The effect of link costs on simple buyer–seller networks ☆

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A R T I C L E I N F O

A B S T R A C T

We examine experimentally how link costs affect the formation of links between a single seller and two potential buyers as well as the ensuing bargaining. Theory predicts that link costs lead to less competitive networks, with one link rather than two links, and that link costs do not affect the bargaining outcomes conditional on the network. We find support for the first but not the second prediction. 2-link networks form less frequently when there are link costs. Given that a 2-link network forms, however, a seller on average offers a smaller share of the pie to the buyers in the presence than in the absence of link costs. This impact of link costs can be explained by a disutility for (advantageous) inequality on the part of the seller.

1. Introduction

Buyers and sellers often have to establish a 'link' between them before they can engage in exchange. The collection of links between buyers and sellers (i.e., the 'network') exerts a strong influence on the outcomes of exchange. Who can interact with whom not only affects the gains from exchange but also how these gains are distributed. Typically, agents with more links and trading opportunities are in a better bargaining position than more isolated agents. For example, Corominas-Bosch (2004) showed that a decomposition of buyer–seller networks allows 'even' and competitive sub-networks to be identified; surplus is shared evenly in the even sub-networks, whereas the short side of the market extracts all surplus in the competitive sub-networks. This implies that, similar to market entry, there is a strong strategic element in the formation of links and that the costs of forming a link play a key role.

The present paper uses experiments to analyze behavior in a simple game with endogenous network formation in addition to endogenous interaction within the network. We address two basic questions. First, we ask how network *formation* is affected by the presence of link costs. In particular, we examine whether competitive networks in which the short side of the market is predicted to get the entire surplus are less likely to arise when links are costly.

Our second question is whether the *bargaining* in the network, and not just the *formation* of the network, is affected by the costs of link formation. Because the network formation stage precedes the bargaining in the network, any link costs

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are sunk at the moment the bargaining in the network commences. Therefore, standard theory would suggest that, given the network that forms, there is no effect of link costs on the bargaining within the network. It is important to establish the absence of such an effect, as this is a basic assumption in the theoretical literature on network formation. In fact, the assumption is so standard that most papers do not mention it explicitly.

To address the two basic questions we focus on the simplest possible, non-trivial buyer–seller network formation game.[1] We analyze a two-stage game between one seller with one indivisible good and two potential buyers. In the first stage, the seller decides whether or not to form a link with each of the two buyers and the buyers simultaneously decide whether to form a link with the seller. In the second stage, conditional on the network that has been formed in the first stage, the players engage in alternating offers bargaining over a shrinking pie.

The subgame perfect equilibrium prediction of the bargaining stage of the one-shot game is such that all the surplus goes to the seller if a competitive network with two linked buyers is formed, whereas the surplus is shared if the seller is linked to one buyer only. Given the payoff predictions from the bargaining stage, in the first stage it is a weakly dominant strategy for the seller to offer a link to both buyers, if the link costs are not too high. For the buyers it is a weakly dominant strategy to offer a link to the seller if links are costless but not if links are costly. After all, the buyers are fully exploited if the competitive network is formed, so they are better off to unilaterally delete a link in case links are costly. This implies that the competitive network is the unique perfect equilibrium outcome if the links are costless, whereas the competitive network is not an equilibrium if links are costly. Hence, the first basic prediction is that the presence of link costs reduces the occurrence of competitive networks. The second basic prediction is that the presence of link costs does not affect the outcomes of bargaining given the network that forms. Once the network has been formed and bargaining starts, the link costs are sunk and the players treat them as such. To test these predictions we will employ a so-called strangers design, which allows for learning while preserving the one-shot character of the interaction to some extent.

The experimental results indicate that, as predicted, the competitive network is less prevalent in case establishing a link is costly. Contrary to the prediction though, this is due to the seller's and not the buyers' linking behavior. Remarkably, it is the seller who is more reluctant to establish a competitive network in the presence of link costs, not the buyers. Regarding the second question, we find that the presence of link costs does have an effect on the bargaining outcomes given the network that forms. Interestingly, this effect is observed when the seller is linked to two buyers but not when the seller is linked to one buyer.

We show that the effects of link costs can – at least qualitatively – be explained by assuming that player care for equality (Fehr and Schmidt, 1999). Specifically, if the seller is very averse to inequality, even if it is to her own advantage, then she will aim for an equitable outcome. This means that in a 2-link network she will compensate herself for the extra link costs she incurs relative to the buyers, while there is no need to do so in the 1-link network.

2. Related literature

Our paper is related to three different strands of experimental literature. The first strand examined the effect of competition on bargaining outcomes. Roth et al. (1991) examined bargaining between one proposer and one responder as well as bargaining between nine competing proposers and one responder. They found that competition had a dramatic effect on the bargaining outcomes. While bilateral bargaining led to a near equal division of the surplus in as much as 70 percent of the cases, with the introduction of proposer competition the occurrence of the near equal division dropped to less than five percent of the cases and almost all surplus went to the responder.[2] Closer to our paper is Charness et al. (2007) who tested the implications of the model in Corominas-Bosch's (2004), which identifies buyer–seller networks that are 'even' and those that are 'competitive', where the latter leave almost no surplus to the long side of the market. The experimental results indicated that the competitiveness of the network had a strong effect on bargaining outcomes, even though the effect was less extreme than predicted.

Analyzing the effect of competition on bargaining outcomes is also central to our study. In our experiment, however, the competitiveness of the network is not given exogenously, but comes about endogenously. In view of the finding that competitive markets and competitive networks tend to leave the long side of the market with little surplus, it is important to analyze whether such competitive networks are formed in the first place, especially if the links are costly and agents may not be able to recover their link costs.[3]

The second strand of related experimental literature focuses on network formation and examines whether behavior in a link formation game is in line with the predictions of various equilibrium concepts.[4] Falk and Kosfeld (2003), for

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[1] Like Corominas-Bosch (2004) we use the labels 'buyer' and 'seller' for the players in our network game. What the players do, however, is bargaining over the division of surplus. Apart from the fact that two buyers cannot link and bargain with each other, there is nothing in the game that is specific to trading.

[2] Other experimental studies that examined the effect of competition on bargaining outcomes include Grosskopf (2003), Güth et al. (1997), and Fischbacher et al. (2003).

[3] This question is not just of theoretical interest. During the revision of the new European directive on procurement rules (EU Directive 2004/18/EC), much discussion was addressed at potential hold-up problems and bidder exploitation. The association of construction companies, for example, feared that competing bidders could be exploited to such a degree that they would not be able to earn back the costs of crafting a decent bid.

[4] See, e.g., Berninghaus et al. (2006, 2007), Callander and Plott (2005), Deck and Johnson (2004), Falk and Kosfeld (2003), Goeree et al. (2009). Also related are papers on market entry, such as Camerer and Lovallo (1999).