Department of Economics

Working Paper Series

Consolidation and Price Discrimination in the Cable Television Industry

David P.Byrne

Mar 2011

Research Paper Number 1118

ISSN: 0819-2642
ISBN: 9780 7340 4471 6

Department of Economics
The University of Melbourne
Parkville VIC 3010
www.economics.unimelb.edu.au

Consolidation and Price Discrimination in the Cable Television Industry*

David P. Byrne

University of Melbourne

March 11, 2011

Abstract

This paper measures the impact of consolidation on cable television prices, product quality, profits and consumer welfare. I estimate a multi-product monopoly model using panel data on cable menus and costs in Canada from 1990 to 1996. Using counterfactual simulations, I find mean consumer welfare rises with acquisitions, as does welfare inequality across consumers. Scale economies are the primary driver of consolidation effects quantitatively, with firm heterogeneity in demand and costs having a smaller impact. Regional consolidation yields non-negligible welfare gains, particularly in rural markets where potential cable quality improvements and cost reductions are the largest.

KEYWORDS: Consolidation; Price Discrimination; Economies of Scale; Firm Heterogeneity; Simulated Method of Moments; Cable Television

*This paper is based on Chapter 4 from my Ph.D. dissertation. I thank my advisors, Chris Ferrall and Susumu Imai, for their advice and support. Seminar participants from The University of Melbourne, University of Toronto and Ryerson have provided various helpful comments. I have particularly benefitted from discussions with Victor Aguirregabiria, Avi Goldfarb, Matt Grennan, Arvind Magesan and Carlos Serrano. Stephen Law has graciously provided the CRTC Master Files data that is used in this study. Funding from the Social Sciences and Humanities Research Council of Canada Doctoral Canada Graduate Scholarship and Ontario Graduate Scholarship awards programs is appreciated. All omissions and errors are my own.

1 Introduction

In the past 30 years, the cable television industries of various industrialized nations have experienced consolidation.[1] The story is similar in many countries: from an industry consisting of many smaller locally-owned cable operators in the late 1970's emerges an industry dominated by fewer, larger firms in the 2000's, with the large firms' expansion largely driven by the acquisition of smaller cable companies over time. Although these histories have been well-documented by industry experts, various open questions remain (Crawford (2009)). What effect do acquisitions have on cable prices, product quality and profits? To what extent do scale economies or unobserved firm-specific factors such as branding or managerial differences persist as factors that drive consolidation? To what degree are consumers made better or worse off?

This paper studies the impact consolidation has on cable prices, bundle quality, firms' cost structure and consumer welfare using panel data for the cable television industry in Canada for the 1990-1996 period. This industry, time period and dataset are particularly conducive for studying consolidation primarily for two reasons: (1) firms are licensed local monopolists in pre-defined geographic markets;[2] and (2) over the sample period, I have access to rarely available supply-side license-level data on firms' labour costs, operating expenses and payments to channel providers known as "affiliation payments". The fact that firms are local monopolists yields two benefits for my empirical analysis. First, in order to expand into other markets firms must acquire other cable companies, which yields many acquisitions in the data and rich within-license variation in firm size and the identity of local cable providers. I use this variation to empirically study how acquisitions and firm size affect the prices, channel counts and firms' costs of offering cable bundles.

Second, the market structure allows me to use a structural multi-product monopoly model to quantify the impact acquisitions, scale effects and firm heterogeneity have on firms' cost structures, the menus of products offered and consumer welfare. Developing such an analysis in a strategic environment would be vastly more complicated since oligopoly models of strategic price and product quality choice can be intractable for even a small number of firms. Importantly, I estimate the model using license-level cost data that have not been available to previous researchers. I use this rich information on costs to separately identify cable content costs (i.e., affiliation payments) from non-content costs (i.e., labour and operating expenses), and for relating firms' cost functions to offered cable prices and bundle quality.

After providing an overview of the industry and data in Section 2, I present the first set of empirical results in Section 3. They are based on a regression analysis that studies the within-

[1] Numerous articles document the history of consolidation in the U.S. cable television industry; see Parsons (2003) for example. Byrne (2010b) documents the history consolidation for the Canadian cable television industry. For the U.K. and Europe, see Wieten, Murdock, and Dahlgren (2000).

[2] Direct Broadcast Satellite enters the market in 1998 and cable companies start bundling cable with phone and internet in 1999. Thus, cable companies are local monopolists in the provision of cable services who primarily earn profits by offering a discrete number of tiered cable bundles (i.e., basic and non-basic cable) to consumers.

license relationship between various outcome variables (cable prices, channel counts, affiliation payments, market shares), acquisitions and the size of a license's cable company in terms of the number of subscribers served nationally. Acquisition and firm size effects are predominantly found in larger, urban markets where both basic and non-basic cable are offered. Controlling for firm size, I find acquisitions have statistically significant relationships with non-basic prices and affiliation payments: non-basic prices and monthly per-subscriber affiliation payments respectively increase by \$3.12 and \$1.48 following an acquisition. To the extent that higher quality channels (i.e., those with higher ratings) are more expensive for cable companies to offer (Crawford and Yurukoglu (2010)), these estimates suggest cable quality rises with acquisitions. There is clear evidence of scale effects in the data, as firm size has a statistically significant effect on all the outcome variables. All else equal, large cable companies offer lower prices, higher channel counts and realize lower affiliation payments across all cable tiers. A five-hundred thousand subscriber increase (which is the magnitude of the difference in firm size between dominant and small firms) in the size of a local cable operator reduces basic and non-basic prices by \$0.15 and \$0.98, increases channel counts by 0.42 and 1.09 and reduces non-basic affiliation payments by \$0.71. Overall, the reduced-form estimates suggest that acquisitions by large firms result in relatively small changes in basic cable bundles and pronounced increases in non-basic prices and channel counts.

I further investigate the economic consequences of consolidation by developing and estimating a structural multi-product monopoly model. The model is presented in Section 4 and an estimation strategy is proposed in Section 5. In the model, consumers have heterogeneous vertical and horizontal preferences over cable services. Firms know the distribution over consumers' types but not their individual types. To maximize expected profits, cable companies screen consumers by offering tiered cable menus that contain basic services and possibly non-basic services. A key aspect of the model's specification is that I allow for firm-specific unobserved heterogeneity in demand and costs, which accounts for potentially important unobserved factors such as branding or managerial differences across firms. I allow firm size to affect marginal costs, which is consistent with regression estimates and the industry fact that larger cable companies tend to negotiate lower affiliation payments with upstream channel providers.[3] I estimate the model with a Simulated Method of Moments estimator that compares the model's predictions for basic and non-basic cable prices, market shares, and non-basic per-subscriber affiliation payments to their empirical counterparts.

Section 6 presents the structural parameter estimates and various findings from three sets of counterfactual experiments that investigate the impact consolidation has on cable bundles, costs and welfare in acquired licenses. The estimates show that both firm heterogeneity and scale effects have a large effect on firms' demand, costs and profit-maximizing menus of cable prices and qualities. The first set of experiments quantify the overall impact of consolidation by comparing the model's predictions for acquired licenses under the observed "consolidation" market structure to a "no-

[3]See for example, Ford and Jackson (1997) or Crawford and Yurukoglu (2010).

acquisitions" counterfactual where no acquisitions occur between 1990 and 1996. Monthly per-subscriber profits rises on average by $1.49 in licenses with only basic cable and by $1.24 in licenses with both basic and non-basic cable under consolidation. These represent 11.9% and 9% increases over their no-acquisitions scenario averages. Consumer surplus is $0.39 higher across all licenses on average, a 6.8% increase over its no-acquisition scenario level. Welfare inequality across consumers rises under consolidation because higher demand consumers realize larger utility gains from higher quality cable under consolidation than low demand consumers. In fact, not all consumers are better off under consolidation. Consumers with sufficiently weak preferences for quality can be worse off if their utility gains from higher quality cable are more than offset by their utility losses from higher prices under consolidation.

I study the determinants of acquisition effects by running a second set of experiments that start from the no-acquisitions scenario and set one of the firm-specific demand effects, firm-specific cost effects, or scale effects to their consolidation levels. Comparing outcomes from these simulations and the no-acquisitions counterfactual allows me to quantify the relative importance of demand heterogeneity, cost heterogeneity and scale effects in driving acquisition outcomes. I find that scale effects are largely responsible for the differences in outcomes under the consolidation and no-acquisitions scenarios. On average, monthly per-subscriber profits in markets with basic and non-basic cable and consumer surplus across all markets increase by $0.87 and $0.30 over their no-acquisition levels if I only allow firm size to change with acquisitions. These changes are 71% and 77% of their total predicted changes between the consolidation and no-acquisitions scenarios. Firm heterogeneity in costs also plays important role in driving consolidation outcomes: average profits and consumer surplus increase by $0.23 and $0.072 if only cost-side firm-specific effects change with acquisitions. Branding effects give rise to an average increase of $0.12 in monthly per-subscriber profits and have a minimal effect on consumer welfare relative to the no-acquisitions scenario.

The final counterfactual experiment evaluates the impact that regional consolidation has on consumer welfare. By the mid 2000's the industry is regionally consolidated with four major cable providers dominating four distinct regions of Canada: Eastlink in Atlantic Canada, Vidéotron in Québec, Rogers in Ontario and Shaw in Western Canada (Byrne (2010b)). I quantify the welfare effects from having regionally dominant firms by comparing outcomes under the 1996 market structure to a counterfactual where only these dominant firms operate in their respective regions. On average, I find that monthly per-subscriber consumer surplus respectively increases by $0.65, $1.07, $0.56 and $0.76 in each region under consolidation. Welfare gains are particularly large in rural licenses where large firms' ability to reduce costs and improve cable quality over the status quo is the most pronounced.

1.1 Related literature

This study contributes to an active body of empirical research on the cable television industry. Crawford and Shum (2006), Chu (2010), and Crawford and Yurukoglu (2010) have recently estimated structural models for the U.S. cable television industry in the 1990's and 2000's that are similar to the model I use.[4] Respectively, these papers study quality degradation, the effect of satellite entry and the welfare implications of à la carte bundling of cable services. In contrast, I focus on consolidation and linkages between firms' cost structures and the menus of products and prices offered. Moreover, my empirical strategy uses previously unavailable license-specific cost data on labour expenses, operating costs and affiliation payments to directly identify and estimate firms' cost functions.

This paper also complements a growing empirical literature in industrial organization that investigates the impact that mergers and acquisitions have on pricing and product variety and/or quality in differentiated product markets. Berry and Waldfogel (2001) and Sweeting (2010) respectively study horizontal mergers and product variety in the U.S. Radio Broadcasting industry and U.S. Music Radio Industry. Both papers find merging firms further differentiate their products following a merger. Recent papers by Draganska, Mazzeo, and Seim (2009) and Fan (2010) develop structural oligopoly models to study mergers and acquisitions with endogenous pricing and product quality. Both papers conduct hypothetical merger simulations and show that different conclusions regarding the welfare impact of mergers can be reached depending on whether product quality is assumed to be exogenous. Like the reduced-form papers, I empirically study the effect observed acquisitions have on prices and product quality. I complement the reduced-form analysis using structural methods to examine the impact consolidation has on cable menus and consumer welfare. The latter task is greatly simplified by studying acquisitions amongst monopolists: I do not require a complex model of strategic price *and* quality setting that can contain multiple equilibria. Such multiplicity potentially compromises the use of counterfactual merger simulations since predictions over equilibrium outcomes are not unique. Moreover, the focus of this paper differs considerably from previous research in this area. I use demand and supply-side data to study the interrelated impact acquisitions have on firms' cost structures and product offerings, whereas prior research focuses on the competition-reducing effects of mergers and acquisitions on prices and product quality.

2 Industry and data

Since 1968, cable companies in Canada have been federally regulated by the Canadian Radio-television and Telecommunications Commission (CRTC), according to the *Broadcasting Act* (the

[4] Various earlier papers study how horizontal firm size and vertical integration affects cable companies' bundle prices and characteristics, as well as their interactions with upstream channel providers in the U.S. cable industry. Both Ford and Jackson (1997) and Chipty and Snyder (1999) find evidence that horizontally integrated cable companies realize cost efficiencies.

Act). Prior to 2001, a primary feature of the *Act* is the issuance of geographical licenses from the CRTC to cable operators that give companies exclusive rights to be the sole cable provider within pre-defined Local Service Areas (LSAs or licenses). Licenses are defined by the CRTC and typically correspond to cities, towns or municipalities. Prior to the entry of Direct Broadcast Satellite in Canada in 1998, these exclusive licenses gave local cable companies monopoly rights over the provision of cable services within pre-defined areas. Licenses are renewable, defined over three to five year time horizons, do not involve fees and can be revoked by the CRTC.[5]

Cable companies earn profits by offering tiered cable bundles in the form of basic cable (including the major broadcast networks like CBC, ABC, NBC and CBS), extended basic cable (including CNN, ESPN or TSN in Canada), and pay/specialty cable packages (including HBO and The Movie Network). The latter two tiers constitute 'non-basic' or 'discretionary' service, both of which involve a tying requirement: subscribers must sign up for basic cable before purchasing any packages from the non-basic tier. The price and channel composition of the bundles are subject to basic price regulation, and channel carriage restrictions. For the purposes of this study, these restrictions are effectively defined in the 1986 *Cable Television Regulations*, which represent a substantial amendment to the *Act*. Basic price regulation puts an upper bound on the allowable increase in basic prices from year-to-year.[6] Carriage restrictions involve three primary components. First, they contain "must carry" provisions that force cable companies to carry all local over-the-air channels in their basic packages. Second, the CRTC licenses which channel providers are allowed to transmit their signals to Canadian cable companies. Conditional on obtaining a license, the CRTC then defines whether a channel can be offered in the basic or non-basic tier. Thus, the CRTC controls the universe of channels that can be offered within cable tiers, while cable companies choose what channels to offer given these universal restrictions. Finally, Canadian content provisions require that cable companies show a fixed proportion of hours of Canadian-based programming.[7] Until 1999, cable companies' primary source of profits comes from their cable services, after which Eastlink becomes the first cable company in Canada to offer telephone service.[8]

Firm size, in terms of national subscribership, plays an important role in determining cable companies' channel costs. As noted above, various empirical studies of the U.S. cable television industry find larger firms are charged lower "affiliation payments" by channel companies. This is because of vertical integration between large cable companies and channel providers and because

[5]Additional background of the history of regulation and technological change in the industry, as well as the construction of the dataset can be found in Byrne (2010b).

[6]The upper bound on basic price growth is determined by the inflation rate, capital cost allowances, and whether cable companies are in financial distress. Licenses with less than 2000 subscribers are not subject to basic price regulations so as to give cable companies an additional incentive to operate in smaller, rural areas.

[7]As of 2009, content rules require at least 60% of all programming between 6:00am and midnight be "Canadian content", and at least 50% of programming between 6:00pm and midnight be "Canadian content", where "Canadian content" is defined by the CRTC.

[8]See http://www.eastlink.ca/about/history/index.asp.

larger firms are in a stronger bargaining position in negotiating with channel providers. Larger cable companies offer more viewership for commercials, which is valuable to channel providers since commercial fees are a key source of their revenue. Since affiliation payments directly affect costs per subscriber, firm size has a potentially large impact on cable companies' cost structures. Moreover, cost differentials amongst large and small firms can affect pricing and channel bundling decisions and the profits that a large firm generates from a license relative to a small firm.

Scale effects give rise to acquisitions in the cable industry. Large firms acquire small firms in order to gain access to new licenses/subscribers and generate additional profits beyond the status quo. The CRTC recognizes this fact and formally defines its national policy with respect to acquisitions in CRTC Public Notice PB89-109. The CRTC decentralizes the buyout process, allowing collections of cable operators to propose acquisitions to the national regulator. These exchanges are not competitive (i.e. there is no bidding for licenses) and the CRTC is explicit in that it *does not* look for rival purchasers. The regulator evaluates transactions on a case-by-case basis, putting the onus on the parties involved to show that a proposed acquisition "yields significant and unequivocal benefits to the communities served." The chief concern of the CRTC is that the basic cable rates do not rise following an acquisition. Firms are free to alter non-basic package prices and content. The predominant benefit put forth by purchasing companies is the fact that they can improve cable services (i.e., they can offer more basic and/or non-basic channels) without raising basic prices. I provide an example of a CRTC-documented decision that involve improved channel offerings in Figure 3 in Appendix C.

2.1 Data

The primary data sources are the CRTC Master Files for the 1990-1996 period.[9] They contain detailed information on firms' revenues, costs, and subscribership at the license-year level of aggregation and are further broken down by basic and non-basic services. The information contained in these files is collected and verified by Statistics Canada on behalf of the CRTC. I use a subset of the variables available including the prices, channel counts and number of subscribers for basic and non-basic cable, the number of homes passed (i.e., the total number of people connected to the local cablesystem) and total non-basic affiliation payments made from cable companies to upstream channel providers. I also use annual cost data at the license level including total salaries and total expenses for administrative and technical costs. I denote the sum of administrative and technical costs as "operating" costs throughout. These costs capture the vast majority of non cable-content related costs as reported in the Master Files.

The Master Files do not distinguish between subscribership and revenues for the extended basic and specialty cable tiers. I therefore compute non-basic cable prices as average revenue per subscriber for extended basic and specialty cable. Non-basic shares are the total share of market

[9]Stephen Law provided these data. They have been previously used in Law (1999) and subsequent papers.

demand for the extended basic and specialty cable tiers. In short, I treat cable companies as offering low quality cable (basic) and possibly high quality cable (non-basic) throughout.

The second data source is the CRTC's Decision and Notices archives. For each license, the CRTC maintains searchable online archives for all license-ownership related decisions from 1984 onwards.[10] Example decision files include new license applications, license renewals and revocations, as well as acquisitions of cable companies. Using these decision files, I track the current cable operator for the universe of 1262 licenses defined in the Master Files over the 1985-2004 period. For each acquisition, I record the acquisition date, the identity of the buying and selling firms, the licenses involved and the transaction price (where available). Although the Master Files contain information on how licenses are allocated across firms in a given year, it is important for my empirical results that the exact timing of acquisition and entry decisions, as well as the firms and locations involved, be accurately recorded. Further, the information contained in the Decision and Notice files identifies the subsidiaries of large cable companies that differ by name from their parent company. The Master Files often fail to distinguish subsidiaries from their parent companies. An example Decision File is listed in Figure 3 in Appendix C.

I also use information from the 1991 and 1996 Canadian Censuses on the total number of households, average household income, average age, average household size, the proportion of the population with post-secondary education and variance in household income. License name identifiers are matched to their corresponding Census Subdivision to obtain the above Census aggregates at the license level. I use the 1996 Geosuite package from Statistics Canada to track location-specific household counts and urban density, which are more accurate measures of local population and urban density than that of a license's Census Subdivision. Moreover, Geosuite provides data for 1991 household counts and urban density, correcting for differences in Census boundaries between the 1991 and 1996 Censuses. For non-Census years, I follow Holmes (2010) and use a weighted average of the 1991 and 1996 data. Specifically, the census variable x_t for $t \in \{1992, \ldots, 1995\}$ is computed as $x_t = \left(\frac{1996-t}{1996-1991}\right)x_{1991} + \left(\frac{t-1991}{1996-1991}\right)x_{1996}$, and I set $x_{1990} = x_{1991}$.

2.2 Estimation sample and summary statistics

I restrict my analysis to the 1990-1996 period because information on non-basic affiliation payments, prices and subscription levels is not available prior to 1990. An added benefit is that I can abstract from complications related to the entry of Direct Broadcast Satellite in 1998. In particular, I can develop and estimate a structural econometric model using a standard multi-product monopoly framework to study the determinants of acquisition effects, conduct welfare analyses and consider counterfactual market structures such as complete regional consolidation.[11]

Table 1 highlights acquisition activity in the industry and amongst the ten largest cable com-

[10] The url for the Decisions and Notice archives is http://www.crtc.gc.ca/eng/dno.htm.

[11] Chu (2010) is the benchmark article on strategic interactions between Direct Broadcast Satellite and traditional satellite providers. Many of my results and analyses complement his findings.

Table 1: Acquisitions and Market Share of Largest Ten Companies: 1990-1996

Year	Total Acquisitions	Large Firms' Acquisitions	Total license Acquisitions	Large Firms' license Acquisitions	Large Firms' Subscribership	Large Firms' Licenses
1990	51	27	157	91	55.39%	21.58%
1991	36	15	58	32	60.69%	24.12%
1992	25	13	60	31	61.87%	25.72%
1993	21	9	31	18	66.16%	27.15%
1994	24	11	37	19	67.77%	28.34%
1995	36	23	175	152	82.60%	39.89%
1996	30	15	43	22	84.74%	41.08%
Total	223	113	561	365	-	-

Notes: "Large Firms" correspond to the largest ten firms in Canada by national subscribership in 1996. These firms are Rogers, Shaw, Vidéotron, Cogeco, C.F. Cable, Eastlink, Western Co-Axial, Persona, Winnipeg Videon and Northgate Cable.

panies from 1990-1996 based on the universe of licenses and subscribership contained in the CRTC Decisions and Notices and in the Census data. The largest ten firms are denoted "large" firms, and are classified based on firms' national subscribership in 1996.[12] In total, there are 223 instances where one cable operator acquires another, leading to 561 individual license acquisitions. The largest ten companies out of 393 firms are responsible for 113 (51%) and 365 (65%) of all firm and license acquisitions. The final two columns of the Table 1 show how the acquisitions by large companies results in an increase in their share of national subscribership and license ownership. Over the sample period, national subscribership among the large firms increases from 55.39% to 84.74%, and the share of licenses owned nearly doubles from 21.58% to 41.08%.

After removing observations with missing data and dropping outliers, the resulting estimation sample is an unbalanced panel consisting of 3723 observations that span seven years across 784 licenses. The sample includes 195 license acquisitions. Table 2 presents basic summary statistics for markets where both basic and non-basic cable is offered ("two-bundle" markets) and markets where only basic cable is offered ("one-bundle" markets). In one-bundle markets, 85% of consumers sign-up for basic cable and pay $22.13 for 15 basic cable channels on average. Consumers in two-bundle markets on average pay $19.14 for 21 basic cable channels and $31.65 for non-basic cable which consists of 30 channels (21 basic plus 9 non-basic). Cable companies pay $7.43 per subscriber per month on average in affiliation payments to upstream channel providers for their non-basic cable services. In two-bundle markets, monthly non cable content related costs in terms of labour and operating costs (technical plus administrative expenses) are $3.42 and $12.78 per subscriber, respectively. The corresponding figures for one-bundle markets are $1.94 and $15.54 for one-bundle markets, indicating that additional cable tiers involve additional labour expenses.

[12]The findings throughout are robust to the definition of "large" firms. Similar patterns emerge if I classify large firms based on the largest 5, 10, 15, 20 and 25 firms by national subscribership in 1996.

Table 2: Estimation Sample Summary Statistics

	Two-Bundle Markets		One-Bundle Markets	
	Mean	Std. Dev.	Mean	Std. Dev.
CRTC Master Files Data				
Basic Price	19.14	4.34	22.13	5.79
Non-Basic Price	31.65	10.76	-	-
Basic Market Share	0.43	0.30	0.85	0.18
Non-Basic Market Share	0.38	0.29	-	-
Basic Channel Counnt	21.15	6.06	15.20	5.44
Non-Basic Channel Count	8.49	6.59	-	-
Per-subs. Affiliation Payment	7.43	6.29	-	-
Per-subs. Labour Cost	3.42	6.29	1.94	2.62
Per-subs. Operating Cost	12.78	4.39	15.54	5.85
Number of Subs.	10438.76	21978.65	509.95	764.14
Homes Passed	12940.93	27361.34	613.45	915.21
Census Data				
Average Household Income	40079.43	8074.56	37796.77	7625.09
Variance of Household Income	706232.70	802496.70	277348.60	191296.30
Urban Density	475.34	524.56	152.87	225.76
Number of Acquired licenses	163		32	
Number of Observations	2808		915	

Notes: All nominal amounts are in 1992 constant dollars. The unit of observation is a (license, year) with the CRTC Master Files Data averaged over each month. "Per-subs." is short for per-subscriber.

The market size and demographics data show that two-bundle markets are much larger, and have higher average income, income volatility and urban density than one-bundle markets. The average market size is 12,940 and 613 homes passed and urban density is 475 and 152 individuals per square kilometre in two and one-bundle licenses on average. The bottom panel of Table 2 shows that roughly three-quarters of the observations and acquisitions in the estimation sample come from two-bundle markets.

Table 3 presents means and standard deviations for the estimation sample based on whether a license has two-bundles offered and whether a license is currently owned by a large firm, as defined in Table 1. Comparing sample means across the two pairs of columns provides some initial evidence that cable bundle characteristics and costs vary with firm size. Large firms offer slightly lower prices and more channels in their basic and non-basic bundles in both two- and one-bundle markets. The differences in channel counts are pronounced, with large firms roughly offering five more basic channels in one-bundle markets, and two and five more basic and non-basic channels in two-bundle markets. The fact that large firms offer more channels at slightly lower prices likely explains part of the difference in shares for large and small firms in two-bundle markets. In particular, 37% (46%) and 44% (35%) of consumers respectively purchase basic and non-basic cable in two-bundle markets

Table 3: Average Cable Package Characteristics, Market Shares, and Affiliation Payments for Large and Small Firms

	Two-Bundle Markets			One-Bundle Markets		
	Large Firms	Small Firms	P-value of t-test	Large Firms	Small Firms	P-value of t-test
Basic Price	19.03	19.20	0.099^{*}	20.95	22.21	$< 0.01^{***}$
	(3.72)	(4.64)		(4.93)	(5.84)	
Non-Basic Price	31.12	31.93	0.058^{*}	-	-	
	(11.54)	(10.31)		-	-	
Basic Market Share	0.37	0.46	$< 0.01^{***}$	0.85	0.85	0.786
	(0.30)	(0.30)		(0.14)	(0.19)	
Non-Basic Market Share	0.44	0.35	$< 0.01^{***}$	-	-	
	(0.29)	(0.28)		-	-	
Basic Channel Count	22.16	20.61	$< 0.01^{***}$	20.52	15.18	$< 0.01^{***}$
	(5.83)	(6.11)		(4.76)	(5.48)	
Non-Basic Channel Count	11.52	6.89	$< 0.01^{***}$	-	-	
	(7.46)	(5.44)		-	-	
Affiliation Payment	7.09	7.61	$< 0.01^{***}$	-	-	
	(6.88)	(5.95)		-	-	
Number of Subs.	16496.94	7241.57	$< 0.01^{***}$	412.08	516.94	0.309
	(28901.25)	(16368.37)		(449.53)	(781.49)	
Homes Passed	20488.88	8957.51	0.124^{**}	508.51	620.95	$< 0.003^{***}$
	(36134.25)	(20230.12)		(564.26)	(935.02)	
Number of Observations	970	1838		61	854	

Notes: Means for each variable are presented in each column with standard deviations in parentheses. ***, **, * indicate statistical significance at the 1, 5, and 10 percent levels respectively. Large firms consists of the ten largest firms by national subscribership in 1996. Small firms are those that are not classified as large firms. t-tests correspond to a test of equality of the sample means for licenses served by large and small firms. All dollar amounts are in 1992 constant dollars.

operated by large (small) firms. Finally, the averages for per-subscriber affiliation payments for non-basic cable in two-bundle markets is \$0.52 higher in markets served by small firms. This finding suggests scale effects in non-basic bundle costs since larger firms realize lower marginal costs despite offering more channels in their non-basic bundles on average.

3 Regression analysis of acquisition and scale effects

In this section, I examine changes in basic and non-basic prices, channel counts, shares and non-basic affiliation payments around acquisitions in the data.[13] The analysis is based on the following regression equation that predicts a dependent variable (i.e., prices, channels, shares, affiliation

[13]Throughout this section, I focus on a subsample of licenses that do not experience a change in the number of products offered (i.e., locations that do not switch from one to two-bundle markets or vice versa) over the 1990-1996 period. In total, 18 out of 784 licenses experience such a change in the number of products offered. None of these changes correspond to an acquisition.

payments), $y_{\ell kt}$, for license ℓ served by cable company k at time t:

$$y_{k\ell t} = \beta_0 + \beta_1 A_{\ell t} + \beta_2 Q_{kt} + X_{k\ell t}\beta_3 + D_t\beta_4 + FE_\ell + \epsilon_{k\ell t} \quad (1)$$

For each dependent variable, I separately estimate (1) for two and one-bundle markets. The covariates of interest are a dummy variable $A_{\ell t}$ which equals one if license ℓ is acquired in year t and all years thereafter, and the horizontal size of firm k in license ℓ in year t, Q_{kt}.[14] The vector of controls $X_{k\ell t}$ include average household income, average age, average household size, the proportion of the population with post-secondary education, urban density, the number of homes passed, and a dummy variable equalling one if firm k is a multi-system operator. To account for year and location unobserved heterogeneity, I include time and license fixed effects: D_t and FE_ℓ. The final term, $\epsilon_{k\ell t}$, is an idiosyncratic error term. Under this license fixed-effects specification, the identification of β_1 relies on within license variation over time in basic and non-basic prices, channel counts, shares and affiliation payments before and after an acquisition. Within license variation in the variables of interest and firm size, which is mainly generated by acquisitions, is what identifies β_2.

3.1 Results

Table 4 presents the OLS estimates for β_1 and β_2 for each dependent variable using two sets of covariates. Specification (1) includes the acquisition dummy, the vector of license and firm-specific controls, year dummies and license fixed effects. Specification (2) adds cable operator firm size. By comparing the results across the two specifications, I can assess the extent to which acquisition effects correspond to changes in the horizontal firm size of acquired licenses' local monopolists.

The column (1) and (2) estimates in the top panel of Table 4 show basic prices and channel counts are predicted to fall with acquisitions in one-bundle markets, however none of the estimated effects are statistically significant. The firm size estimates from specification (2) suggest larger firms tend to offer more basic channels at higher prices, though only the estimate in the channel count equation is statistically significant. Interpreting the magnitude of the channel effect, a five hundred thousand subscriber increase in a license's cable operator size (which is common for acquisitions involving the largest firms in the sample) is predicted to yield 3.30 additional basic channels. There is a statistically significant relationship between acquisitions and basic market shares; shares are predicted to rise by 5% with acquisitions.

The estimates in the bottom two panels of Table 4 contain β_1 and β_2 estimates for basic and non-basic prices, channel counts and non-basic affiliation payments in two-bundle markets. Focusing on the column (2) estimates, only non-basic prices have a statistically significant relationship with acquisitions. Acquisitions lead to a \$3.12 increase in non-basic prices. The firm size coefficients for basic and non-basic prices and channel counts are all statistically significant at conventional

[14] This specification borrows from Sweeting (2010)'s regression equation.

Table 4: OLS Estimates Relating Acquisitions and Firm Size to Prices, Channel Counts, Shares and Affiliation Payments

One-Bundle Markets ($N = 844$)	Basic Prices		Basic Channels		Basic Share	
	(1)	(2)	(1)	(2)	(1)	(2)
$A_{\ell t}$	-1.003	-1.260	-0.205	-0.590*	0.050**	0.054**
	(0.782)	(0.895)	(0.332)	(0.351)	(0.024)	(0.027)
Q_{kt} (100,000's)		0.441		0.661***		-0.007
		(0.337)		(0.203)		(0.012)
R^2	0.113	0.115	0.477	0.481	0.063	0.064
Two-Bundle Markets ($N = 2692$)	Basic Prices		Basic Channels		Basic Share	
	(1)	(2)	(1)	(2)	(1)	(2)
$A_{\ell t}$	-0.407**	-0.285	-0.206	-0.561	-0.016	-0.035*
	(0.186)	(0.188)	(0.332)	(0.357)	(0.019)	(0.020)
Q_{kt} (100,000's)		-0.029*		0.084**		0.004***
		(0.018)		(0.037)		(0.002)
R^2	0.190	0.191	0.232	0.236	0.203	0.206

Two-Bundle Markets ($N = 2692$)	Non-Basic Prices		Non-Basic Channels		Non-Basic Share		Affil. Payments	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
$A_{\ell t}$	2.297*	3.118**	1.481***	0.564	0.018	0.036*	0.880	1.476*
	(1.173)	(1.282)	(0.480)	(0.495)	(0.018)	(0.019)	(0.707)	(0.763)
Q_{kt} (100,000's)		-0.195**		0.217***		0.004**		-0.141***
		(0.337)		(0.203)		(0.001)		(0.048)
R^2	0.054	0.056	0.482	0.496	0.204	0.207	0.058	0.062

Notes: Estimates obtained by OLS. Standard errors are listed in parentheses and are clustered at the license-level. ***, **, * indicate statistical significance at the 1, 5, and 10 percent levels respectively. Columns (1) and (2) correspond to two. Specification (1) includes time, license fixed effects and license-level controls for average household income, average age, average household size, share of the population with post-secondary schooling, urban density, total population and a dummy variable equalling one if the cable company operates in multiple licenses; Specification (2) adds license-level controls for firm size (subscribership across all licenses). All dollar amounts are in 1992 constant dollars.

levels. They suggest larger firms charge lower prices, offer more channels and realize higher market shares. The magnitude of the predicted acquisition effects implied by the acquisition and firm size estimates can be illustrated by way of example. Consider a hypothetical acquisition of the median sized firm operating in a two-bundle market in 1993, AGI Cablevision, by its nearby dominant firm, Shaw Cable. The acquisition and firm size estimates predict that such an acquisition leads to \$0.47 and 0.0003 decreases in basic prices and channel counts. The predictions for non-basic services imply relatively large \$1.82 and 2.03 increases in non-basic prices and channel counts.

The final set of estimates in the bottom panel of Table 4 indicate statistically significant relationships between monthly non-basic per-subscriber affiliation payments, and acquisitions and firm size. The estimates highlight opposing forces that potentially affect non-basic channel costs following acquisitions. Controlling for firm size, affiliation payments are predicted rise by \$1.48 per

subscriber following acquisitions. To the extent that higher quality channels are more costly to cable providers (Crawford and Yurukoglu (2010)), this estimate provides additional evidence that acquisitions lead to higher quality cable. Conversely, larger firms are predicted to realize lower affiliation payments, which is evidence of scale effects. For example, the firm size effect alone reduces affiliation payments by \$0.94 per subscriber per month in the hypothetical AGI/Shaw acquisition. The net effect of the acquisition and size effects predicts a \$0.54 increase in affiliation payments, which is less than 30% of the predicted non-basic price increase from an AGI/Shaw acquisition.

3.2 Endogeneity of acquisitions

If firms' acquisition decisions are driven by the characteristics of target firms and/or their cable menus, then the OLS estimates of β_1 and β_2 in Table 4 will suffer from selection bias. For example, if large cable companies acquire small ones because small firms offer poor non-basic cable services, then the OLS estimates for β_1 and β_2 in the non-basic channel counts equation would be biased upward due to selection effects. In Appendix A, I provide two robustness checks that investigate the impact endogeneity has on my reduced-form estimates for acquisition and scale effects. Overall the main conclusions from this section are generally unaffected by selection bias. There is some evidence that selection is based on firm size in two-bundle markets: licenses served by relatively smaller firms are more likely to be acquired. This selection affects the magnitude but not the direction of the estimated acquisition effects.

4 Multi-product monopoly model

To evaluate the consumer welfare impact of acquisitions, and to investigate the importance of branding effects, cost heterogeneity and scale effects have on cable companies' cost structures and cable bundles, I develop and estimate a multi-product monopoly model that captures basic features of the industry.

4.1 Demand

The utility consumer i obtains from subscribing to cable bundle j offered by cable company k in license n is given by:

$$u_{ijkn} = t_i q_{jkn} - p_{jkn} + X^0_{jkn}\beta_0 + \epsilon_{ijkn} \tag{2}$$

where cable bundle quality and prices are respectively denoted by q_{jkn} and p_{jkn}.[15] The other components of the utility function include consumer i's marginal utility for cable quality t_i, non-cable

[15] For the sake of brevity in notation, I omit time subscripts throughout this section. The index n can be thought of as a "license-year" observation in this section.

content related factors that consumers value $X^0_{jkn}\beta_0$ (such as branding effects), and consumer i's idiosyncratic utility for good j, ϵ_{ijkn}. Throughout, I normalize the outside option utility to 0, which pins down the level of utility is this discrete-choice set-up. The specification assumes consumers have a common degree of price sensitivity. In estimating and simulating data from the model, this greatly simplifies finding firms' profit-maximizing cable price and quality choices. I normalize the coefficient on prices to one, which defines the level of utility in terms of dollars throughout and allows me to separately estimate the variances of the vertical and horizontal preference shocks. Consumers' marginal utility for quality are i.i.d draws from a normal distribution with license-specific mean $\mu_n = X^1_n\beta_1$ and variance $\sigma^2_n = X^2_n\beta_2$. The horizontal preference are i.i.d Extreme Value Type 1 distributed, with zero mean and scale parameter σ^2_ϵ.

I use J_{nk} to denote the number of cable bundles offered in market n by firm k such that $j \in \{1 \dots J_{nk}\}$. The menu of quality and prices for each bundle is denoted by $\{(p_{jkn}, q_{jkn})\}_{j=1}^{J_{nk}}$. Without loss of generality, I order package indices such that higher quality packages are indexed by larger j values (i.e., $q_{J_{nk}}$ is the highest quality cable package out of J_{nk} bundles offered by company k in market n). The tying requirement that basic cable must be purchased before an individual buys non-basic cable ensures cable bundle quality can be ordered in this way.

Consumers choose the cable bundle that maximizes their utility. Conditional on an individual's vertical type t_i, the market share in license n for bundle j can be computed directly as:

$$s_{jkn}(t_i) = \frac{\exp\left(\frac{t_i q_{jkn} - p_{jkn} + X^0_{jkn}\beta_0}{\sigma_\epsilon}\right)}{\sum_{j'=1}^{J_{nk}} \exp\left(\frac{t_i q_{j'kn} - p_{j'kn} + X^0_{j'kn}\beta_0}{\sigma_\epsilon}\right)} \tag{3}$$

The market share for bundle j can be computed by integrating (3) over the vertical type distribution:

$$s_{jkn} = \int s_{jkn}(t_i)\phi(t_i; \mu_n, \sigma^2_n)dt_i \tag{4}$$

Denoting Q_n total potential subscribers in market n, aggregate demand for bundle j is the market share times potential market size: $Q_{jkn} = s_{jkn}Q_n$.

4.2 Supply

Turning to the supply side, the marginal cost cost incurred by cable company k from offering cable bundle j in market n is specified as:

$$c_{jkn}(q_{jkn}, Q_{jkn}) = \underbrace{Z^0_{kn}\gamma_0}_{\text{non-content costs}} + \underbrace{(Z^1_{kn}\gamma_1)q_{jkn} + (\gamma_2/\rho)q^\rho_{jkn}}_{\text{content costs}} \tag{5}$$

I distinguish between cable companies' per-subscriber non-content related costs (i.e., labour and operating costs) from their content-related costs (i.e., affiliation payments).[16] Following previous researchers, I abstract from fixed affiliation costs and focus on the per-subscriber marginal costs that cable companies and channel providers negotiate over. Cable quality q_{jkn} can be thought of as a hedonic index of the individual channels included in bundle j, where each channel is weighted by a measure of popularity (such as television ratings). Previous research shows that higher quality cable channels come at a higher marginal cost to cable companies (Crawford and Yurukoglu (2010)). Therefore, I assume that $c(\cdot)$ is independent of the number of consumers in market n and is increasing and convex in quality: $c'(\cdot) > 0,\ c''(\cdot) > 0$. The curvature assumptions on $c(\cdot)$ are standard for this class of screening models and ensure that an interior solution can be found (see Mussa and Rosen (1978) and Bensanko, Donnenfeld, and White (1987)).

Beyond my lack of data on the identity of channels within bundles, Chu (2010) notes a secondary motive for using a single quality index in computing firms' per-subscriber costs: it greatly reduces the dimensionality of the firm's profit-maximization problem. Modelling the optimal bundling choices of firms is a high dimensional problem since it involves choosing the optimal subset of channels from the power set of all possible channel combinations. Although the dimensionality of the problem can be handled in estimation using the moment inequality approach of Pakes, Porter., Ho., and Ishii (2006) (as employed by Crawford and Yurukoglu (2010)), it can be problematic for conducting counterfactual simulations where the solution to firms' optimal bundling problem must be found.[17] Using a single quality index thus greatly simplifies simulating outcomes with the model.

Cable companies know the distributions for t_i and ϵ_{ijkn}, but not individuals' vertical types or horizontal preference shocks. Given a set of J_{nk} bundles with corresponding prices and qualities $\{(p_{jkn}, q_{jkn})\}_{j=1}^{J_{nk}}$, the total expected profits earned by cable company k in market n is thus:

$$\pi_{kn} = \sum_{j=1}^{J_{nk}} \Big[(p_{jkn} - c_{jkn}) s_{jkn} Q_n \Big] \tag{6}$$

Firms choose their cable prices and bundle quality to maximize their expected profits. I denote the profit-maximizing price-quality schedule for firm k in market n by $\{(p^*_{jkn}, q^*_{jkn})\}_{j=1}^{J_{kn}}\}$. In Appendix B, I outline how I calculate shares and the optimal prices and qualities. Note that the firms' objective function abstracts from the discrete choice over the number of bundles to offer. I do not incorporate this choice as I rarely observe firms change the number of bundles offered within a license in the sample, irrespective of the local cable provider. Moreover, the number of cable

[16] In preliminary analyses of the data, I find that labour and operating costs grow in constant proportion with the number of subscribers within a license. There is little evidence to suggest that average labour and technical related costs decline with market size or number of subscribers within a license.

[17] See Chu, Leslie, and Sorensen (2009) for recent work on handling dimensionality problems in bundling models. They show simple pricing rules based on bundle size can serve as a good approximation to firms' optimal bundling decisions.

bundles rarely change with acquisitions as well.

It is worth noting that I abstract from the effect of basic price regulation, which as discussed, restricts the year-to-year increases in basic prices. Two sets of findings from preliminary empirical analyses suggests that basic price regulation has, at best, a weak effect on offered cable bundles. First, the vast majority of year-to-year changes in nominal basic prices in the data is well below the inflation-allowance permitted by the CRTC of 80% of a given year's inflation rate. Second, the inclusion of regulatory dummy variables for Class 1 and 2 licenses in regression equation (1) (without the license fixed effects) yields statistically and economically insignificant effects of regulation on prices, channel counts and costs in Class 1 and 2 licenses relative to the unregulated Type 3 licenses.

5 Empirical implementation

This section outlines how I estimate the multi-product monopoly model. My estimation approach differs from the prior work of Chu (2010) and Crawford and Yurukoglu (2010) because I do not have information on channel identity within cable bundles. Previous authors with access to channel identity data in the U.S. develop estimation strategies based on firms' optimal bundling decisions or using bundle quality measures based on channel identities and television ratings data. On the other hand, I have license-year level cost data on firms' affiliation payments, labour costs and operating expenses to estimate cable companies' cost functions which governs price and quality choices. Previous researchers who do not have disaggregated cost data identify cost functions using aggregate data on average channel costs across all cablesystems in the U.S., or back out marginal costs from pricing first order conditions when only demand-side data is available.

5.1 Covariates

The non-content utility shifters in X^0_{jkn} include a constant, a dummy for basic cable, year dummies and firm-specific dummies for the eleven largest cable companies in terms of national subscribership in 1995-1996.[18] These covariates allow for persistent differences in non-content utility for basic and non-basic cable, annual trends in demand and firm-specific unobserved effects such as branding. I include a constant, license-level measures of average household income and urban density in X^1_n.[19] I expect demand to be higher in markets with higher average income and lower in urban centres where there are more alternatives to watching cable television. I allow the variance of vertical taste

[18] These companies include the "large" ten firms listed in Table 1 as well as MacLean Hunter which is a large multi-system operator in Ontario up until it is acquired by Rogers in 1996. Allowing for firm-specific branding effects for all companies in the sample is infeasible because I do not observe enough license-year observations for smaller firms to estimate their firm-specific demand effects with the highly non-linear estimation routine.

[19] I have experimented with specifications that include demand shifters for average age, average household size and educational attainment. These covariates increase the number of parameters to estimate without adding much explanatory power. I therefore use a parsimonious specification based on average income and urban density, both of which have a well-identified effect on consumer demand.

shocks to vary with market size and observable consumer heterogeneity by including a constant and license-year level measures of total population and variance in household income in X_n^2. I take a license's potential market size, Q_n, as exogenous and measure it as the number of homes passed.

The non-content marginal cost shifters, Z_{kn}^0, include a constant, a basic cable dummy, the logarithm of the number of subscribers a cable company serves nationally, urban density, average household income, per-subscriber labour and operating costs in license ℓ, year dummies and firm-specific dummy variables for the eleven largest firms. The content-related cost shifters, Z_{kn}^0 includes the same variables as in Z_{kn}^0 with the exception of the demographic variables and per-subscriber labour and operating costs. This specification allows firm size to affect the level and slope of the marginal cost function at a diminishing rate. This captures potential scale effects from negotiations over affiliation payments with channel providers in a "reduced-form" fashion. The basic cable dummy variable accounts for differences in promotional or services costs between basic and non-basic cable. Urban density is expected to have a negative effect on non-content related costs due to economies of density. Finally, year and firm-specific dummies account for annual trends and unobserved firm-specific effects in costs (such as managerial ability).

5.2 Estimation

I estimate the parameters of the model using a Simulated Method of Moments (SMM) estimator that compares the model's predictions for prices, shares and non-basic per-subscriber affiliation payments to those observed in the data. In estimation, I account for endogenous quality choice, but treat cable quality as unobserved to the econometrician. The predicted qualities adjust to rationalize the prices, shares and affiliation payments that are observed in the data.

More specifically, I denote the model's predictions for prices, shares, and (total) per subscriber non-basic cost as $p_{jknt}^*, s_{jknt}^*, c_{2knt}^*,\ j = 1, 2$. Recall that for a given parameter vector these are obtained from solving the two-step optimization problem that maximizes total profits (i.e., equation (6)). The following $H = 5$ equations relates the model's predictions to their empirical counterparts:

$$\begin{aligned} s_{1knt} &= s_{1knt}^* + u_{s_{1knt}} \qquad s_{2knt} = s_{2knt}^* + u_{s_{2knt}} \\ p_{1knt} &= p_{1knt}^* + u_{p_{1knt}} \qquad p_{2knt} = p_{2knt}^* + u_{p_{2knt}} \\ \text{affilpay}_{2knt} &= c_{2knt}^* - Z_{kn}^0\gamma_0 + u_{c_{2knt}} \end{aligned} \tag{7}$$

The model's $P \times 1$ parameter vector is $\theta = \{\beta_0, \beta_1, \beta_2, \gamma_0, \gamma_1, \gamma_2, \rho, \sigma_\epsilon^2\}$, which in total contains $P = 71$ parameters. I collect the exogenous variables with the $K \times 1$ vector Z_i, where $i \in 1 \ldots N$ and i indexes license-years and N is the number of license-years. In total, there are $K = 26$ exogenous variables. Stacking the econometric errors, the $H \times 1$ error vector for observation i is denoted by $u_i(Z_i, \theta) = [u_{s_{1knt}}\ u_{s_{2knt}}\ u_{p_{1knt}}\ u_{p_{2knt}}\ u_{c_{2knt}}]'$.

I estimate the model under the assumption that the prediction errors are orthogonal to the

exogenous variables. By iterated expectations, I assume the following $L = H \times K = 130$ moment equations hold at the true parameter vector:

$$E[Z_i' u_i(Z_i, \theta_0)] = 0 \tag{8}$$

Building from the moment conditions in (8), the SMM estimator for θ is defined as:

$$\hat{\theta} = \arg\min_{\theta \in \Theta} \Big[\sum_{i=1}^{N} W_i' u_i(Z_i, \theta) \Big]' \Lambda \Big[\sum_{i=1}^{N} W_i' u_i(Z_i, \theta) \Big] \tag{9}$$

where W_i is a $H \times K$ block diagonal matrix where each diagonal element is $w_i = Z_i$, and Λ is a $L \times L$ positive definite weighting matrix. I obtain an initial consistent estimate of θ using $\Lambda_1 = [N^{-1} \sum_{i=1}^{N} (W_i' W_i)]^{-1}$. Using the first-step estimate $\hat{\theta}_1$, I compute the predicted residuals from the model, $\hat{u}_i(Z_i, \hat{\theta}_1)$ and use them to construct an optimal weighting matrix $\Lambda_2 = [N^{-1} \sum_{i=1}^{N} (W_i' \hat{u}(Z_i, \hat{\theta}_1) \hat{u}(Z_i, \hat{\theta}_1 c)' W_i)]^{-1}$, that I use to obtain an efficient second-step estimate $\hat{\theta}_2$. To conduct inference, I compute standard errors for $\hat{\theta}_2$ using the following estimator for the asymptotic variance matrix:

$$\hat{\Omega} = \Big\{ \Big[\sum_{i=1}^{N} W_i' \nabla_\theta \hat{u}_i(\hat{\theta}_2) \Big]' \Big(\sum_{i=1}^{N} W_i' \hat{u}_i(\hat{\theta}_2) \hat{u}_i(\hat{\theta}_2)' W_i \Big)^{-1} \Big[\sum_{i=1}^{N} W_i' \nabla_\theta \hat{u}_i(\hat{\theta}_2) \Big]' \Big\}^{-1} \tag{10}$$

where $\nabla_\theta \hat{u}_i(\hat{\theta}_2)$ is the gradient vector of $\hat{u}_i(\hat{\theta}_2)$ with respect to θ evaluated at $\hat{\theta}_2$. I discuss the specifics in calculating and minimizing the SMM objective function in Appendix B.

5.3 Identification

While the parameters jointly move to minimize the distance between the model's predictions and their empirical counterparts, for expositional purposes I discuss identification of the demand and supply parameters separately.

The demand-side parameters, $\{\beta_0, \beta_1, \beta_2, \sigma_\epsilon^2\}$, are identified by the parametric assumptions on the t_i and ϵ_{ijkt} distributions, the profit-maximization assumption, variation in prices and shares, exogenous demand-side covariates, and exogenous variation in prices and quality arising from licenses' local cost conditions. The mean of the vertical type distribution affects the level of predicted prices and market shares. Thus, variation in exogenous demand shifters (like average income) and prices and market shares across license-years identifies β_1. The variance of the vertical type distribution affects the model's predictions for substitution patterns among cable bundles; lower variability in vertical types yields higher predicted price elasticities of demand. Using exogenous variation in cable prices and shares due to differences in supply-size factors (such local wages and firm size), I can determine the model's predictions for demand responses to exogenous price changes. These predictions in substitution patterns are compared to their analogues in the data to identify β_2. Sim-

ilarly, more variable horizontal taste shocks reduces consumers' elasticity of demand with respect to prices. Thus, σ_ϵ^2 adjusts to line up the model's predictions over differences in shares within and across licenses to exogenous (supply-side driven) variation in prices to their empirical counterparts. The non-content cost parameters, β_0, account for differences in the level of prices and shares across years and licenses served by larger firms, after accounting for exogenous local demand and cost shifters.

The supply side parameters, $\{\gamma_0, \gamma_1, \gamma_2, \rho\}$, are identified by the profit-maximization assumption, variation in non-basic affiliation payments, exogenous supply-side content and non-content cost shifters and exogenous variation in quality due to demand differences across markets. Firms' non-content costs are identified directly by the reported per-subscriber labour and operating costs as collected by the Statistics Canada. Given a licenses' labour and operating costs, the size and identity of the local cable company and the model's prediction for offered cable quality, I can compute the model's prediction for non-basic affiliation payments. Thus, the marginal cost function (5) can be traced out using data on non-basic affiliation payments, variation in labour and operating expenses and exogenous variation in cable quality due to differences in excluded demand shifters across license-years.

The optimization routine that minimizes the SMM objective function encounters convergence problems if the baseline demand and variance parameters in β_0 and β_1 freely adjust with all the other parameters. In estimation, I therefore restrict $\beta_{01} = 8$ and $\sigma_{02} = 3.5$ and estimate the remaining parameters.[20] I obtain these restrictions through an initial grid search under various parameterizations that compares the model's predictions for various moments of the price, market share and cost distributions to those in the data. I have estimated the model under different normalizations and find similar qualitative and quantitative results.[21]

6 Findings

The demand and supply side parameter estimates are presented in the left and right panels of Table 5. On the demand-side, the year dummies do not suggest a clear trend in the demand for cable. The firm-specific dummies provide evidence of branding effects: the eleven large firms deliver more non-content utility to households than smaller firms, with the exception of Rogers. As expected, higher average income and urban density have a positive and negative impact on the mean of the vertical type distribution and the demand for cable. Licenses with more homes passed and higher variance in the household income distribution have vertical type distributions with larger variances. The sample averages across license-years for non-content utility, and the mean and variance of the vertical type distribution are \$16.09 (s.d.=\$0.38), \$7.04 (s.d.=\$1.28) and \$3.56

[20] Previous authors estimate their models under similar consolidation normalizations on the vertical type distribution. Chu (2010) restricts the consolidation level of the shape parameter for the vertical type distribution.

[21] These results are available upon request.

Table 5: Multi-Product Monopoly Model Parameter Estimates and Standard Errors

Demand-Side Estimates				Supply-Side Estimates			
	Covariate	Estimate	Std. Error		Covariate	Estimate	Std. Error
β_0	Constant	15.8000	(0.3461)	γ_0	Constant	2.0000	(0.7156)
	1990	0.0760	(0.2751)		Log(Firm Size)	-0.2110	(0.2449)
	1991	-0.0700	(0.4130)		Urban Density	-0.0160	(0.1448)
	1992	0.1410	(0.5196)		Average Income	0.0850	(0.1679)
	1993	0.2340	(0.4449)		Labour Cost	0.6100	(0.1667)
	1994	0.1810	(0.3731)		Operating Cost	0.5550	(0.2299)
	1995	0.4130	(0.5805)		1990	2.9950	(0.7106)
	Rogers	-0.0150	(0.2966)		1991	3.5980	(0.7599)
	Shaw	0.2950	(0.3718)		1992	3.6340	(0.7696)
	Cogeco	0.0030	(0.4175)		1993	0.4510	(0.7590)
	Vidéotron	0.8020	(0.4747)		1994	0.5660	(0.8159)
	Eastlink	0.0940	(0.7371)		1995	0.3670	(0.8228)
	Persona	1.0720	(1.6148)		Rogers	-1.6870	(2.1019)
	MacLean-Hunter	0.4510	(0.3255)		Shaw	-1.1390	(0.8542)
	Videon	0.2300	(1.7534)		Cogeco	0.1570	(0.5821)
	C.F. Cable	1.0460	(0.8688)		Vidéotron	-0.6650	(0.4575)
	Western Coaxial	-0.8130	(0.5074)		Eastlink	-1.2540	(0.8236)
	Fundy Cable	1.6960	(0.6102)		Persona	-0.8280	(1.5265)
	Basic Dummy	-0.9670	(0.0908)		MacLean-Hunter	-0.6360	(0.9331)
					Videon	-1.3390	(2.9782)
β_1	Constant	8.0000	(0.1368)		C.F. Cable	-1.6070	(3.1498)
	Average Income	0.8110	(0.0460)		Western Coaxial	-0.7830	(1.0463)
	Urban Density	-0.9640	(0.0556)		Fundy Cable	-0.9810	(1.3647)
					Basic Dummy	-1.0090	(0.0674)
β_2	Constant	3.5000	(0.0826)				
	Homes Passed	0.0560	(0.0456)	γ_1	Constant	1.6550	(0.2271)
	Variance in Income	0.1050	(0.0137)		Log(Firm Size)	-0.2270	(0.1848)
σ^2_ϵ	-	0.9080	(0.0487)		1990	1.4970	(0.2241)
					1991	1.2400	(0.3339)
					1992	0.9850	(0.4214)
					1993	-0.2120	(0.3400)
					1994	-0.3470	(0.2865)
					1995	-0.1410	(0.4114)
					Rogers	-0.7220	(0.3706)
					Shaw	-0.9410	(0.3381)
					Cogeco	-0.7180	(0.3683)
					Vidéotron	-1.1270	(0.4170)
					Eastlink	-1.1690	(0.4611)
					Persona	-1.9230	(1.1319)
					MacLean-Hunter	-0.7140	(0.2871)
					Videon	-0.9410	(0.8813)
					C.F. Cable	-0.9520	(0.6424)
					Western Coaxial	-0.7320	(0.3037)
					Fundy Cable	-0.8800	(0.5172)
				γ_2	-	1.9140	(0.0816)
				ρ	-	2.4680	(0.0433)

Notes: Number of observations is 3723. All nominal amounts are in 1992 constant dollars. Average income and income variance are de-meaned. Urban density, homes passed, and per-subscriber labour cost and operating cost are divided by their sample means. Firm size is terms of 250,000 subscribers.

(s.d.=$0.88).[22] These compare to sample averages for predicted cable prices and quality across all bundles of $1.40 (s.d=$0.86) and $23.33 (s.d.=$7.33). The estimated variance of the horizontal taste shock distribution is $0.91, which is below the sample average of the vertical type distribution variance. The sample average for the estimated own-price elasticity of demand for basic cable is -4.39 (s.d.=2.01), which is comparable to estimates for the U.S. of -5.9 (Chipty (2001)) and -2.79 (Crawford and Yurukoglu (2010)).

On the supply-side, the estimated effect urban density, average income and per-subscriber labour and operating expenses have on non-content costs have their expected signs. There is a downward shift in non-content and content costs between the early and middle part of the 1990's. With the exception of Cogeco, the estimated firm-specific effects in non-content costs suggest that the eleven large firms are able to achieve lower non-content costs. Similarly, the estimates indicate that unobserved firm heterogeneity results in per-subscriber content-costs are systematically lower for the eleven largest firms. The standard errors imply that the firm-specific content-cost effects are more accurately estimated than the non-content cost effects. Firm size has a well-identified negative effect on both non-content and content costs. Thus, scale effects also play an important role in determining firms' marginal costs and offered cable bundles, which is consistent the basic empirical patterns from sections 2 and 3. The sample averages for predicted monthly per-subscriber non-content and content costs for basic cable are $3.43 (s.d.=$1.78) and $2.49 (s.d.=$1.92), and $4.38 (s.d.=$1.78) and $8.72 (s.d.=$2.80) for non-basic cable. The average monthly per-subscriber profit levels of $12.33 (s.d.=$3.15) and $16.95 (s.d.=$3.90) for basic and non-basic cable. The model predicts that cable operators realize large profit margins in the estimation sample.

Recalling that I do not use an explicit measure of quality in estimation, it is important to check if the model's predictions over cable bundle quality correspond with some measure of cable quality in the data. As a check, I present scatter plots of the model's predictions for basic and non-basic quality against observed channel counts in Figures 1 and 2 in Appendix C. The figures show that higher predicted quality corresponds to more channels being offered.[23]

6.1 The impact of consolidation

Using the estimated model, I measure the impact consolidation has on cable bundles, firms' profits and consumer surplus by simulating outcomes under three scenarios: (1) the "consolidation" scenario, where market structure is set to what is observed in the data; (2) the "no-acquisitions" scenario, where I assume no acquisitions occur between 1990 and 1996; and (3) the "no-quality" scenario, where I constrain cable qualities to their predicted no-acquisitions levels, and allow firms

[22] Recall the normalization of the price coefficient in the utility function implies all utility measures are in terms of 1992 constant dollars.

[23] Like Chu (2010), I have also estimated the model without horizontal preference shocks (i.e.: $\sigma_n = 0$) and similar estimates and results throughout. These findings are available upon request. I therefore focus on the fully estimated model in the results below.

Table 6: Acquisition Effects on Cable Bundles, Costs and Profits

	Two-Bundle Markets			One-Bundle Markets		
	Consolidation	No-Acqs.	No-Quality	Consolidation	No-Acqs.	No-Quality
Basic Price	17.07	16.68	16.76	23.75	23.11	22.95
	(2.65)	(2.46)	(2.43)	(1.92)	(1.86)	(1.92)
Non-Basic Price	31.01	30.42	30.03			
	(5.00)	(5.09)	(5.04)			
Basic Quality	0.67	0.60	0.60	1.84	1.71	1.71
	(0.39)	(0.36)	(0.36)	(0.23)	(0.21)	(0.21)
Non-Basic Quality	2.35	2.23	2.23			
	(0.47)	(0.49)	(0.49)			
Basic Share	0.491	0.489	0.463	0.837	0.829	0.847
	(0.050)	(0.054)	(0.064)	(0.038)	(0.036)	(0.043)
Non-Basic Share	0.419	0.417	0.449			
	(0.053)	(0.056)	(0.070)			
Basic Marginal Cost	3.25	3.98	3.20	7.16	8.13	6.64
	(1.92)	(1.75)	(1.92)	(2.72)	(2.26)	(3.07)
Non-Basic Marginal Cost	11.36	12.19	10.60			
	(3.27)	(3.23)	(3.54)			
Basic Affil. Payment	1.21	1.39	1.17	4.73	5.16	4.20
	(0.62)	(0.67)	(0.61)	(1.03)	(0.88)	(1.46)
Non-Basic Affil. Payment	8.32	8.59	7.55			
	(2.51)	(2.66)	(2.73)			
Per-Subscriber Profit	15.01	13.77	14.98	13.97	12.48	13.91
	(2.77)	(2.62)	(2.77)	(3.14)	(2.44)	(3.10)

Notes: All amounts are per-subscriber averages across all licenses and periods, and dollar amounts are in terms of 1992 constant dollars. Sample standard deviations are in parentheses. The term q$N(t_i)$ refers to the sample average of Consumer Surplus at the N^{th} quantile of the vertical type distribution.

to optimally set prices under the consolidation market structure. By comparing predictions under the first two simulations, I can quantify magnitude of the overall impact of acquisitions. Comparing the second and third simulations isolates the impact consolidation has on prices alone. Throughout, I focus on consolidation effects for licenses that acquired at some point between 1990-1996, where both firm heterogeneity and scale effects generate differences between the consolidation and no-acquisitions outcomes.

Table 6 contains sample averages and standard deviations for the predicted outcomes under each scenario, broken down by one and two-bundle markets. Comparing the second and third columns shows that acquisitions yield higher priced and higher quality cable, provided at lower costs in two-bundle markets. On average, bundle prices and qualities are \$0.39 and \$0.07 higher for basic cable and \$0.59 and \$0.12 higher for non-basic cable under consolidation relative to the no-acquisitions scenario. Marginal costs for basic and non-basic services are \$0.73 and \$0.83 lower per month on average. Thus, cost-reductions arising from acquiring firms' scale and firm-specific

Table 7: Acquisition Effects Consumer Welfare

	Consolidation		No-Acqs.		No-Quality	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Mean CS	6.135	(1.117)	5.747	(1.066)	5.978	(1.087)
CS q10	1.605	(0.882)	1.637	(0.881)	1.712	(0.854)
CS q25	3.093	(0.431)	2.966	(0.417)	3.060	(0.415)
CS q50	4.886	(1.177)	4.575	(1.081)	4.694	(1.129)
CS q75	7.891	(1.943)	7.270	(1.878)	7.717	(1.841)
CS q90	12.679	(2.998)	11.775	(2.897)	12.285	(2.966)

Notes: All amounts are per-subscriber averages across all licenses and periods, and dollar amounts are in terms of 1992 constant dollars. Sample standard deviations are in parentheses. The term q$N(t_i)$ refers to the sample average of Consumer Surplus at the N^{th} quantile of the vertical type distribution across license-years.

effects are large enough to yield lower marginal cost despite higher quality being offered under the consolidation scenario. Average monthly per-subscriber profits is \$1.24 higher under consolidation, a 9% increase over its no-acquisitions level.

Comparing the third and fourth two columns of Table 6, I find that the no-quality experiment results in \$0.08 higher basic prices and \$0.39 lower non-basic prices on average relative to the no-acquisitions scenario. This highlights the conflicting impact acquiring firms' demand-increasing branding effects, and cost-reducing scale and firm-specific effects have on cable prices. These price differences lead to 0.026 lower basic shares and 0.032 higher non-basic shares under the no-quality counterfactual. Thus, acquiring firms in two-bundle markets induce consumers to purchase higher-priced non-basic cable by reducing its price relative to basic prices when they are unable to adjust cable quality. Average monthly per-subscriber profits are similar under the no-quality and consolidation scenarios (respectively, \$14.98 and \$15.01). This suggests that acquiring firms' ability to generate additional profits through cost reductions and price adjustments can account for a large share of the incremental profits under consolidation irrespective of cable quality differences in the consolidation and no-acquisitions scenario.

The results for one-bundle markets in the last three columns of Table 6 yield similar results. Comparing consolidation to the no-acquisitions counterfactual, I find on average that basic prices and cable quality are \$0.64 and \$0.17 higher, marginal costs are \$0.97 lower, and per-subscriber profits are \$1.49 higher. Under the no-quality counterfactual, prices are \$0.16 lower on average relative to the no-acquisitions scenario. This highlights the importance of acquiring firms' cost advantages over their branding effects in determining cable prices. If unable to adjust basic quality, acquiring firms cut cable prices to induce demand, which can be seen by the 0.018 higher basic share under the no-quality scenario. Similar to the findings for two-bundle markets, I find that average per-subscriber monthly profits are comparable under the no-quality and consolidation scenarios (respectively, \$13.91 and \$13.97).

Table 7 contains sample averages and standard deviations across license-years for monthly mean per-subscriber consumer surplus, and for per-subscriber consumer surplus at five quantiles of the vertical type distribution. Across the three simulations, consumers realize a surplus of $6.14, $5.75 and $5.98 per month on average. The difference in average consumer welfare between the consolidation and no-acquisitions scenarios of $0.39 implies that acquisition-related increases in cable quality yield increases in utility that more than offset utility losses from higher prices on average. The average difference in consumer surplus between the no-acquisitions and no-quality scenarios of $0.23 suggests that consolidation generates welfare gains from large firms' branding effects and price-reducing scale effects irrespective of improved cable quality.

Comparing consumer surplus across the quantiles of the vertical type distribution in Table 7 highlights differences in welfare for consumers with differing tastes for cable. Looking across the columns shows that, with the exception of the 10th quantile, consumers are better off across all quantiles under consolidation, followed by the no-quality and no-acquisitions scenarios. Consumers at the 10th quantile are worse off by $0.03 per month on average under consolidation relative to the no-acquisitions counterfactual. This suggests that subscribers with weak tastes for cable quality do not realize a large enough increase in utility from higher cable quality to offset the welfare-reducing price increases under consolidation. Looking down the columns of Table 7 shows that consumers with stronger tastes for cable quality realize considerably more surplus than those with weak tastes. For example, consumer surplus at the 75th and 25th percentile of the vertical type distribution is $4.80 and $4.30 higher under the consolidation and no-acquisitions scenarios. The average difference in consumer surplus between lower and higher percentiles on the vertical type distribution is larger under consolidation relative to the no-acquisitions scenario. Thus, inequality in consumer welfare across high and low demand consumers increases under consolidation.

6.2 Scale effects, heterogeneity and acquisition outcomes

This section presents results from three additional simulations, each of which is analogous to the no-acquisitions counterfactual except either the firm-specific non-content dummies, the firm-specific non-content and content cost dummies, or firm sizes are set to their consolidation levels. I label these simulations the "demand heterogeneity," "cost heterogeneity" and "scale effects" scenarios. By analyzing the predicted *changes* in the model's predictions between the no-acquisitions experiment and each of these counterfactuals, I can assess the relative importance of firm heterogeneity and scale effects in driving acquisition outcomes in acquired licenses.

I present means and standard deviations for the simulated differences in cable bundles, costs and profits between the no-acquisitions scenario and the consolidation, demand heterogeneity, cost heterogeneity and scale effects scenarios in Table 8. Looking across the columns for two-bundle markets, the magnitude of the changes are largest for the scale effects simulation, followed by the cost and demand heterogeneity simulations. The predicted changes in basic and non-basic prices of

Table 8: Decomposition of Consolidation Effects on Cable Bundles, Costs and Profits by Demand Heterogeneity, Cost Heterogeneity and Scale Effects

	Two-Bundle Markets				One-Bundle Markets			
	Consolidation	Demand. Heterog.	Cost Heterog.	Scale Effects	Consolidation	Demand. Heterog.	Cost Heterog.	Scale Effects
Δ Basic Price	0.39	0.12	0.07	0.22	0.64	0.08	0.05	0.50
	(0.90)	(0.33)	(0.16)	(0.65)	(0.81)	(0.18)	(0.07)	(0.64)
Δ Non-Basic Price	0.60	0.05	0.13	0.37				
	(1.54)	(1.06)	(1.10)	(1.38)				
Δ Basic Quality	0.07	-0.00	0.02	0.06	0.13	-0.01	0.01	0.13
	(0.14)	(0.02)	(0.03)	(0.14)	(0.16)	(0.02)	(0.02)	(0.15)
Δ Non-Basic Quality	0.12	-0.01	0.03	0.09				
	(0.23)	(0.14)	(0.16)	(0.23)				
Δ Basic Share	0.003	-0.001	-0.000	0.002	0.008	0.003	0.000	0.005
	(0.036)	(0.028)	(0.033)	(0.034)	(0.011)	(0.007)	(0.001)	(0.007)
Δ Non-Basic Share	0.002	0.003	0.001	0.001				
	(0.035)	(0.029)	(0.033)	(0.035)				
Δ Basic Marginal Cost	-0.74	-0.00	-0.14	-0.57	-0.97	-0.04	-0.07	-0.86
	(0.98)	(0.04)	(0.16)	(0.83)	(1.11)	(0.08)	(0.10)	(1.02)
Δ Non-Basic Marginal Cost	-0.83	-0.04	-0.15	-0.64				
	(1.22)	(0.55)	(0.61)	(1.10)				
Δ Basic Affil. Payment	-0.18	-0.00	-0.03	-0.12	-0.43	-0.04	-0.02	-0.36
	(0.35)	(0.04)	(0.05)	(0.29)	(0.53)	(0.08)	(0.04)	(0.47)
Δ Non-Basic Affil. Payment	-0.28	-0.04	-0.04	-0.19				
	(0.74)	(0.55)	(0.59)	(0.72)				
Δ Per-Subscriber Profit	1.24	0.12	0.23	0.87	1.49	0.15	0.10	1.23
	(1.75)	(0.38)	(0.28)	(1.30)	(1.74)	(0.31)	(0.15)	(1.46)

Notes: All amounts are per-subscriber averages across all licenses and periods, and are in 1992 constant dollars. Sample standard deviations are in parentheses.

$0.22 and $0.37 under the scale effects counterfactual are 56% and 62% of their predicted differences between the consolidation and no-acquisition scenarios. Similarly, the predicted increases in cable quality and decreases in marginal costs for basic and non-basic quality are at least 75% of their corresponding differences under consolidation and no-acquisitions. The eleven large firms' ability to reduce non-content and content cable costs through firm-specific unobservables also plays a non-negligible role in determining acquisition outcomes. The fourth column of Table 8 shows that relative to the no-acquisitions predictions, the firm heterogeneity scenario results in $0.02 and $0.03 higher basic and non-basic cable quality, $0.07 and $0.13 higher prices, and $0.14 and $0.15 lower marginal costs. The third column shows that branding lead acquiring firms to increase basic and non-basic prices by $0.12 and $0.05 on average, with little adjustment in cable quality and costs.

In one-bundle markets, scale effects play an even larger role in determining acquisition outcomes. This is because scale effects diminish with in firm size, and acquisitions of one-bundle licenses typically involve relatively smaller incumbents; recall from Table 3 that the national subscribership

Table 9: Decomposition of Consolidation Effects on Consumer Surplus by Demand Heterogeneity, Cost Heterogeneity and Scale Effects

	Consolidation		Demand Heterog.		Cost Heterog.		Scale Effects	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Δ Mean CS	0.388	(0.583)	0.003	(0.156)	0.072	(0.198)	0.296	(0.505)
Δ CS q10	-0.032	(0.174)	0.010	(0.117)	-0.016	(0.124)	-0.040	(0.186)
Δ CS q25	0.127	(0.222)	0.013	(0.086)	0.018	(0.084)	0.086	(0.167)
Δ CS q50	0.311	(0.516)	0.011	(0.058)	0.057	(0.093)	0.237	(0.449)
Δ CS q75	0.622	(0.890)	0.009	(0.057)	0.119	(0.173)	0.483	(0.785)
Δ CS q90	0.904	(1.344)	-0.021	(0.455)	0.181	(0.560)	0.703	(1.203)

Notes: All amounts are per-subscriber averages across all licenses and periods, and dollar amounts are in terms of 1992 constant dollars. Sample standard deviations are in parentheses. The term CS q$N(t_i)$ refers to the sample average of Consumer Surplus at the N^{th} quantile of the vertical type distribution.

of firms serving one-bundle markets is considerably smaller than those serving two-bundle markets on average. Scale differences between acquiring and selling firms in these markets therefore have relatively larger marginal effects on acquisition outcomes than acquisitions amongst larger firms in two-bundle markets. The last column of Table 8 illustrates this result as the average predicted \$0.50 and \$0.13 increases in basic prices and cable quality and \$0.36 decrease in marginal costs are at least 78% of their respective differences under the consolidation and no-acquisition scenarios.

The sample averages and standard deviations across license-years for the change in mean consumer surplus at five quantiles of vertical type distribution are listed in Table 9. The scale effects counterfactual yields the largest average change in mean consumer surplus of \$0.296 per-subscriber per month (76% of the predicted difference between the consolidation and no-acquisitions scenarios.), followed by average changes of \$0.072 and \$0.003 under the cost and demand heterogeneity simulations. Similarly, the magnitude of the average predicted changes in consumer welfare across the quantiles of the vertical type distribution are largest under the scale effects simulation.

6.3 Regional consolidation and consumer welfare

By the mid 2000's, the industry has four regionally dominant firms: Eastlink in Atlantic Canada, Vidéotron in Québec, Rogers in Ontario and Shaw in Western Canada (Byrne (2010b)).[24] In this section, I estimate the welfare changes arising from regional consolidation by comparing consumer surplus under the 1996 market structure to a counterfactual scenario where the four major regions

[24]The CRTC acknowledges this fact in 2001 when it replaces the existing disaggregated licensing scheme with a regional approach that requires firms to hold one license for *all* of their Class 1, Class 2 and Type 3 licenses across these distinct regions of Canada; see CRTC Public Notice 2001-59. In implementing this new policy, the CRTC defines five regions: Region 1: British Columbia, the Yukon, Nunavut, the Northwest Territories; Region 2: Alberta, Saskatchewan, and Manitoba; Region 3: Ontario; Region 4: Québec; Region 5: New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland.

are solely run by Eastlink, Vidéotron, Rogers and Shaw.[25] While these simulations ignore the subsequent effects of satellite entry and the internet, they provide a sense of the magnitude of the welfare impact of regional consolidation. To the extent that satellite entry causes cable companies to reduce prices and raise quality across cable tiers (as Chu (2010) overwhelmingly finds to be the case), these results provide a lower bound on the welfare impact of consolidation.

Table 10 contains sample averages and standard deviations for monthly mean per-subscriber consumer surplus across all licenses and for four subsets of licenses based on the quartiles of the urban density distribution within each region under the 1996 and regional consolidation market structures. The average increase in mean consumer surplus under regional consolidation ranges from $1.07 in Québec to $0.65 in the Atlantic region. The relatively large average gains in Québec arise because many small local cable operators exist in the rural parts of province in 1996. The introduction of a large firm such as Vidéotron to these rural licenses implies large potential welfare gains due to scale and firm heterogeneity effects.

The average consumer surplus differences across the intervals of the urban density distribution for the four regions show that licenses with lower urban density stand to realize the largest potential gains from consolidation. For example, in Western Canada licenses lying between and 0 and 25th percentile of the urban density distribution realize an average increase of $1.25 in monthly per-subscriber surplus under regional consolidation. This is nearly three times the $0.45 welfare gain for urban licenses in the 75-100 interval within this region. Across all four regions, welfare gains are largest for either the 0-25 or 25-50 intervals. This is because large cable operators tend to operate in urban licenses and not rural ones in 1996. As the dominant companies spread into increasingly rural parts of Canada in the 2000's, they bring their scale advantages, firm-specific branding effects and cost reductions from firm-specific competencies such as managerial experience in running cablesystems. This allows larger acquiring firms to offer higher quality cable services and charge prices that consumers are willing to pay.

7 Conclusion

This article empirically studies the economic consequences of consolidation in the Canadian cable television industry. The analysis uses complementary reduced-form and structural approaches to evaluate acquisition effects and investigate outcomes under counterfactual market structures. I find acquisitions of smaller cable companies by large ones results in higher priced and higher

[25] There are some exceptions to this characterization of market structure worth noting. Rogers is dominant in New Brunswick and Newfoundland, while Eastlink owns almost all of the licenses in Nova Scotia and Prince Edward Island. Cogeco also has a strong presence in Eastern Ontario and throughout Québec. I do not incorporate these particulars of market structure in this section as I mainly aim to quantify the magnitude of the impact regional consolidation has on consumer welfare. To the extent that scale effects result in welfare gains for consumers due to improved cable bundles, I will underestimate consolidation effects for licenses served by Rogers in New Brunswick and Newfoundland and overestimate them for licenses served by Cogeco in Québec and Ontario.

Table 10: The Effect of Regional Consolidation on Consumer Surplus

	Regional Consolidation		1996 Market Structure		CS Difference	
	Mean	Std. Dev.	Mean	Std.	Mean	Std.
Atlantic (Eastlink)						
Mean CS	6.989	(0.798)	6.342	(0.834)	0.647	(0.510)
CS q0-25	7.562	(0.622)	7.014	(0.857)	0.548	(0.492)
CS q25-50	7.441	(0.649)	6.539	(0.727)	0.902	(0.516)
CS q50-75	6.708	(0.504)	6.161	(0.445)	0.547	(0.531)
CS q75-100	6.229	(0.595)	5.626	(0.592)	0.603	(0.452)
Québec (Vidéotron)						
Mean CS	6.866	(0.856)	5.797	(0.746)	1.069	(0.478)
CS q0-25	7.270	(0.696)	5.973	(0.664)	1.297	(0.283)
CS q25-50	7.363	(0.605)	6.105	(0.623)	1.258	(0.356)
CS q50-75	6.939	(0.565)	5.958	(0.678)	0.981	(0.537)
CS q75-100	5.894	(0.651)	5.154	(0.635)	0.740	(0.480)
Ontario (Rogers)						
Mean CS	6.457	(1.439)	5.893	(1.379)	0.563	(0.537)
CS q0-25	7.518	(0.660)	6.655	(0.855)	0.863	(0.545)
CS q25-50	7.516	(0.876)	6.870	(1.067)	0.646	(0.573)
CS q50-75	6.026	(0.607)	5.616	(0.822)	0.410	(0.487)
CS q75-100	4.724	(1.145)	4.394	(1.127)	0.330	(0.377)
West (Shaw)						
Mean CS	6.969	(1.106)	6.208	(0.990)	0.761	(0.612)
CS q0-25	8.137	(0.742)	6.890	(0.655)	1.247	(0.421)
CS q25-50	7.034	(0.659)	6.153	(0.731)	0.881	(0.543)
CS q50-75	6.492	(0.521)	6.039	(0.628)	0.453	(0.551)
CS q75-100	6.178	(1.208)	5.731	(1.382)	0.447	(0.547)

Notes: All amounts are per-subscriber averages across all licenses and periods, and dollar amounts are in terms of 1992 constant dollars. Sample standard deviations are in parentheses. The term CS q$N - N'$ refers to the sample average of Consumer Surplus for licenses whose urban density is between the N and N' quartiles of the urban density distribution across licences in 1996.

quality non-basic cable, delivered at a lower costs, with relatively smaller changes in basic cable bundles. Consumers welfare rises on average with acquisitions, suggesting the utility losses from price increases are more than offset by the utility gains from having higher quality cable services. A decomposition of the determinants of acquisition outcomes shows that cost-reducing scale effects are the primary driver of consolidation effects, while demand and cost heterogeneity have a smaller, yet important role. Finally, I conduct an experiment to evaluate regional consolidation, like that observed by the mid-2000's in Canada. I find that consumers are generally better off being served by dominant cable companies, particularly in rural parts of the country where the potential for cable quality improvements and cost reductions is the largest.

There are at least two avenues of future research worth noting. I have focused on consolidation during an earlier period for the cable industry because of the empirical convenience of studying local monopolies and the accessibility of rarely available cost data. It would be interesting to study consolidation effects during more contemporary times, where Direct Broadcast Satellite and telephone companies are direct competitors to traditional cable companies. If consumer switching costs amongst cable providers persist (Shcerbakov (2009)), then large cable companies have recently had an additional incentive beyond scale and firm-specific reasons to acquire other firms and penetrate new markets prior to the entry of new competitors. Second, I have taken firms' acquisition decisions as exogenous. Constructing an econometric model of endogenous prices, product quality *and* acquisitions is a very challenging exercise that is well beyond the scope of this paper. Estimating models of endogenous acquisitions is a current research frontier that permits further analyses of the determinants of consolidation in the cable television industry, as well as other industries. This is an area of research that I am currently pursuing (Byrne (2010a)).

References

Bensanko, D., S. Donnenfeld, and L. J. White (1987): "Monopoly and Quality Distortion," *Quarterly Journal of Economics*, 102, 743–767.

Berry, S. T., and J. Waldfogel (2001): "Do Mergers Increase Product Variety? Evidence from Radio Broadcasting," *Quarterly Journal of Economics*, 55, 49–67.

Byrne, D. P. (2010a): "Acquisitions as a Response to Deregulation: Evidence from the Cable Television Industry," Queen's Economics Department Working Paper No. 1242.

——— (2010b): "An Empirical Study of the Causes and Consequences of Mergers in the Canadian Cable Television Industry," Ph.D. Dissertation, Department of Economics, Queen's University.

Chipty, T. (2001): "Vertical Integration, Market Foreclosure, and Consumer Welfare in the Cable Television Industry," *American Economic Review*, 91, 428–453.

Chipty, T., and C. M. Snyder (1999): "The Role of Firm Size in Bilateral Bargaining: A Study of the Cable Television Industry," *Review of Economics and Statistics*, 81, 326–340.

Chu, C. S. (2010): "The Effect of Satellite Entry on Cable Television Prices and Product Quality," *Rand Journal of Economics*, 41, 730–764.

Chu, C. S., P. Leslie, and A. Sorensen (2009): "Bundle-Size Pricing as an Approximation to Mixed Bundling," *American Economic Review*, forthcoming.

Crawford, G. (2009): "Cable Regulation in the Satellite Era," Chapter 5 in Rose, N. ed, Economic Regulation and Its Reform: What Have We Learned?

Crawford, G., and M. Shum (2006): "The Welfare Effects of Endogenous Quality Choice: The Case of Cable Television," manuscript, John Hopkins University.

Crawford, G. S., and A. Yurukoglu (2010): "The Welfare Effects of Bundling in Multichannel Television," Working Paper, Stanford.

Draganska, M., M. Mazzeo, and K. Seim (2009): "Addressing Endogenous Product Choice in Merger Analysis," Working Paper, Stanford.

Fan, Y. (2010): "Ownership Consolidation and Product Quality: A Study of the U.S. Daily Newspaper Market," Working Paper, University of Michigan.

Ford, G. S., and J. D. Jackson (1997): "Horizontal Concentration and Vertical Integration in the Cable Television Industry," *Review of Industrial Organization*, 12, 501–518.

Holmes, T. J. (2010): "The Diffusion of Wal-Mart and Economies of Density," *Econometrica*, Forthcoming.

Law, S. (1999): "Holding the Line: The CRTC and the Pricing of Canadian Basic Cable Television," *Canadian Journal of Economics*, 32, 630–653.

Mussa, M., and S. Rosen (1978): "Monopoly and Product Quality," *Journal of Economic Theory*, 18, 301–317.

Pakes, A., J. Porter., K. Ho., and J. Ishii (2006): "Moment Inequalities and Their Application," mimeo, Michigan State University.

Parsons, P. R. (2003): "Horizontal Integration in the Cable Television Industry: History and Context," *Journal of Media Economics*, 16, 23–40.

Shcerbakov, O. (2009): "Measuring Consumer Switching Costs in the Television Industry," Mimeo, Mannheim University.

Storn, R., and K. Price (1997): "Differential Evolution - A Simple and Efficient Heuristic for Global Optimization over Continuous Spaces," *Journal of Global Optimization*, 115, 341–359.

Sweeting, A. (2010): "The Effects of Mergers on Product Positioning: Evidence from the Music Radio Industry," *Rand Journal of Economics*, Forthcoming.

Train, K. E. (2003): *Discrete Choice Methods with Simulation*. Cambridge University Press.

Wieten, J., G. Murdock, and P. Dahlgren (2000): *Television Across Europe, A Comparative Introduction*. SAGE Publications Ltd.

SUPPLEMENTAL APPENDIX

A Endogeneity of acquisitions

As a first check on potential endogeneity in the reduced-form estimates of merger effects from Section 3, I compare the pre-merger characteristics of acquired licenses to non-acquired licenses prior to acquisitions to see if there are systematic differences in the types of licenses that are acquired.[26] Using the sample of all non-acquired licenses and pre-merger observations for all acquired licenses, I regress a given license-level characteristic on a dummy variable that equals one if a license is subsequently acquired. If the coefficient estimate on the acquisition dummy is statistically significant, then the dependent variable for acquired licenses systematically differs from non-acquired licenses. I present the results from these regressions for one and two-bundle markets in Table 11, where the dependent variables are basic and non-basic prices, channel counts and shares, as well as horizontal firm size (national subscribership) of a license's current cable company.[27] For one-bundle markets, the only statistically significant estimate is for basic shares (at the 1% level), suggesting that acquiring firms potentially target one-bundle markets with low-demand. For two-bundle markets, only the regression where firm size is the dependent variable delivers a statistically significant result (at the 5% level). The coefficient estimate suggests that two-bundle markets served by smaller firms are more likely to be acquired, which reflects the fact from Table 1 that the dominant firms are involved in the majority of acquisitions. There do not appear to be systematic differences in acquired licenses based on the characteristics of the current cable bundles since as other estimates are statistically insignificant.

As another check on endogeneity, I re-estimate equation (1) using sub-samples of the data that vary the extent to which selection effects matter. For example, acquisitions involving the dominant firms may be more influenced by selection effects as scale efficiencies may allow larger companies to offer more lucrative bundles that potentially earn higher profits. I continue to classify a firm as "large" if it is one of the ten largest cable companies in 1996 by national subscribership. I re-estimate equation (1) for two-bundle markets using two subsamples that respectively exclude small and large firm acquisitions.[28] The results are listed in Table 12. Comparing the top and bottom panels, I find qualitatively similar results for the two sets of estimates, implying that to the extent that scale-based selection effects exist, they are not driving the general conclusions of my reduced-form analysis. The results do suggest that scale-based selection effects may put upward pressure on the magnitude of the acquisition coefficients for non-basic prices, channels and affiliation payments in Table 4.

[26] The two merger endogeneity checks in this appendix follow Sweeting (2010)'s approach.

[27] I include time dummies and the firm and demographic controls from above in the regressions, and replace the license fixed effects with province fixed effects.

[28] I do not list results for one-bundle markets as there are no acquisitions of one-bundle markets by large firms as I have defined them. This is because one-bundle market acquisitions typically involve rural cablesystems that larger firms do not actively acquire.

Table 11: Tests of Whether Acquired licenses are Representative

	Basic Price	Non-Basic Price	Basic Channels	Non-Basic Channels	Basic Share	Non-Basic Share	Firm Size
One-Bundle Markets ($N = 680$)							
Coefficient on	-0.697	-	-0.252	-	-0.102***	-	-0.001
license ever acquired	(1.109)	-	(0.802)	-	(1.039)	-	(0.069)
Two-Bundle Markets ($N = 1910$)							
Coefficient on	-0.263	-0.283	0.476	-0.424	-0.001	-0.028	-0.901**
license ever acquired	(0.448)	(0.853)	(0.500)	(0.453)	(0.027)	(0.025)	(0.374)

Notes: Estimates obtained by OLS. Standard errors are listed in parentheses and are clustered at the license-level. ***, **, * indicate statistical significance at the 1, 5, and 10 percent levels respectively. The specification is analogous to Specification (2) from Table 4, expect the license fixed effects are replace with province dummies. All nominal amounts are in 1992 constant dollars.

Table 12: Estimation Results by Large and Not Large Buying Firms in Two-Bundle Markets

	Basic Price	Non-Basic Price	Basic Channels	Non-Basic Channels	Basic Share	Non-Basic Share	Affiliation Payments
Exclude Small Acquiring Firms ($N = 2664$)							
A_{lt}	-0.458***	3.771***	-1.733	4.260*	-0.058**	0.136***	1.723***
	(0.126)	(0.534)	(2.055)	(2.310)	(0.023)	(0.022)	(0.360)
Exclude Large Acquiring Firms ($N = 1926$)							
A_{lt}	-0.444**	2.274*	-0.132	1.348***	-0.014	0.014	0.851
	(0.196)	(1.231)	(0.336)	(0.490)	(0.020)	(0.019)	(0.742)

Notes: Estimates obtained by OLS. Standard errors are listed in parentheses and are clustered at the license-level. ***, **, * indicate statistical significance at the 1, 5, and 10 percent levels respectively. The specification is analogous to Specification (2) from Table 4. A firm is classified as large if it operates in ten or more licenses in 1996. All nominal amounts are in 1992 constant dollars.

B Computational details

I numerically evaluate the integral that defines each cable bundle's market share, defined in equation (4), using 200 draws from a Halton sequence with a different prime number seed for each license-year. As noted by Train (2003), Halton sequences have substantially better coverage properties than machine-generated pseudo random number generators, which reduces the variance of the shares estimates. By using fewer draws, I also reduce the computational cost in simulating vectors of shares for each observation.

I use the Simplex method to find $\{(p^*_{jkn}, q^*_{jkn})\}_{j=1}^{J_{kn}}\}$, the qualities and prices that maximize expected profits (equation (6)). Since non-basic cable prices and quality are restricted to be higher than basic cable prices and quality, this simplifies finding the optimal prices and qualities. I have experimented with many starting values for many parameterizations of the model and find the same profit maximizing price and quality vectors across license-years.

Calculating the SMM objective function is a computationally intensive task since it involves solving N non-linear optimization problems (i.e., finding (p^*_{jkn}, q^*_{jkn}) for each observation). Since I can independently compute s^*, p^*, c^*_2 across licenses and time, I parallelize my code which allows me to perform these license-year level computations on multiple processors simultaneously. This substantially speeds up computation of the SMM objective function. One SMM objective function evaluation in MATLAB takes approximately 140 seconds when using 8 Xeon X5620 processors simultaneously with 24 GB of RAM. I minimize the SMM objective function using the Differential Evolution global optimization routine (Storn and Price (1997)).

C Figures

Figure 1: Predicted Basic Quality vs. Basic Channel Counts

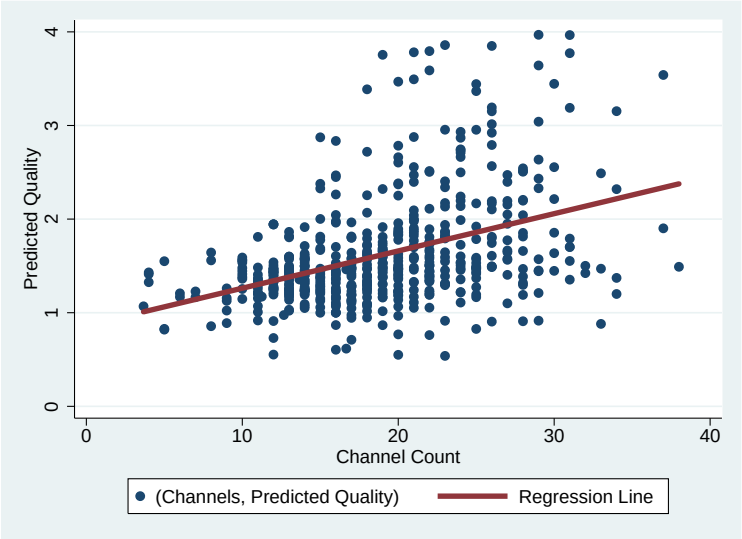

Figure 2: Predicted Non-Basic Quality vs. Non-Basic Channel Counts

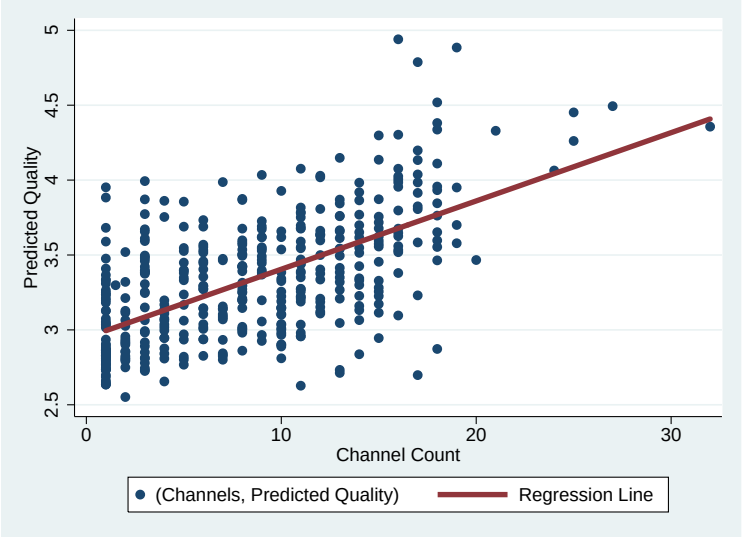

Figure 3: CRTC Decision 89-46

Canadian Radio-television and Telecommunications Commission | Conseil de la radiodiffusion et des télécommunications canadiennes

Canada

Decision
Ottawa, 14 February 1989
Decision CRTC 89-46
Adelaide Radio & T.V. Limited
St. Mary's, Ontario - 882794100

Pursuant to Public Notice CRTC 1988-212 dated 22 December 1988, the Commission approves the application for authority to transfer effective control of Adelaide Radio & T.V. Limited, licensee of the broadcasting receiving undertaking serving St. Mary's, through the transfer of all of the common voting shares from the existing shareholders (the Tipping family) to Rogers Cable T.V. Limited (Rogers).

Rogers has proposed to purchase 100% of the shares of Adelaide Radio & T.V. Limited for the purchase price of $600,000. Based on information filed with the application, the Commission has no concerns with respect to the availability or adequacy of the required financing.

Rogers is a wholly-owned subsidiary of Canadian Cablesystems Limited, which in turn, is indirectly and ultimately controlled by Mr. Edward Rogers of Toronto.

Through various companies, Mr. Rogers owns CFTR and CHFI-FM Toronto and eight cablesystems in Ontario, one in Alberta and five in British Columbia. Mr. Rogers also holds a 25.4% interest in YTV Canada Inc., the youth-oriented specialty service; a 74.2% interest in the multilingual station CFMT-TV and a majority interest in the Canadian Home Shopping Network (CHSN) Ltd., a non-programming cable service.

As stated in a number of decisions relating to applications for authority to transfer ownership or effective control of broadcasting undertakings, and because the Commission does not solicit applications for such transfers, the onus is on the applicant to demonstrate to the Commission that the application filed is the best possible proposal under the circumstances, taking into account the Commission's general concerns with respect to transactions of this nature.

The Commission reaffirms that the first test any applicant must meet is that the proposed transfer of ownership or control yields significant and unequivocal benefits to the communities served by the broadcasting undertaking, to the Canadian broadcasting system as a whole, and that it is in the public interest.

In particular, the Commission must be satisfied that the benefits, both those that can be quantified in monetary terms and others which may not easily be measurable in terms of their dollar value, are commensurate with the size of the transaction and that they take into account the responsibilities to be assumed, the characteristics and viability of the broadcasting undertakings in question, and the scale of the programming, management, financial and technical resources available to the purchaser. In assessing this application, the Commission has taken into consideration Rogers' commitment to provide St. Mary's with a level of cable service equivalent to that of the neighbouring Grand River system. Also, Rogers intends to extend the company's service hours thereby decreasing response time for service calls and improving accessibility to the cable company. The Commission also notes the extensive experience and resources upon which the purchaser may draw in order to maintain and improve service to subscribers.

In evaluating the benefits to be derived from this transaction, the Commission has taken into account that Rogers has committed to spend $568,000 to improve technical services $500,000 of which may be recovered through rate applications filed under subsection 18(6) of the Cable Television Regulations, 1986 (the regulations). In this respect, Rogers has committed to spend approximately $120,000 for improvements in the St. Mary's signal package by including in the channel line-up Canadian specialty services and FM services not currently available. Further, in this regard, Rogers has undertaken to rebuild the system in order to increase capacity on the basic service from 15 to 29 channels. The estimated capital cost of this proposal is $380,000.

Although an application to recover these capital expenditures which represent about $500,000 may be filed under subsection 18(6) of the regulations, the Commission notes Rogers' commitment that the basic monthly fee at St. Mary's will be no more than the authorized rate for the adjacent Grand River system.

Having examined the financial situation of the current licensee, the Commission notes that Adelaide Radio & T.V. Limited has experienced declining rates of returns on net fixed assets and, in this regard, considers that the licensee appears unable at present to finance basic on-going maintenance programs and would have difficulty financing the extensive capital improvements that will be necessary in the future.

In light of the foregoing, the Commission considers that these expenditure commitments will benefit St. Mary subscribers. In addition, the purchaser has proposed quantifiable benefits totalling $68,000 that will accrue to subscribers through technical improvements and other programming and operating expenditures.

Specifically, Rogers will introduce by September 1989 full-service community programming that will, among other things, provide coverage of St. Mary's town council meetings. Also, Rogers will incorporate a descrambling system enabling subscribers greater flexibility in the selection of discretionary services.

The Commission has therefore concluded that the benefits, both intangible and quantifiable, are commensurate with the size of the transaction, the viability of the undertaking in question, the responsibilities involved and the resources available to the purchaser. In view of all the foregoing and having examined the information available to it, the Commission is satisfied that the proposed transfer of control will yield significant benefits to cable subscribers in St. Mary's and that approval of the application is in the public interest.

The Commission acknowledges the intervention received from Mr. Chris West in support of this application.

Fernand Bélisle
Secretary General