# Dyad Calling Behavior: Asymmetric Power and Tie Strength Dynamics

Mengze Shi [a] & Botao Yang [b],* & Jeongwen Chiang [c]

[a] *Rotman School of Management, University of Toronto, 105 St. George Street, Toronto, ON M5S 3E6, Canada*
[b] *Marshall School of Management, University of Southern California, 3670 Trousdale Pkwy, Los Angeles, CA 90089, United States*
[c] *China Europe International Business School (CEIBS), Shanghai, China*

## Abstract

We develop a model of dyad calling behavior as the outcome of asymmetric power between the initiating and receiving callers and the strength of their tie. Using a unique mobile phone service dataset, we estimate the model which encapsulates the evolving relationship between pairs of callers. We find that, first, the initiating callers enjoy more power than the receiving callers in determining the call volume. Second, the call volume between a pair of callers increases with the number of their common contacts. Finally, the reciprocity effect is prevalent in mobile phone service consumption. We discuss and demonstrate the implications of our results on firms' telecommunication service pricing decisions.
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*Keywords:* Social network; Tie-strength; Reciprocity; Decision power; Telecommunication service pricing; Structural model

## Introduction

The mobile phone has evolved into a communication device for the everyman. Statistics show that the number of mobile phone service subscriptions in the world increased from 738 million in year 2000 to more than 7 billion as of 2015 (International Telecommunication Union 2015). Financial data also shows that consumers worldwide have spent tens of billions of dollars each year on purchasing new mobile phones and paying phone bills.

A unique feature of telecommunication service is "consumption externality" (Littlechild 1975). This feature stems from the fact that a phone call requires two parties to "consume" jointly and simultaneously. In other words, telecommunications literally take two to tango. As it takes two parties to complete a call, the volume of calls is not entirely determined by one party alone. Since the initiating and receiving callers may have different values for the communications and pay different prices, they desire different call volumes. In jointly determining the amount of communications, the pair has to take into account both callers' preferences. The relative weight of an initiating (versus receiving) caller's preference in determining call volume reflects the "power" of this caller in their joint decision making. Here a caller's power refers to the *personal sense of power* in social context (Anderson, John, and Keltner 2012), and is defined by the extent to which the caller can make other callers yield to his or her preference for the volume of calls.[1]

Telecommunication service consumption (the volume of calls) also depends on the strength of the relationship between the two parties. The strength of tie between a pair of callers may depend on the structure of their social networks, e.g., the number of common contacts. Moreover, social ties are dynamic in nature: making longer calls can strengthen the social tie between two parties, which may intensify their personal interactions and cause them to call each other more often later.

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[1] Our definition of power is consistent with that in Anderson and Weitz (1989), "Power is defined as the ability of one party (A) to get another party (B) to undertake an activity that B would not norm do." In this paper we are agnostic about the sources of power. The power may possibly arise from social norm associated with calling etiquette.

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\* Corresponding author.
  *E-mail addresses:* mshi@rotman.utoronto.ca (M. Shi),
botaoyan@marshall.usc.edu (B. Yang), jwchiang@ceibs.edu (J. Chiang).

With the rapid development and increasing competition in the telecommunication industry, marketing practitioners need to understand the nature of consumption externality and tie strength dynamics as well as their implications for pricing and promotion decisions for communications within and between networks. If the initiating and receiving callers have different power in deciding call volume, then the service providers should consider callers' power in their pricing decisions on incoming (or receiving) and outgoing (or initiating) calls. In the markets with competing networks, callers' power should affect prices for both within network and between network calls. Knowledge on tie-strength dynamics should also affect how service providers assess their pricing and promotion decisions. For instance, a price promotion on outgoing calls will not only lead to immediate changes in the consumption of targeted customers, but also long-term impact on these customers' relationships in their social networks, and hence long-term impact on calling activities in the subsequent time periods.

To study these unique social features in calling behavior and implications on marketing decisions, we develop a model in which each pair of consumers jointly determines the duration of calls in each period. The explicit consideration of calling prices internalizes the consumption externality and allows us to identify the power of callers in determining the volume of calls. Following the social network literature, we consider the strength of a pair's social ties to be directional, asymmetric, reciprocal and dynamic (as elaborated in the next section). We postulate that phone calls can enhance the strength of social ties, and that stronger ties mean more subsequent calls.

To estimate the effect of power and social relation on calling behavior, we acquired a unique wireless telecommunication panel dataset that contains detailed information on callers and receivers, the time and duration of calls, outgoing and incoming call prices, and the socio-demographics of all callers. We find that, first, the outgoing call price matters more than the incoming call price in determining the duration of calls made, indicating that the initiating caller enjoys more power than the receiving caller in determining the volume of calls. Second, the volume of calls between a pair of callers increases with the strength of their tie, and the number of common social contacts shared by a pair of callers is a good predictor of the tie strength. Third, our results validate the reciprocity effect; specifically, caller A's ties to caller B will strengthen according to the duration of calls that A received from B in the previous period.

Based on our estimates, we further examine the implications on pricing policies. First, we conduct an analytical exercise to show the implications of asymmetric decision power on competing firms' discriminatory pricing schemes. Specifically, when the initiating caller enjoys more power than the receiving caller, the equilibrium profit margin can be lower for outgoing calls than that for the incoming calls. Second, we resort to counter factual analysis to evaluate the effect of temporary price cuts on outgoing and incoming calls, respectively. We show how much revenue may be underestimated when the social network effect is not accounted for.

Our model is the first to use a microeconomic framework to model joint decision making and tie strength dynamics. There is an extensive literature of empirical research on consumer behavior in the mobile phone service industry. Some studies have investigated consumer service usage when facing non-linear pricing schemes, whereas others have looked into service plan choice when future usage and/or service quality are uncertain for consumers (Ascarza, Lambrecht, and Vilcassim 2012; Huang 2008; Iyengar, Ansari, and Gupta 2007; Iyengar, Jedidi, and Kohli 2008; Lambrecht and Skiera 2006; Lambrecht, Seim, and Skiera 2007; Miravete 2003; Narayanan, Chintagunta, and Miravete 2007). This empirical literature, however, has neglected both consumption externality and tie strength dynamics.

We provide structural estimates for the callers' power in dyadic level and find that initiating callers enjoy more power than the receiving callers in determining the volume of calls. Some analytical research has modeled such joint decision-making process and pointed to its importance in deciding telecommunication service pricing and regulatory policies such as receiver-pay policy (Hermalin and Katz 2004; Jeon, Laffont, and Tirole 2004). However, to the best of our knowledge, no study has empirically examined this issue.

Our paper demonstrates that consumers' social relation can affect marketing decisions in telecommunication service industry. Marketing literature has investigated the effect of social relationship on a variety of buying behavior (see Iacobucci 1996; Van den Bulte and Wuyts 2007 for reviews of the literature). For instance, past research in marketing has examined the related issues in the context of new product diffusion, commercial World Wide Web structure, social commerce, and demand estimation with social interactions (Hartmann 2010; Katona and Sarvary 2008; Stephen and Toubia 2010; Van den Bulte and Joshi 2007), but not in the marketing of telecommunication services.

The reminder of the paper is organized as follows. We first present the model and then describe the data and empirical methods. After reporting and discussing the estimation results, we show the pricing and promotion implications. Finally, we conclude with main results and offer directions for future research.

## Model

In this section, we follow the utility-maximizing approach to develop a dyad model of calling behavior with asymmetric power and dynamic tie strength. We first describe a model of calling decisions, specifically the way in which call volume between a pair of callers depends on two callers' preferences weighted by their power (as defined earlier), the tie strength of these callers and their other characteristics. We then explain how the tie strength is measured and how it evolves over time.

### A Model of Joint Calling Decision with Asymmetric Power

We consider a network that consists of $I$ individual callers. Each individual caller communicates with a subset of people in the network. We let $T_i$ denote the personal calling network of caller $i$, and $n_i$ denote the size of $T_i$, where $i = 1, 2,...I$. We