniform matching networks, respectively. An explanation of how to read these figures is provided in Corbae and Duffy [1], in the discussion of Figures 7–9 in section 5.2.2 of that paper.

Figure M5: 4 Groups Initially in M Play 5 Games

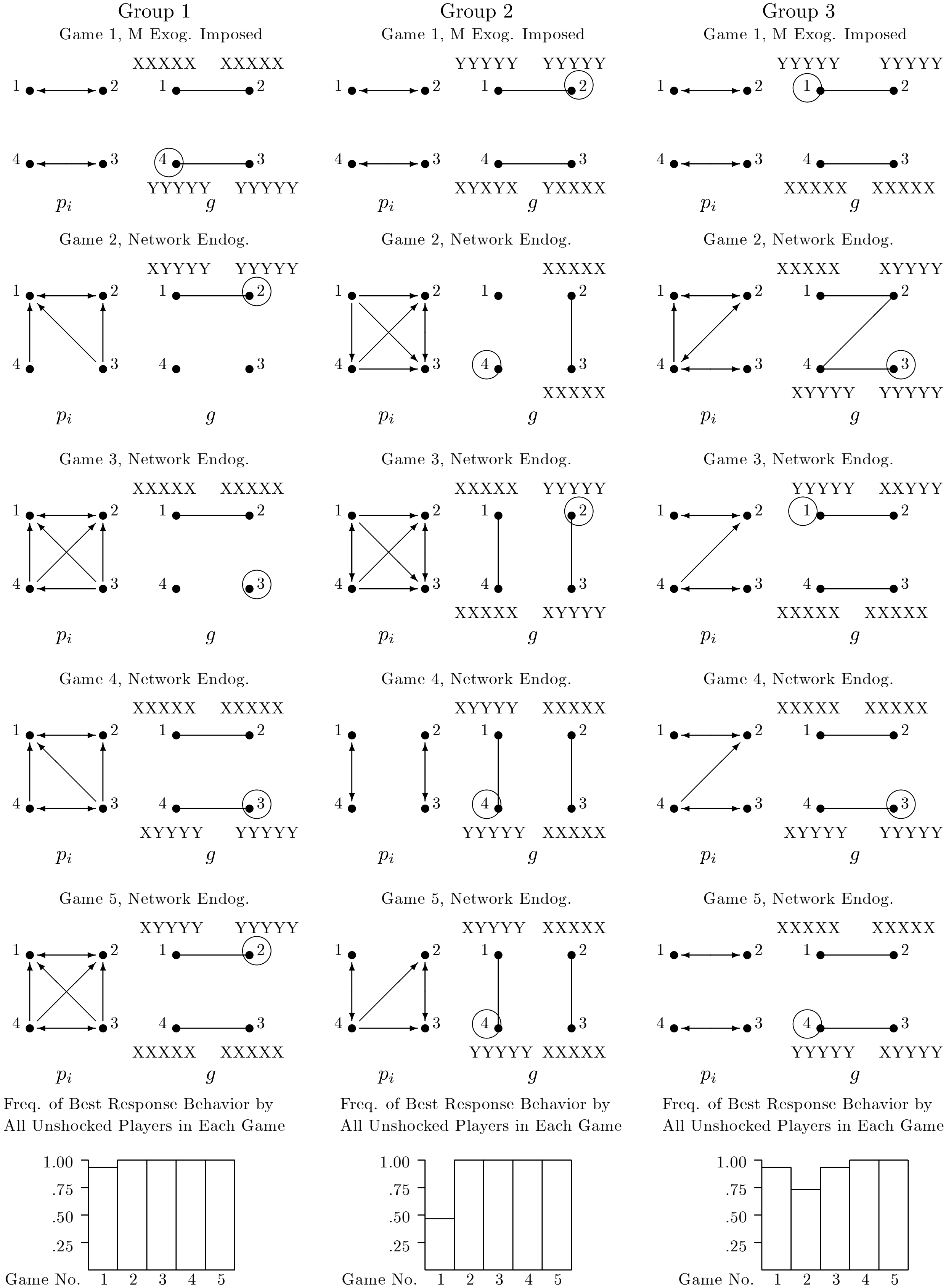
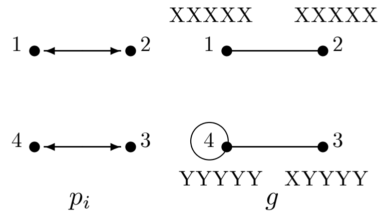


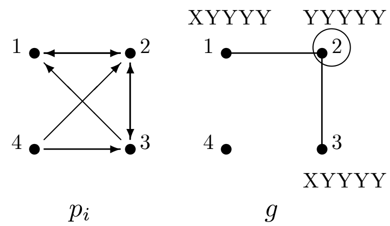
Figure M5, Continued: 4 Groups Initially in M Play 5 Games

Group 4

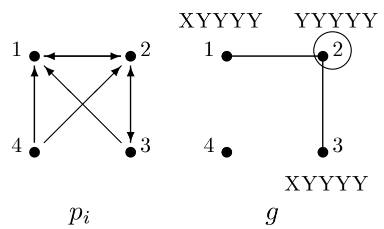
Game 1, M Exog. Imposed



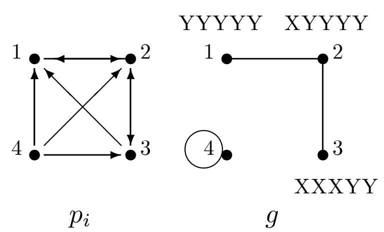
Game 2, Network Endog.



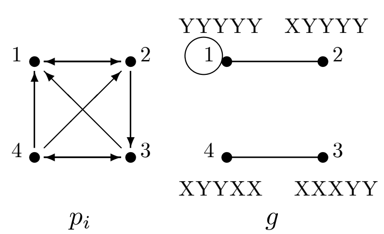
Game 3, Network Endog.



Game 4, Network Endog.



Game 5, Network Endog.



Freq. of Best Response Behavior by
All Unshocked Players in Each Game

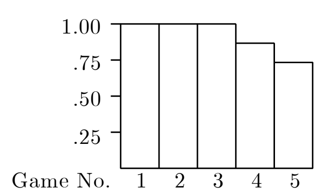


Figure LI5: 4 Groups Initially in LI Play 5 Games

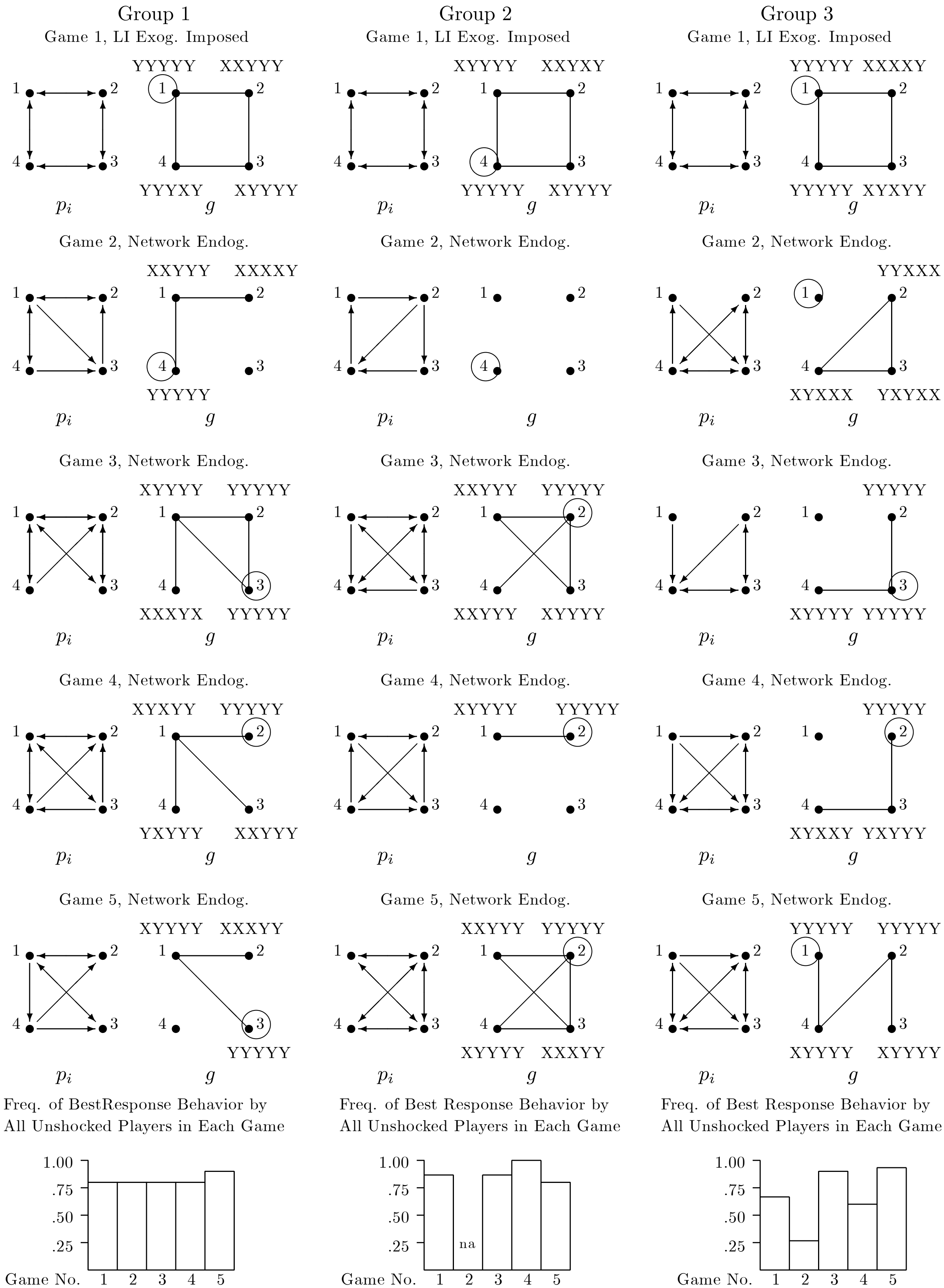
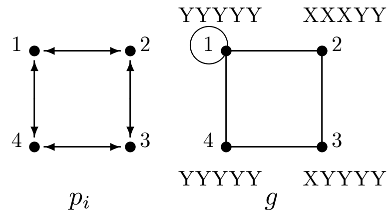


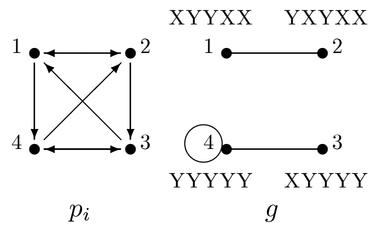
Figure LI5, Continued: 4 Groups Initially in M Play 5 Games

Group 4

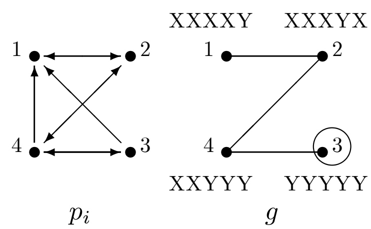
Game 1, LI Exog. Imposed



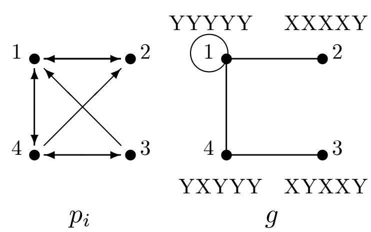
Game 2, Network Endog.



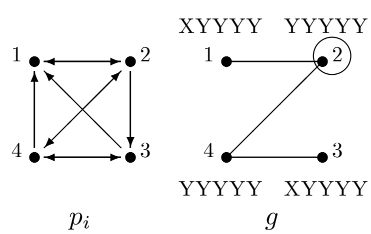
Game 3, Network Endog.



Game 4, Network Endog.



Game 5, Network Endog.



Freq. of Best Response Behavior by
All Unshocked Players in Each Game

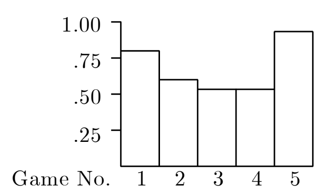


Figure UM5: 4 Groups Initially in UM Play 5 Games

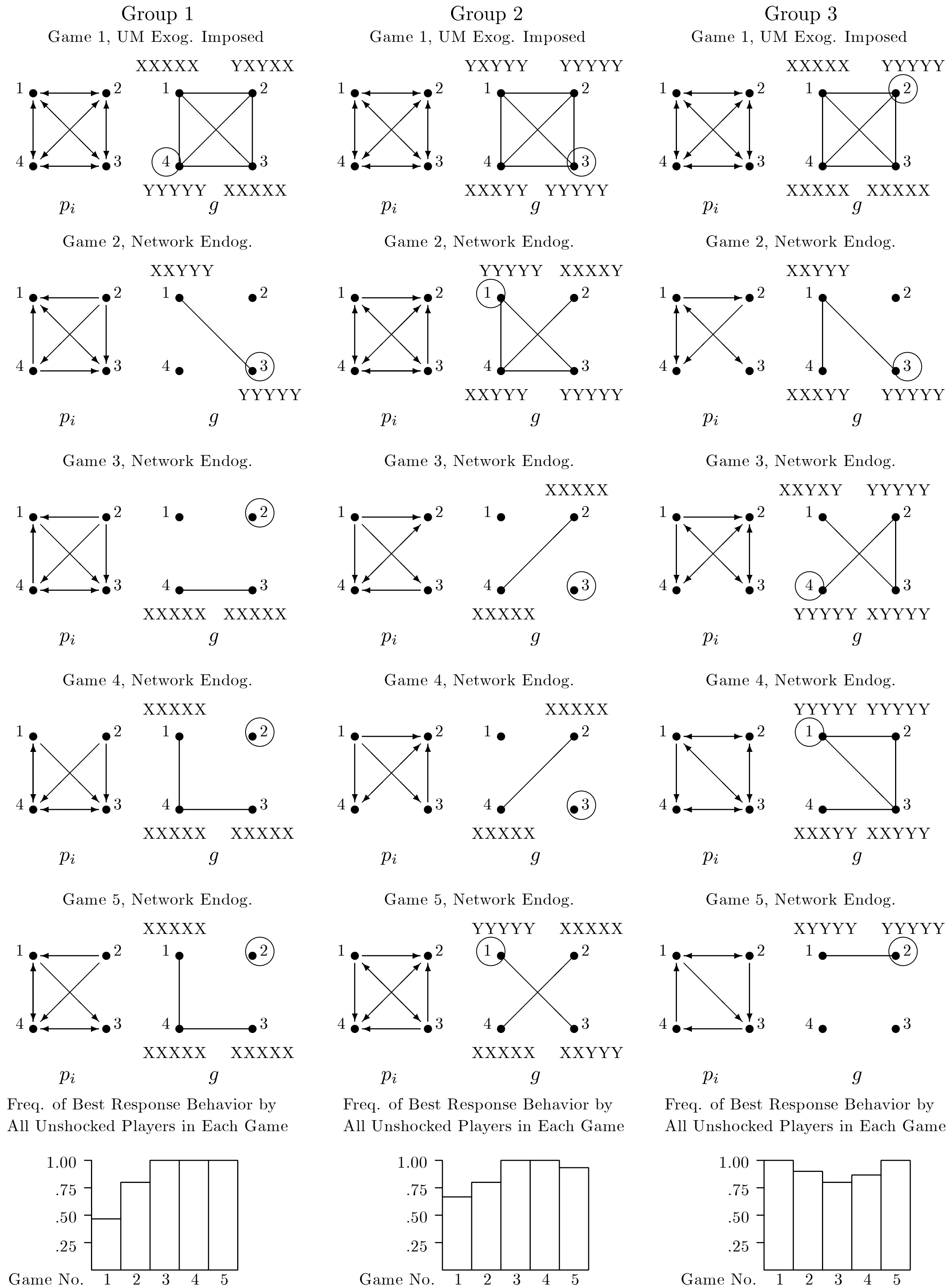
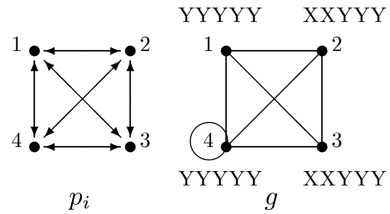


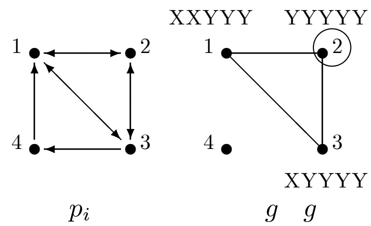
Figure UM5, Continued: 4 Groups Initially in UM Play 5 Games

Group 4

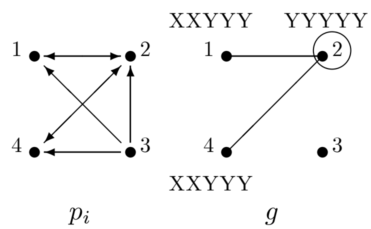
Game 1, UM Exog. Imposed



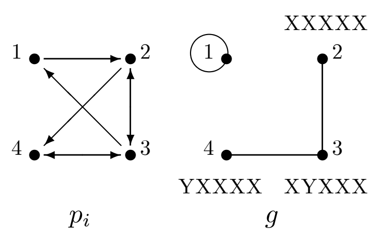
Game 2, Network Endog.



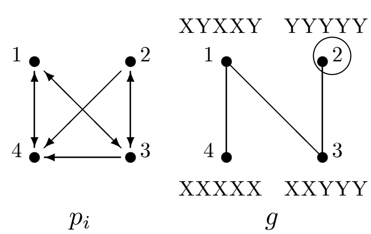
Game 3, Network Endog.



Game 4, Network Endog.



Game 5, Network Endog.



Freq. of Best Response Behavior by
All Unshocked Players in Each Game

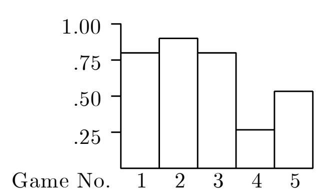
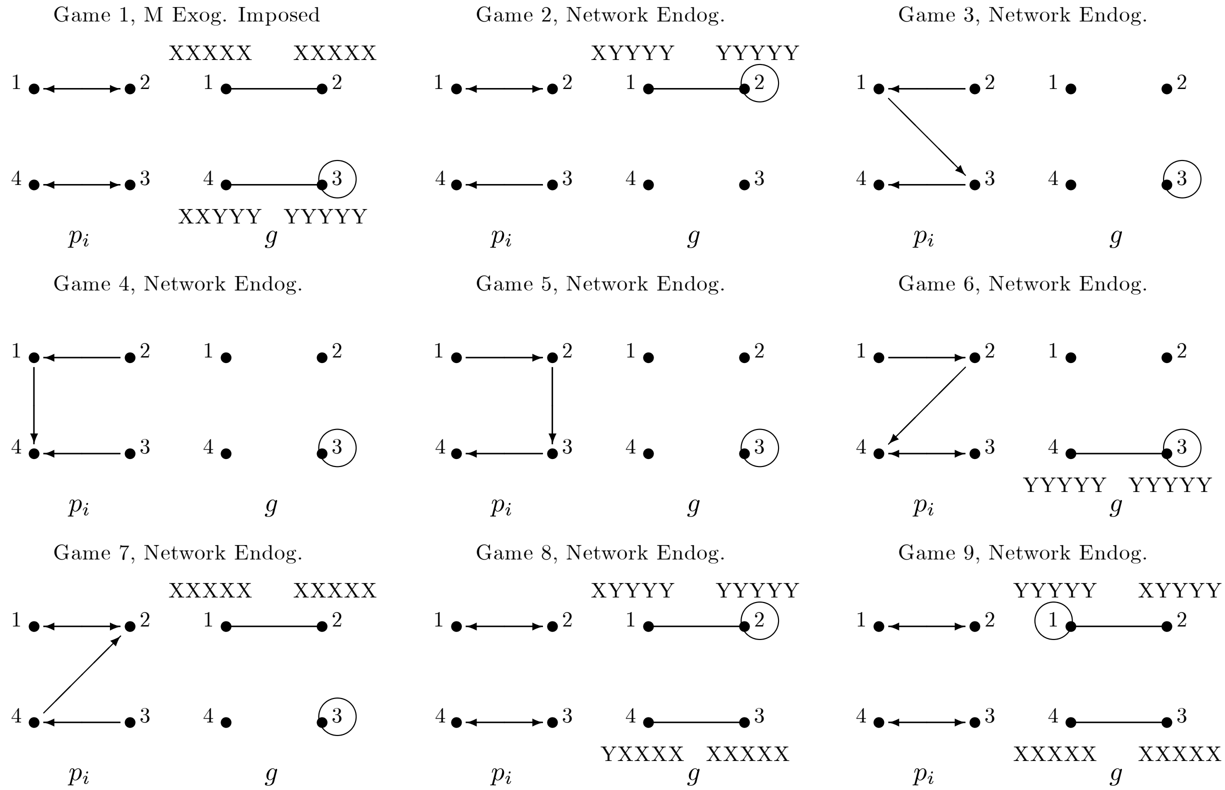


Figure M9.a: Group 1 Initially in M Plays 9 Games



Freq. of Best Response Behavior by
All Unshocked Players in Each Game

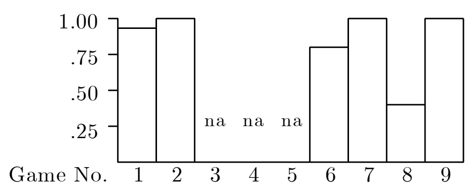
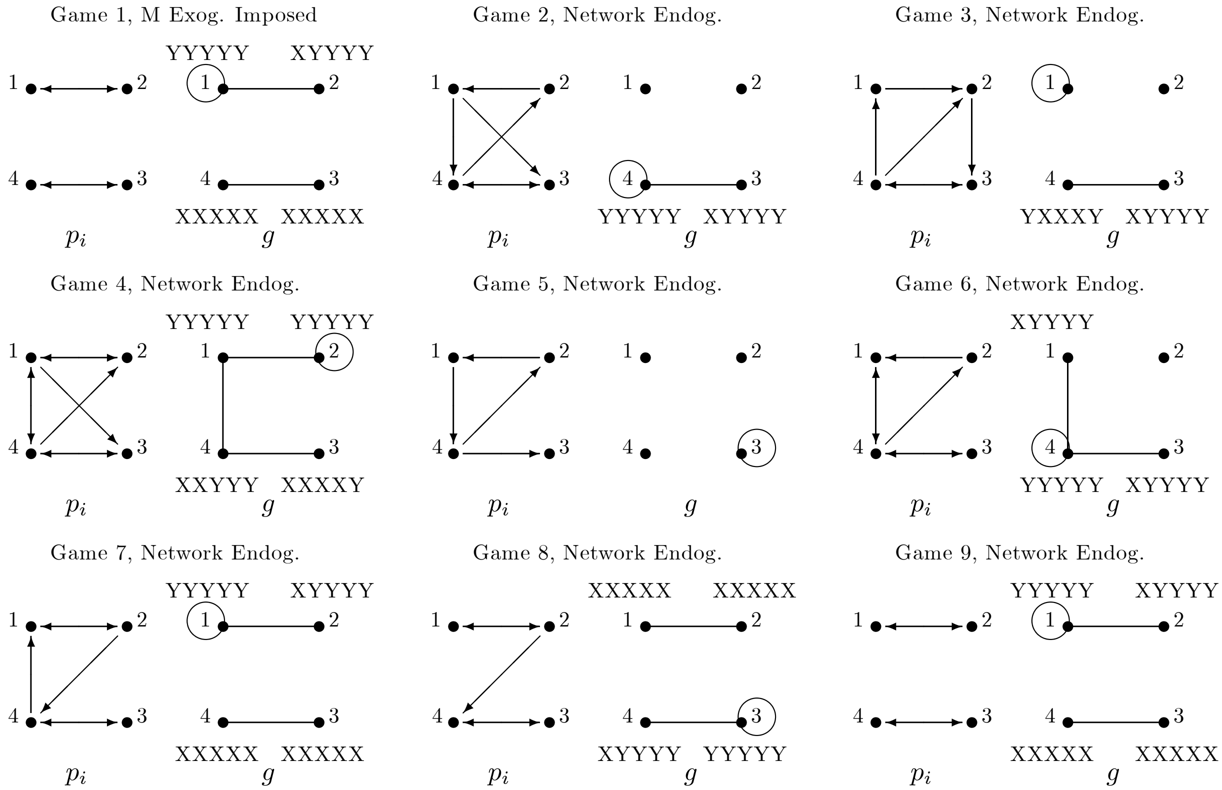


Figure M9.b: Group 2 Initially in M Plays 9 Games



Freq. of Best Response Behavior by
All Unshocked Players in Each Game

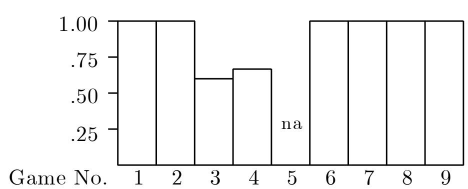
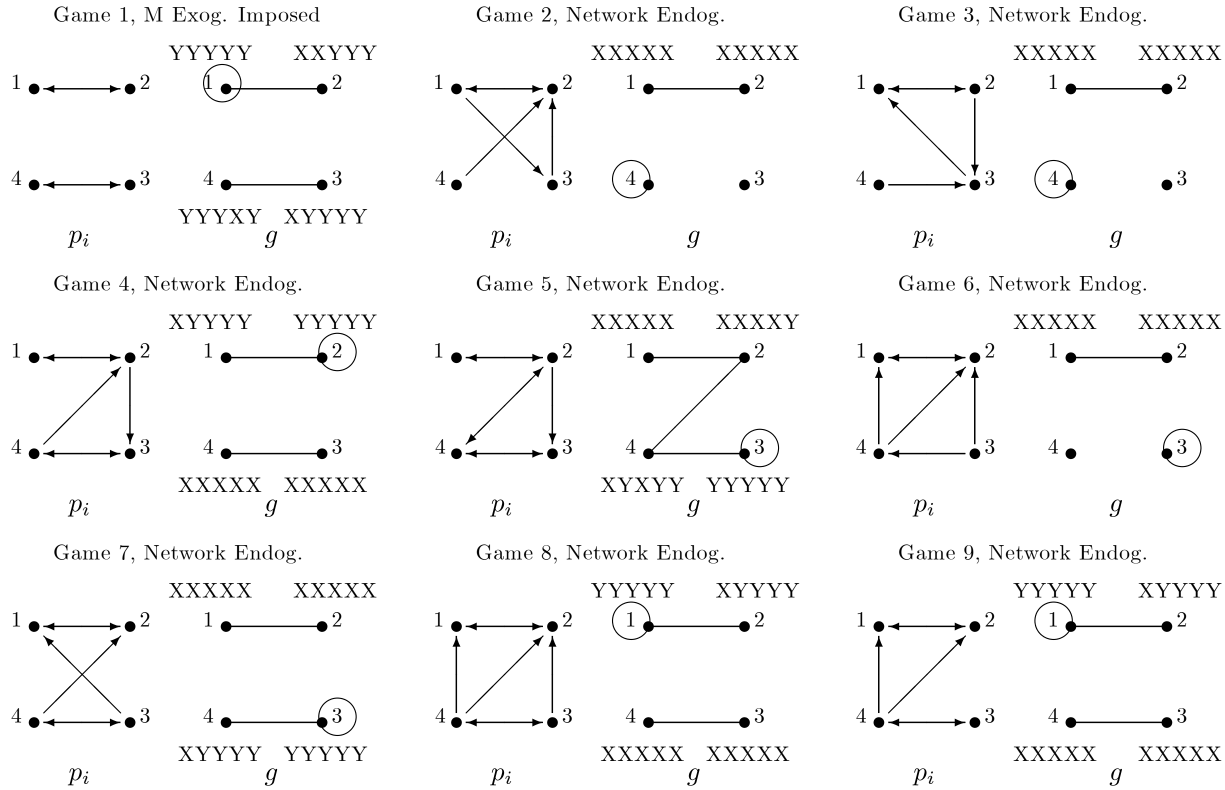


Figure M9.c: Group 3 Initially in M Plays 9 Games



Freq. of Best Response Behavior by
All Unshocked Players in Each Game

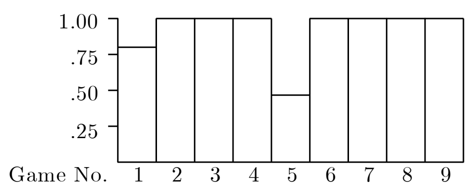
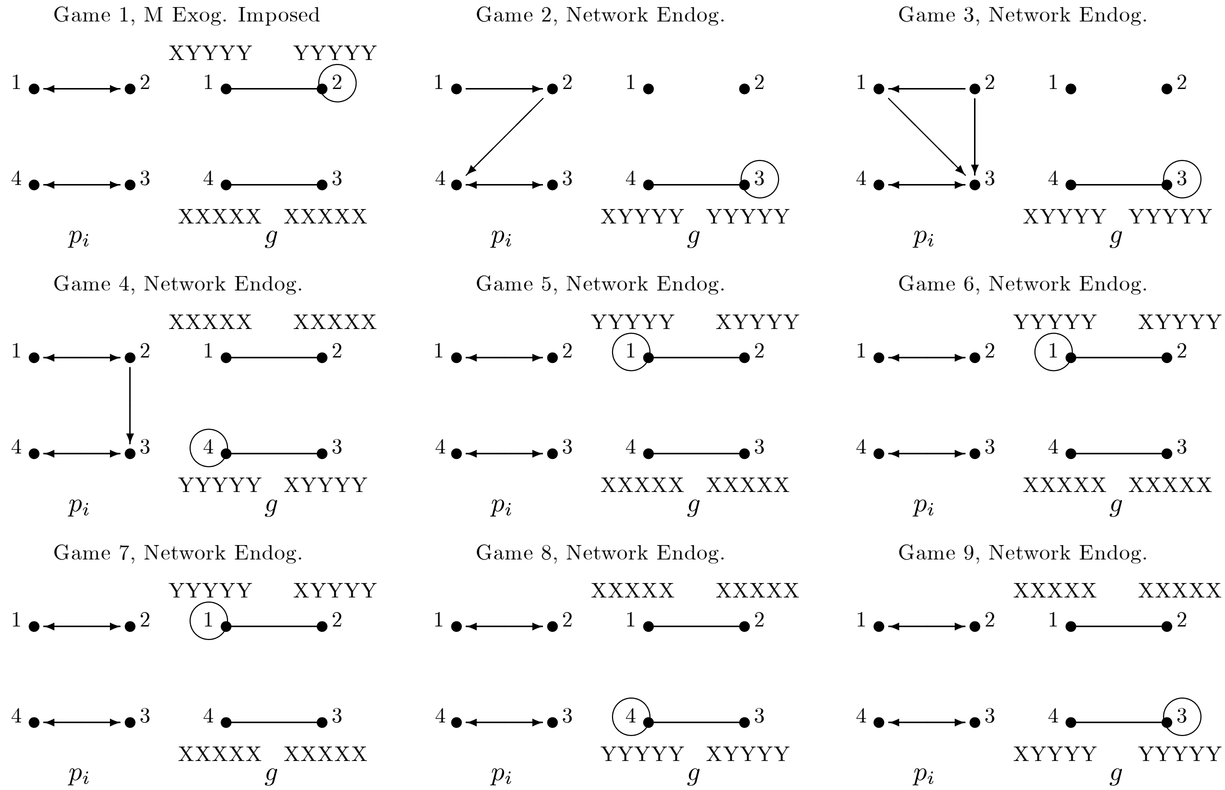


Figure M9.d: Group 4 Initially in M Plays 9 Games



Freq. of Best Response Behavior by
All Unshocked Players in Each Game

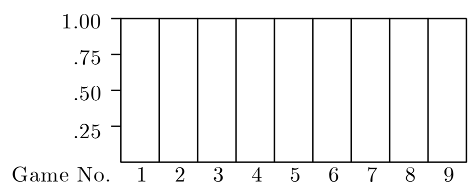
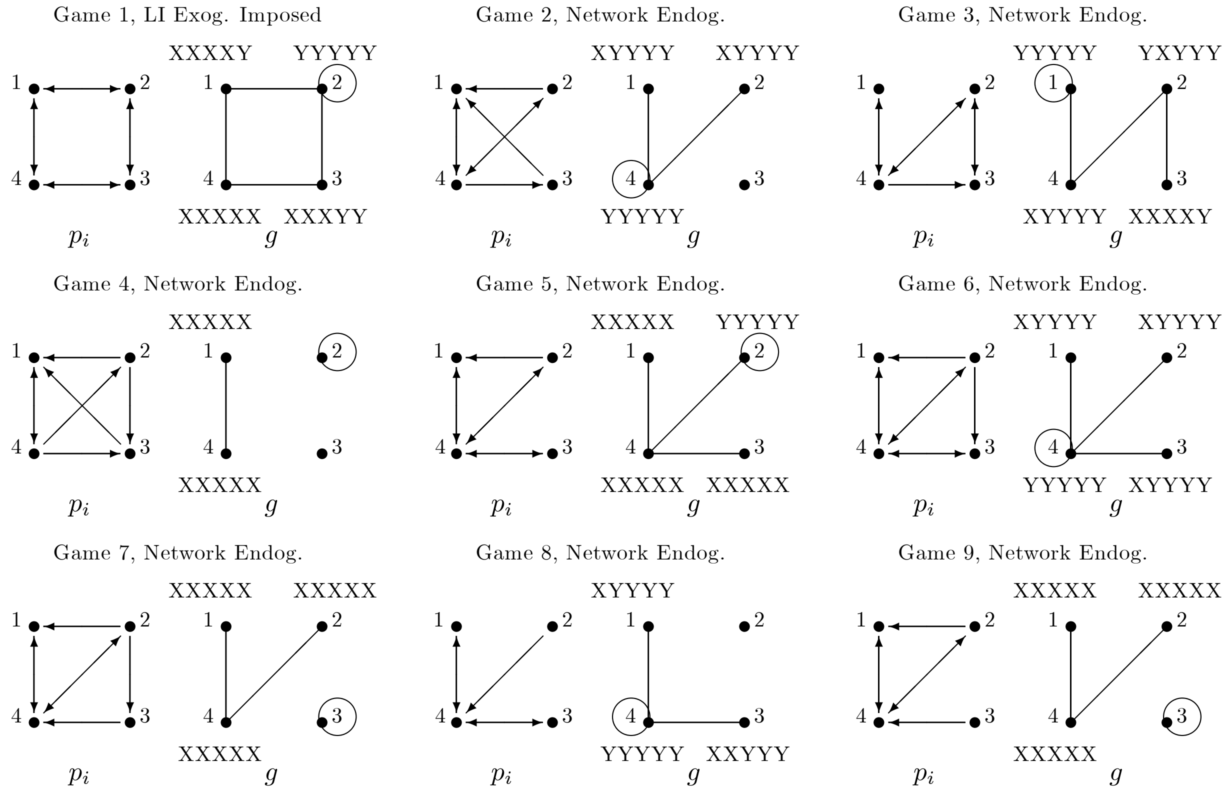


Figure LI9.a: Group 1 Initially in LI Plays 9 Games



Freq. of Best Response Behavior by
All Unshocked Players in Each Game

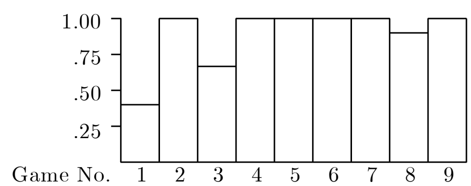
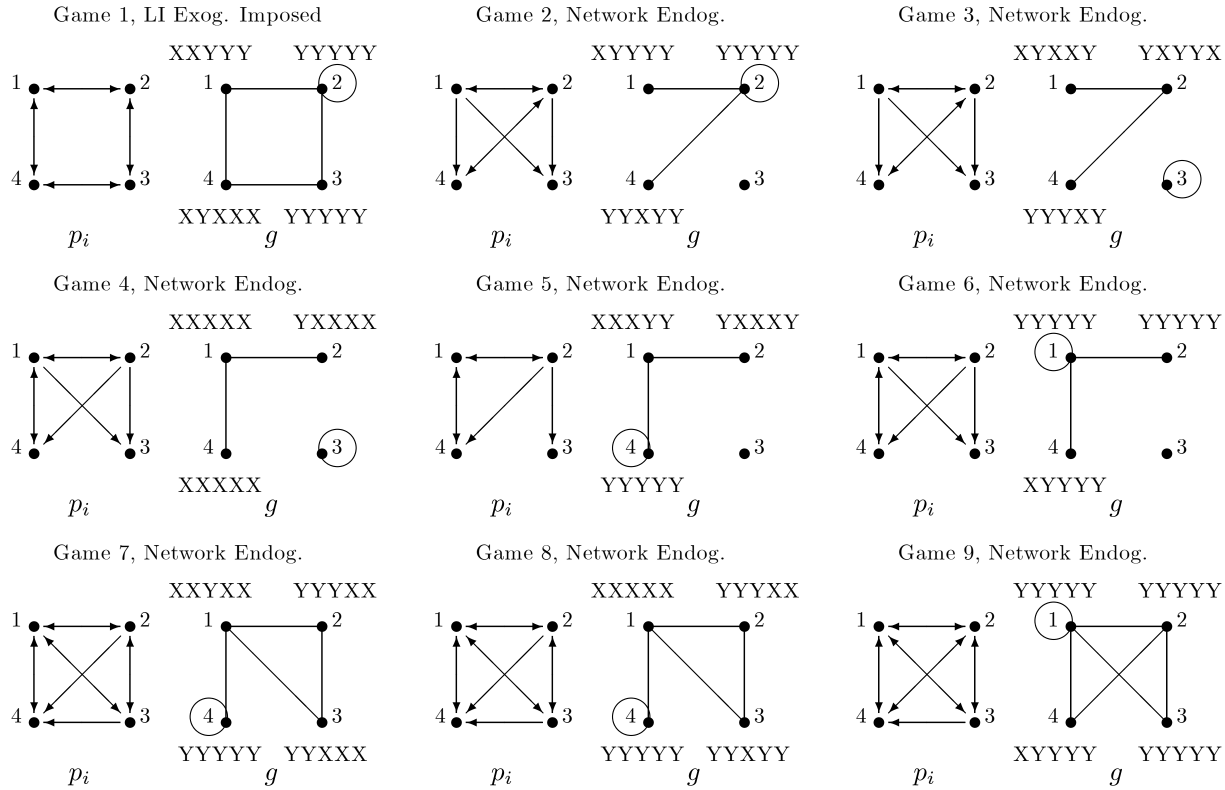


Figure LI9.b: Group 2 Initially in LI Plays 9 Games



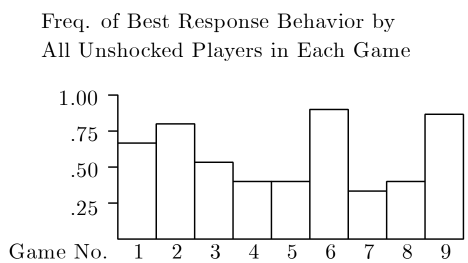
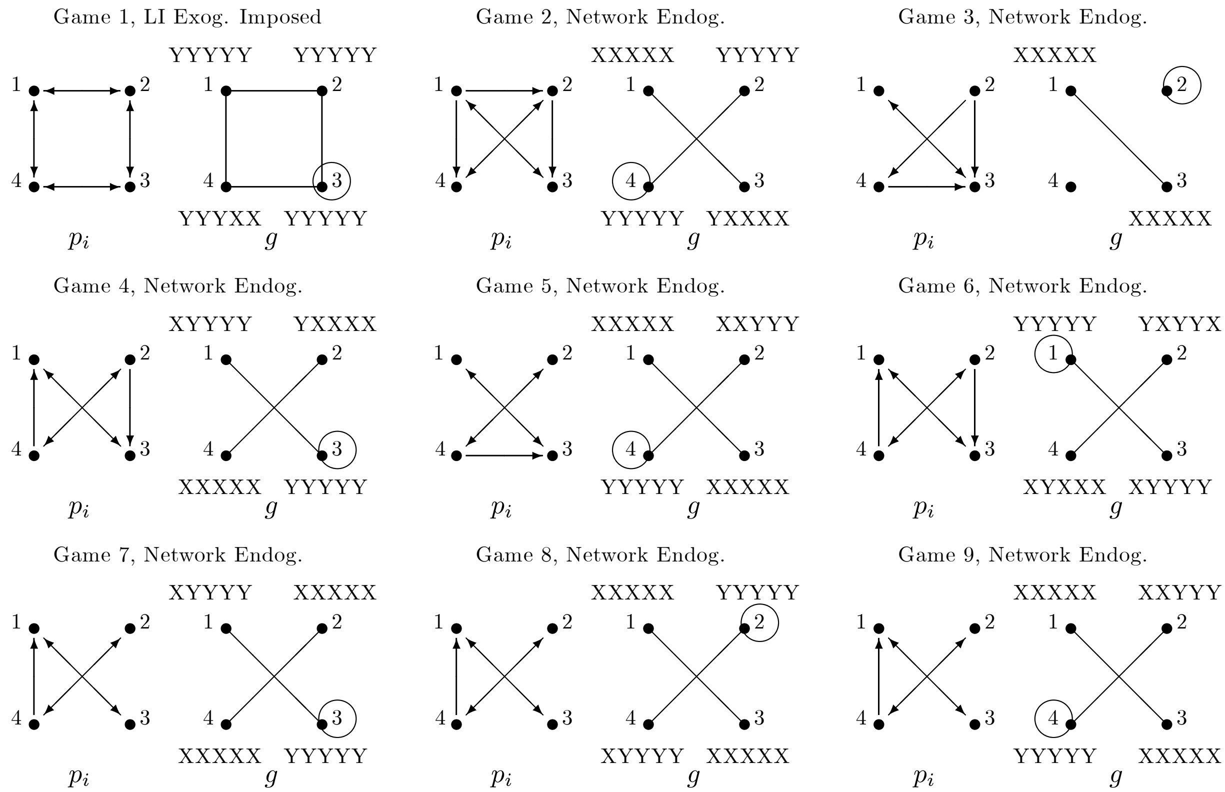


Figure LI9.c: Group 3 Initially in LI Plays 9 Games



Freq. of Best Response Behavior by
All Unshocked Players in Each Game

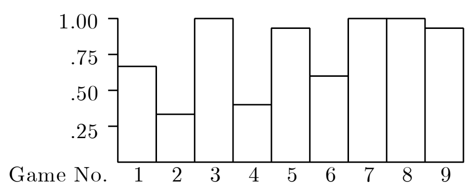
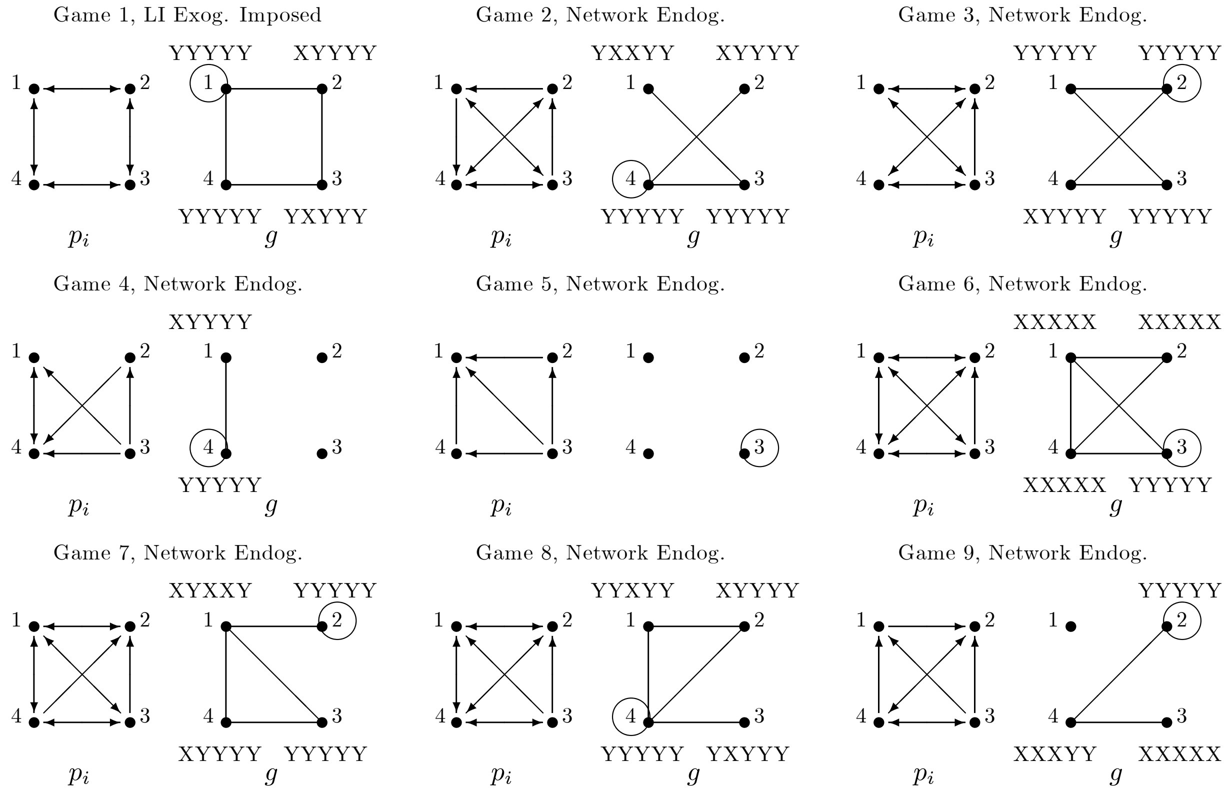


Figure LI9.d: Group 4 Initially in LI Plays 9 Games



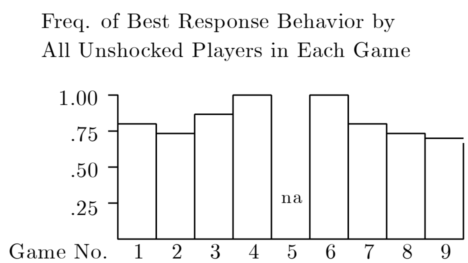
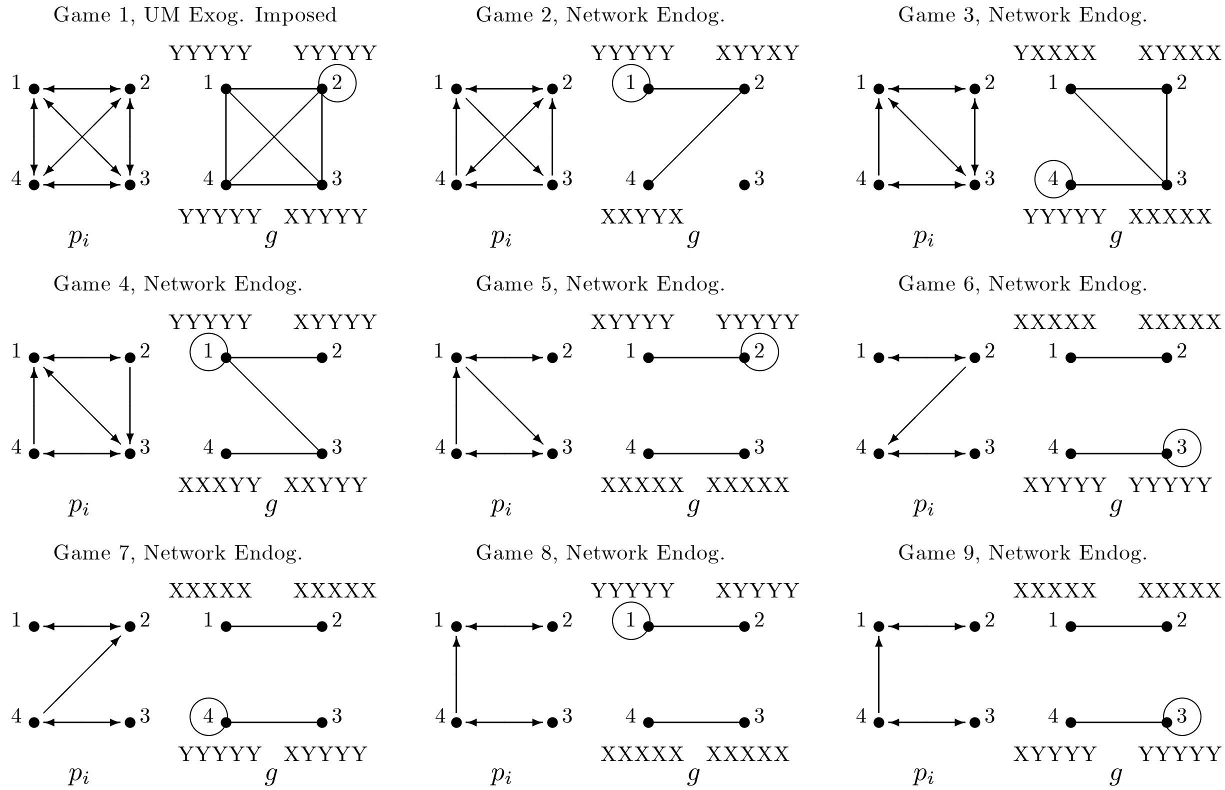


Figure UM9.a: Group 1 Initially in UM Plays 9 Games



Freq. of Best Response Behavior by
All Unshocked Players in Each Game

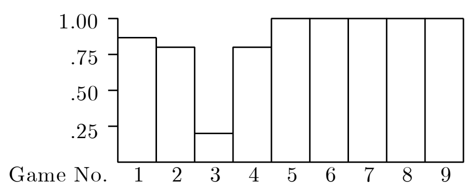
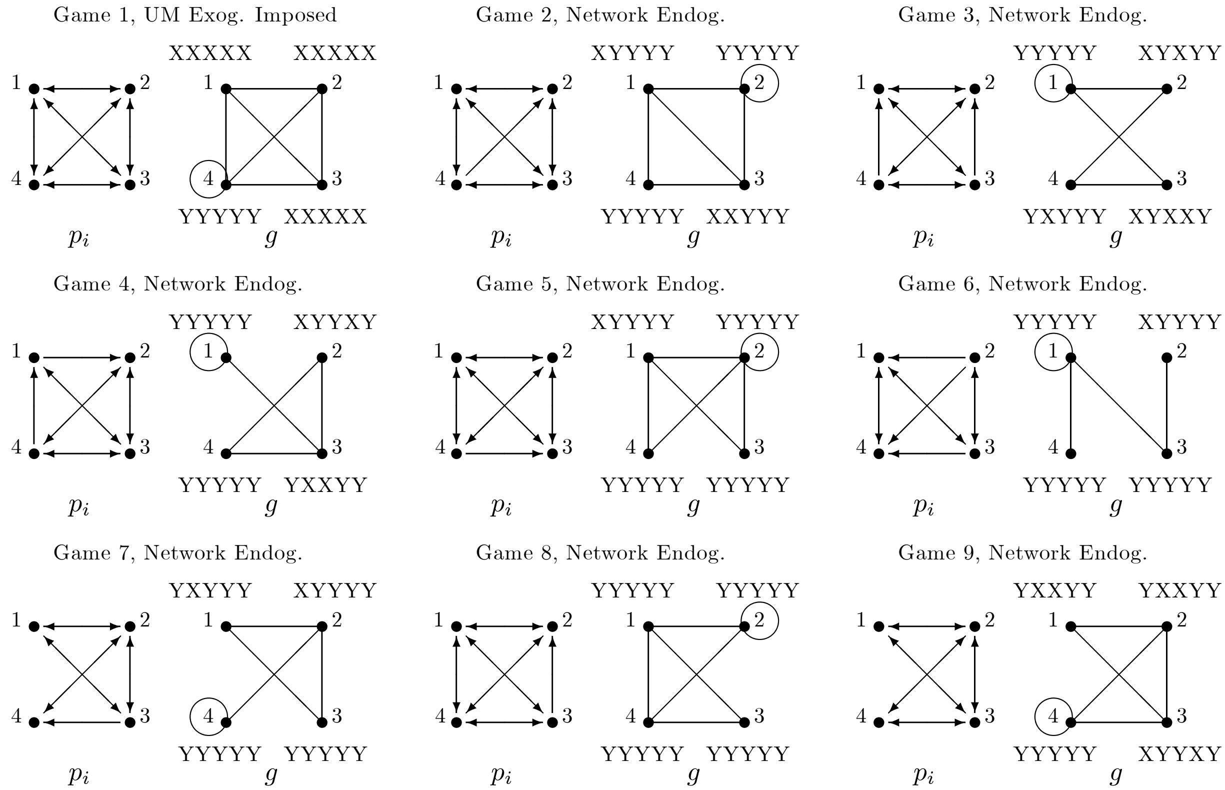


Figure UM9.b: Group 2 Initially in UM Plays 9 Games



Freq. of Best Response Behavior by
All Unshocked Players in Each Game

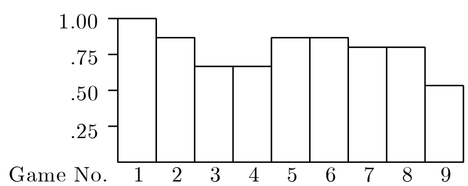
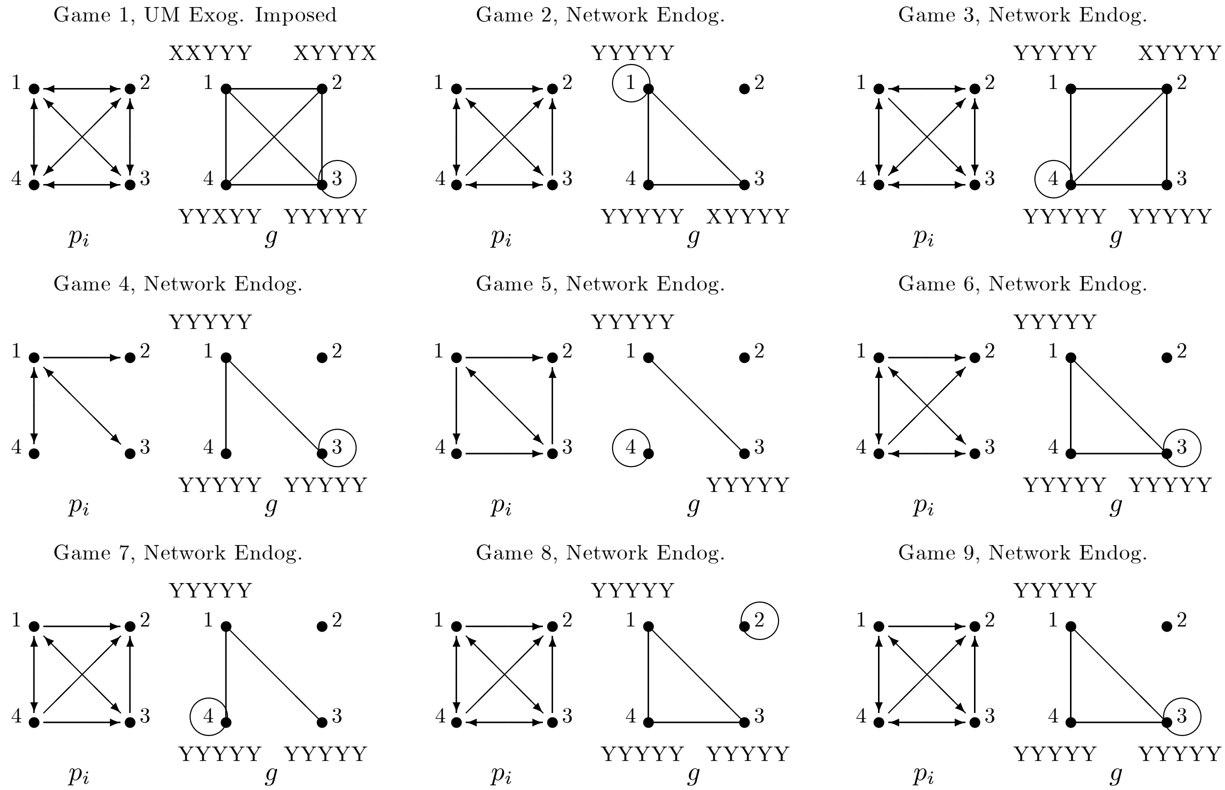


Figure UM9.c: Group 3 Initially in UM Plays 9 Games



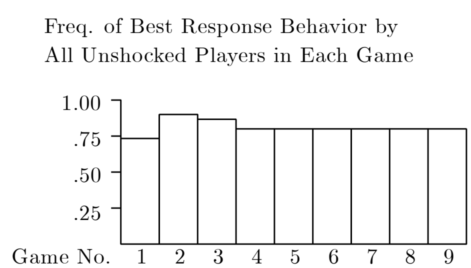
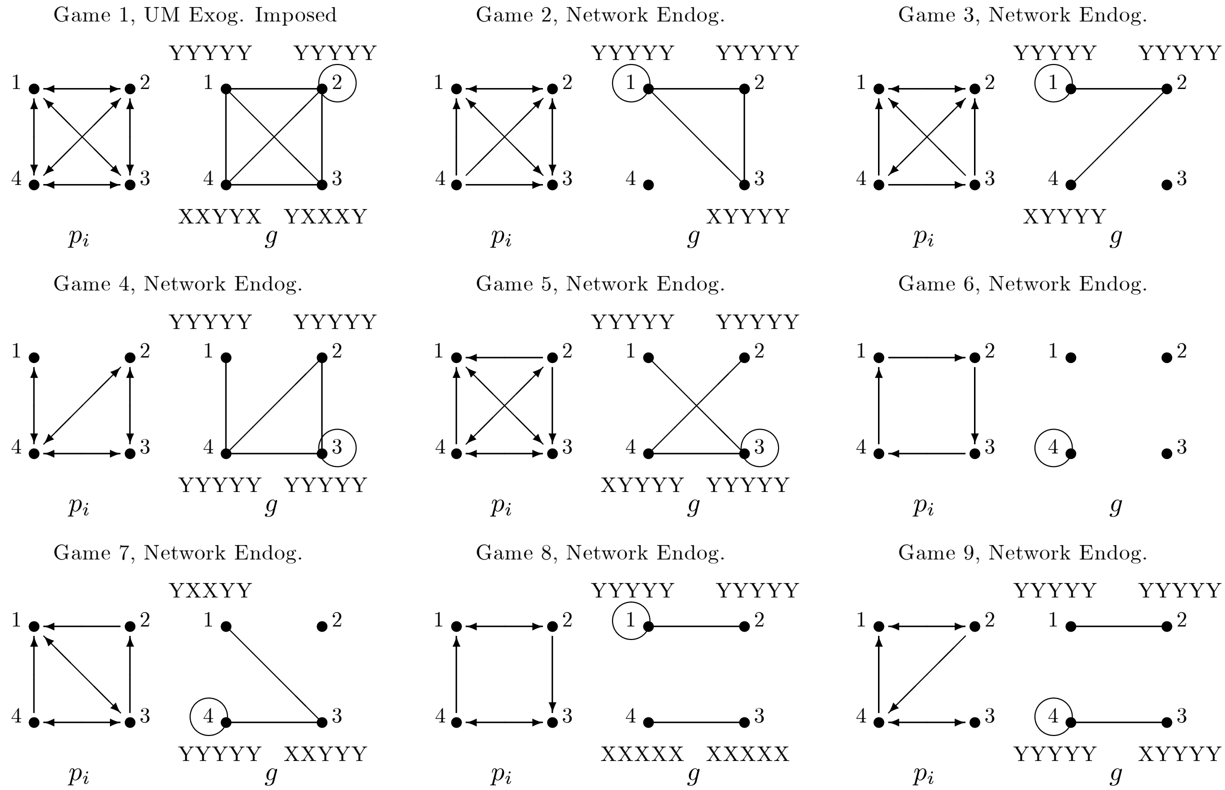
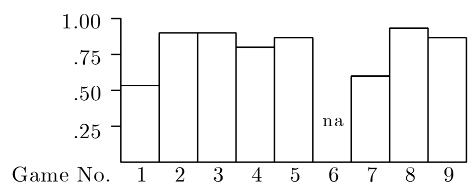


Figure UM9.d: Group 4 Initially in UM Plays 9 Games



Freq. of Best Response Behavior by
All Unshocked Players in Each Game



References

[1] Corbae, D. and J. Duffy (2007): “Experiments with Network Formation” working paper, available at http://www.pitt.edu/~jduffy/networks/