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Can you hear me now? The rise of smartphones and their welfare effects

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ABSTRACT

The advent of smartphones has caused a dramatic change in consumers' access to information and media. Using data on consumer telephone service choices, along with geographic data on cellular network infrastructure and software applications, we estimate the demand for telephone services. We allow for the possibility that consumers purchase both landline and wireless service. Among our results, we find evidence that smartphones are much stronger substitutes to landlines than traditional wireless services, suggesting the growth of smartphones may speed up the decline of landline services. Using our demand estimates, we estimate the effect that smartphone availability has had on consumer welfare. We estimate that average monthly surplus (per-consumer) from smartphone introduction is approximately $35.50, which implies an aggregate monthly consumer surplus of approximately $7.03 billion for wireless consumers in the United States. This welfare increase is due to the expanded consumer choice set, as well as the effect that smartphone growth has had on improvements in cellular networks and a reduction in the price of wireless voice services.

1. Introduction

The U.S. wireless industry has grown dramatically in the past decade. Estimated wireless revenues have more than doubled from $71.1 billion in 2002 to $178.4 billion in 2012 (CTIA, 2013). In 2011, the average U.S. household spent $1226, or about 2.5 percent of their total annual expenditures, on telephone services (BLS, 2012).[1] This is up from 2.2 percent in 2006 (BLS, 2007). Anecdotally, a significant portion of this growth is attributable to the development of the smartphone.[2]

Despite the growing financial importance of the telephone industry, and the wireless industry in particular, the academic literature on wireless or mobile telephone service demand is rather small. Ahn and Lee (1999) were among the first to study the demand for mobile telephone services, using country-level data to study the relationship among per capita GDP, per capita fixed telephone lines, and mobile phone service demand. In a more recent study, Caves (2011) used U.S. state-level

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[1] This figure includes both landline and wireless services.

[2] Smartphones are mobile phones with built-in (mobile) operating systems that allow for more advanced computing capabilities and better connectivity than traditional cellular phones. They combine the functions of a mobile phone, a personal digital assistant (PDA), a portable media player, a compact digital camera, a portable video camera, a hand-held gaming system, and a GPS navigation system into a single multi-use device. Modern smartphones also include high-resolution touchscreens and web browsers.

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data from 2001 through 2007 and found that a one percent decrease in the price for wireless services is estimated to decrease the demand for landline services by 1.2–1.3 percent. A key feature of smartphones is their broadband internet capabilities. Thompson and Garbacz (2011) find that mobile broadband, such as that provided to smartphones, has an important direct effect on GDP, especially for low income countries, but that the effect of fixed broadband (e.g. home internet service) is no different than zero. Using a panel of OECD countries, Czernich, Falck, Kretschmer, and Woessmann (2011) estimate a 10 percentage point increase in broadband penetration raised annual per capita economic growth by 0.9–1.5 percentage points during the period 1996–2007.

Much of the prior literature on mobile telephone services is comprised of country or region studies. Wallsten (2001) explores the impacts of privatization, competition, and regulation on mobile operator performance in Africa and Latin American. The author finds that competition is correlated with increases in per capita services, decreases in price, and that privatization combined with an independent regulator is positively correlated with telecom performance measures. Regarding country case studies, Tishler, Ventura, and Watters (2001), Kim and Kwon (2003), Iimi (2005), and Doganoglu and Grzybowski (2007) examine the Israeli, Korean, Japanese, and German markets for mobile telecom services, respectively. Alleman and Rappoport (2014) study the entire information and communications technology sector, and discover that weaker regulation led to higher prices and more investment in Latin America.

The goal of this study is to examine the U.S. market for telephone services, both wired and wireless, in an attempt to understand consumer behavior and welfare. More specifically, the analysis begins with the estimation of demand for both landline ("fixed-line", "main line", "home phone") telephone service and wireless ("mobile") telephone services. Smartphones and traditional wireless service are differentiated in the consumer's choice problem. A discrete choice model is used, derived from Gentzkow (2007), that allows for the possibility that consumers purchase both landline and wireless services.[3] Demand estimates show evidence that smartphones are much stronger substitutes to landlines than traditional wireless telephone services. Accounting for unobserved heterogeneity in tastes is found to be important in the context of telephone demand. Results also indicate that improvements in cellular network infrastructure and especially smartphone features, as measured by the deployment of cellular towers and the availability of smartphone applications (apps), respectively, increase consumer utility. This suggests that network quality, which should be directly affected by the increased prevalence of cellular towers, is an important component in the decision to purchase a wireless phone.

Using the estimates from the demand model, along with telephone pricing information, a counterfactual simulation is conducted. Specifically, this allows for the quantification of the effect that the introduction of the smartphone has had on consumer welfare. Results demonstrate that monthly consumer surplus, due to the introduction of the smartphone, is approximately $35.52 per consumer. When aggregated based on the size of the wireless market, this implies a total monthly consumer surplus of $7.03 billion or $84.36 billion annually. This value is actually quite similar to Hausman et al. (2002) estimate of the increase in consumer surplus due to the introduction of the cell phone, which ranged from $52.8 billion to $111 billion annually. Interestingly, it is predicted that approximately 25 percent of early smartphone subscribers were new wireless customers.[4] The growth of the smartphone (at least in the short run) did not come exclusively at the expense of existing wireless customers.

The remainder of the paper is organized in the following manner. Section 2 describes the market for wireless telephone services. Section 3 presents the data used for the analysis. In Section 4, the model of consumer demand is described. Estimation results are presented and discussed in Section 5. Section 6 describes the estimates for the welfare impact of the introduction of the smartphone. Conclusions are presented in Section 7.

2. The market for cellular telephone services

As of October 2012, 99.5 percent of the U.S. population and 67.8 percent of the U.S. land mass were covered by at least one wireless service provider (FCC, 2011). The wireless industry is characterized by four nationwide carriers (Verizon, AT&T, Sprint, and T-Mobile) and a number of smaller regional carriers (e.g. U.S. Cellular).[5] Wireless industry revenues have grown by approximately 33 percent in the last five years (CTIA, 2013). This growth has come primarily from smartphones and their required data plans.[6] Thus, the increase in industry revenue over the last few years can be directly tied to the popularization of smartphones. A number of consumers, especially younger consumers, now use their wireless phones as the primary device by which they send email and even browse the internet.

[3] Ida and Kuroda (2009) is the most closely-related wireless telephone study, model-wise. They estimate a discrete choice model of different mobile telephone services, specifically focusing on the choice between second generation (2G) and third generation (3G) mobile phone communication technology standards. The authors find that demand substitutability among alternatives is stronger within providers than within like services. For example, the closest substitute for a provider's 3G service is the same provider's 2G service, not another provider's 3G service.

[4] In other words, these were consumers that had purchased only landline services, or no telephone service, prior to the introduction of the smartphone.

[5] The Herfindahl–Hirschman Index (HHI) for the mobile wireless industry was 2873 in 2011 (FCC, 2011). Traditionally, a market with a HHI above 2500 is considered highly concentrated.

[6] In fact, total wireless industry voice services revenue fell from $111.9 billion in 2006 to $108.5 billion in 2011 while data services revenue rose from $15.2 billion to $62.7 billion over the same period (FCC, 2011).