The Impact of Consolidation on Cable TV Prices and Product Quality*

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Abstract

This paper estimates a multi-product monopoly model with price regulation using new panel data from local Canadian cable television markets. Through counterfactual simulations, I measure the impact of consolidation on cable prices, product quality, profits, and consumer surplus. I find consolidation results in higher quality cable, lower operating costs, negligible price changes, and large increases in firms' profits and consumer surplus. Firm-size effects that reduce cable content costs are the main drivers of consolidation outcomes quantitatively, with firm heterogeneity in demand and costs having a smaller impact. Basic cable price regulation amplifies consumer welfare gains from consolidation.

Keywords: Consolidation; Price discrimination; Basic cable price regulation; Simulated Method of Moments; Cable television

JEL Codes: L12, L96, C33

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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 1970s emerges an industry dominated by fewer, larger firms in the 2000s. Over time, dominant firms expand by actively acquiring smaller cable companies. Although these histories have been well-documented by industry experts, various open questions remain (Crawford (2009)). What impact do acquisitions have on cable prices, product quality, and profits? To what extent do firm size effects or unobserved firm-specific factors such as branding or managerial differences drive consolidation outcomes? Are consumers made better or worse off from consolidation? What effect does basic cable price regulation, like that historically implemented in many countries, have in shaping consolidation outcomes?

This paper studies the interrelated impact of consolidation and price regulation on cable prices, bundle quality, and welfare using panel data for the cable television industry in Canada for the 1990-1996 period. Three key aspects of the industry, time period, and dataset facilitate the study: (1) firms are regulated licensed monopolists in pre-defined geographic licenses/licenses;[2] (2) license-level data on basic cable price-caps are available from Canada's telecommunications regulator; and (3) I have access to rarely available supply-side license-level data on cable companies' labor costs, operating expenses, and affiliation payments made from cable companies to upstream channel providers.

The fact that cable operators are local monopolists yields two key benefits. First, firms must acquire other cable companies if they want to expand into new licenses. This 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 study how acquisitions and firm size affect cable prices, channel counts, and costs. Second, the market structure allows me to use a structural multi-product monopoly model to measure the impact acquisitions, regulation, firm size, and firm heterogeneity have on prices, product quality, costs, and consumer welfare. Developing such an analysis in a strategic environment is vastly more complicated since oligopoly models of 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 previously available. Using these data, I separately identify cable content costs (affiliation payments) from non-content costs (labor and operating expenses), examine firm heterogeneity in costs, and relate firms' cost structures to their offered cable prices and product quality.

[1] Numerous articles document the history of consolidation in the U.S. cable television industry; see Parsons (2003) for examples. Byrne (2010a) 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 license 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.

1.1 Summary of findings

I provide an overview of the industry and data in Sections 2 and 3. The data highlight a consolidation process where the eleven largest cable companies are the acquiring firms in more than half the acquisitions in the sample. This period of consolidation is particularly important for national cable companies such as Rogers Cable (Rogers) and Shaw Communications (Shaw) that now dominate Canada's telecommunications landscape.

In Section 4, I present a reduced-form analysis of the impact that acquisitions and firm size (in terms of the number of subscribers served nationally) have on license-level cable prices, bundle quality, and costs. Controlling for firm size, non-basic prices and monthly per-subscriber affiliation payments increase by \$3.12 and \$1.48 following acquisitions. To the extent that higher quality channels (i.e., those with higher ratings) demand a higher premium from consumers, and are more expensive for cable companies to offer (Crawford and Yurukoglu (2012)), these estimates suggest that cable quality rises in acquired licenses. There is evidence of firm size effects as well. Larger cable companies tend to offer lower prices, more channels, and realize lower affiliation payments for basic and non-basic cable. These findings suggest that larger cable companies: (1) obtain discounts in negotiating affiliation payments with channel companies (Crawford and Yurukoglu (2012)), which allows them to offer more channels; and (2) realize license-level labor and operating cost efficiencies which are passed down to consumers as lower cable prices. Overall, the reduced-form estimates indicate that acquisitions by large cable companies result in higher channel counts, while post-acquisition price and cost changes are ambiguous.

In light of the reduced-form findings, I develop and estimate a structural multi-product monopoly model to quantify the impact of consolidation, and investigate underlying determinants of acquisition effects. The model is presented in Section 5, and an identification and estimation strategy is outlined in Section 6. In the model, consumers have heterogeneous vertical preferences over cable quality, and horizontal preference shocks for basic and non-basic cable. Cable companies only know the distribution over consumers' types, and earn profits in their licenses by offering basic and non-basic cable prices and bundles, subject to basic price regulation. A key aspect of the model is that I allow for firm-specific heterogeneity in cable quality, cable content costs, and non-content labor and operating costs for each of the dominant eleven largest cable companies in the sample. The model also allows for license-level unobserved heterogeneity in cable demand.

Section 7 presents the structural parameter estimates and results from various counterfactual simulations. The demand-side parameters indicate important firm-specific heterogeneity in cable quality. Multi-system cable operators (MSO) tend to offer higher per-channel quality than locally-owned single-system cable companies. Dominant national cable providers, like Rogers and Shaw, offer even higher quality cable than smaller MSOs, particularly for non-basic cable. The sample medians of the estimated own price elasticity of demand for basic and non-basic cable are -5.68 and -14.47.

The supply-side parameter estimates imply median monthly margins of 30% in licenses with basic and non-basic cable. Collectively, the cost parameter estimates speak to the tension from the reduced-form results between firm size and firm-specific effects in driving acquisition outcomes. Larger cable companies realize lower per-channel content costs, and exhibit firm-specific non-content labor and operating cost efficiencies, which enables them to offer more channels and charge lower prices. However, dominant acquiring cable companies also exhibit higher-firm specific content cost premiums (due to offering higher average channel quality), which gives them an incentive to offer fewer channels and charge higher prices.

Using the estimated model, I quantify the impact of consolidation by comparing the model's predictions for acquired licenses under the observed "consolidation" market structure to a "no consolidation" scenario where no acquisitions occur between 1990-1996. These simulations fix basic price caps to their observed values in the data. The predictions from these simulations generally correspond to the sign and magnitude of the reduced-form merger effects: channel counts rise, per-subscriber marginal costs fall, and prices tend to fall or change very little. Average monthly per-subscriber profits increases by $3.52 in licenses with basic and non-basic cable under consolidation, which represents a 64% increase over its no consolidation scenario average. Mean consumer surplus is $3.15 per month higher on average, a 107% increase over its no consolidation 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. Consolidation-based consumer welfare gains are largest in relatively more urban licenses that tend to be acquired by the most dominant cable providers in the sample, Rogers and Shaw.

The second set of simulations evaluate the impact of basic price regulation by comparing a "regulation" scenario to a "no regulation" scenario where cable operators are unconstrained in setting basic prices. These simulations assume the "consolidation" market structure observed in the data. An important overarching finding is that the model's predictions exhibit non-negligible differences without basic price regulation. Thus, accounting for price regulation is important for quantifying the impact of consolidation in this context. Price regulation mainly impacts prices: average basic and non-basic prices are $1.74 and $1.62 higher without price regulation in licenses with basic and non-basic cable. Cable operators' average per-subscriber profits increase by $1.29 per-month in licenses with basic and non-basic cable in the absence of price regulation (a 18% increase over its regulation scenario levels). On average, mean consumer welfare falls from $6.10 per-month with basic price regulation to $4.89 without basic price regulation.

I run a third set of simulations to quantify the effect basic price regulation has on consolidation outcomes. In particular, I compare the difference in predicted outcomes under the "consolidation" and "no consolidation" market structures with and without basic price regulation. I find that in the absence of basic price regulation, acquiring cable companies tend to reduce basic and non-basic prices from their relatively higher levels to generate higher revenues from acquired licenses. In contrast, acquiring cable companies tend to increase basic and non-basic channel counts to generate additional revenues with basic price regulation. Consolidation-induced consumer welfare gains tend to be higher under price regulation, pointing to an indirect benefit to consumers from the policy. On average, mean consumer surplus across acquired licenses is $6.10 per-month in a "consolidation" and "regulation" world, and $1.99 per-month in a "no consolidation" and "no regulation" world. From the perspective of consumers, these large welfare gains shed favorable light on the policy choices of the Canadian Radio-television and Telecommunications Commission during the last 25 years in enforcing basic cable price regulation, and taking a laissez-faire stance on acquisitions that encourages cost-reducing cable mergers.

My final set of simulations start from the no consolidation scenario, and set one of firm-specific content cost and demand effects, firm-specific non-content cost effects, or content cost-reducing firm-size effects to their consolidation levels. Comparing outcomes from these simulations to the no consolidation counterfactual allows me to quantify the importance of firm heterogeneity and firm size in driving consolidation outcomes. I find that content cost-reducing firm size effects are the main driver of consolidation effects, reducing costs and prices, and increasing channel counts. The firm-specific content cost and demand effects simulation, which mainly captures the impact firm-specific differences in cable quality has on demand and content costs, mainly results in higher non-basic cable prices and content costs, and lower non-basic channel counts relative to the no consolidation simulation. These firm-specific cable content-based effects conflict with the content cost-reducing firm size effects, and the latter dominates in driving consolidation outcomes. The firm-specific non-content cost simulation results in lower basic and non-basic cable prices relative to the no consolidation counterfactual. The cost efficiencies of dominant acquiring firms are passed down to consumers in the form of lower cable prices and are another source of welfare gains from consolidation.

1.2 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 (2012) develop structural models that endogenize the cable price and bundling decisions of firms, and incorporate various forms of heterogeneity in consumers' preferences, and firms' costs.[3] Using U.S. cable television data from 1990s and 2000s, these papers study quality degradation, the impact of satellite entry, and the welfare implications of à la carte bundling of cable services. In contrast, I focus on consolidation and linkages between the cost structures

[3]Crawford and Yurukoglu (2012) further model the bargaining game between upstream channel providers and downstream cable operators that determines per-subscriber channel costs (or "affiliation payments").

of firms and the menus of products and prices offered.[4] Further, I use data on license-specific basic cable price-caps to provide the first analysis of the impact of basic price regulation using a "new generation" cable industry model.[5] In the absence of price-cap data, and given the complexity of the rules in the U.S. that govern basic cable price-caps, these recent studies do not examine nor account for basic price regulation. My empirical strategy also uses unique license-level cost data on labor, operating expenses, and affiliation payments to directly identify and estimate firms' cost functions. This allows for considerable flexibility in modelling the cost functions of firms, and allowing for unobserved firm heterogeneity in costs.

This paper also fits into a broader economics literature on empirical merger evaluations that stems from Nevo (2000). He shows how Berry, Levinsohn, and Pakes's (1995) structural model of license demand and supply can be used to simulate mergers, and evaluate their impact on equilibrium prices and welfare. In practice, the outcomes of such merger simulations heavily depend on the extent to which a merger can generate cost efficiencies that help offset post-merger price increases due to increased market power. While data on prices and license shares are typically available to researchers and policymakers to conduct these analyses, cost data is often unavailable, so assumptions about the nature of firms' cost structure and merger-related efficiencies must be made. Thus, a key contribution of this paper is to illustrate how supply-side data can be used to directly identify merger-related cost efficiencies, and quantify their impact on post-merger prices, product quality, and welfare.

Moreover, merger analyses typically assume firms only compete on prices as differentiated Bertrand competitors. This assumption is often made because (1) measuring product quality is difficult; and (2) oligopoly models of endogenous price *and* quality are difficult to work with. Such models often have multiple equilibria that imply a non-unique mapping from the model to the data, which complicates merger simulations.[6] By examining mergers among local monopolists, I abstract from these complications because firms simply chooses prices and product quality to maximize profits, thus permitting a relatively transparent analysis of the impact of mergers on prices and product quality. Further, allowing for price regulation in a monopoly setting is straightforward, which facilitates a novel analysis of interactions between price regulation and the impact of mergers on various economic outcomes of interest.

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

[5] Earlier studies by Mayo and Otsuka (1991) and Rubinovitz (1993) estimate demand models for the U.S. and analyze the impact of basic price regulation. Both studies conclude price regulation is effective at keeping basic cable prices below monopoly levels. Crawford (2000) evaluates the 1992 Cable Act in the U.S. using a structural discrete-choice demand model. He finds firms responded to the Act by adjusting basic and non-basic cable prices in a way that yielded no welfare benefits to consumers. All of these prior studies take bundle characteristics or quality as exogenous and do not evaluate the impact regulation has on cable prices *and* bundles.

[6] Draganska, Mazzeo, and Seim (2009), and Fan (2010) relax this assumption, and develop structural oligopoly models that endogenize price-setting and product quality choice of firms. These models allow one to evaluate mergers' impact on prices and product quality. However, merger evaluations are complicated by multiple equilibria in these models. To conduct merger simulations, one would have to find every vector of equilibrium prices and product quality, and either specify an equilibrium selection rule, or report the non-unique predictions of the impact of mergers on prices, product quality, and welfare.

This study further complements empirical research on consolidation and product positioning in media markets. Most studies examine consolidation in U.S. media markets following the 1996 *Telecommunications Act* ("the Act"). Berry and Waldfogel (2001) and Sweeting (2010) document that product variety rises in the U.S. radio broadcasting and music radio industries during the post-Act consolidation wave. Jeziorski (2011b) and Tyler-Mooney (2010) develop static structural two-sided license models of listener and advertiser demand to measure the welfare effects of consolidation in the U.S. radio industry. Related studies examine how economies of scale and scope affect market structure, and the acquisition decisions of firms during the post-Act consolidation wave in the U.S. radio (Smith and O'Gorman (2008), Jeziorski (2011a)), and broadcast television channel (Calfee-Stahl (2011)) industries. These authors estimate cost synergies without cost data by inferring the synergies that rationalize observed acquisitions through the lens of structural merger models. I complement these studies by directly examining scale and firm-specific cost synergies using cable content and non-content cost data. I document the impact of media mergers on prices and product quality, and infer how cost synergies rationalize these price and product quality changes through the lens of a multi-product monopoly model.

2 Cable television in Canada

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 *Act*). Prior to 2001, a primary feature of the *Act* was the issuance of geographical licenses from the CRTC to cable operators that gave 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 horizons, do not involve fees and can be revoked by the CRTC.[7]

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, or The Sports Network (TSN)), 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

[7]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 (2010a).

an upper bound on the allowable increase in basic prices from year to year. This price regulation effectively defines an individual basic cable price cap for each license every year. The upper bound on basic price growth is largely determined by the inflation rate: year-to-year nominal basic cable prices are allowed to increase up to 80% of year-to-year inflation based on the Canadian CPI. Price increases are also permitted for cable licensees that are under financial distress, and to compensate companies that make major capital investments in cable systems. There are three regulatory classes: Class 1 (more than 6,000 subscribers), Class 2 (between 6,000 and 2,000 subscribers) and Part 3 (fewer than 2,000 subscribers). Class 1 and 2 licenses are subject to basic price regulations, with Class 1 licenses having more severe restrictions on basic price increases. Part 3 licenses are not subject to basic price regulations to give cable companies an additional incentive to operate in smaller markets in rural areas.

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 regulates via licensing 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, the CRTC requires that at least 50% to 60% of cable company programming has "Canadian content" (i.e., shows about or produced in Canada, or staring or produced by Canadians). Prior to 1999, the profits of cable companies came mainly from cable services. Eastlink became the first cable company in Canada to offer telephone service in 1999, which signalled the start of a wave of "convergence" between television, phone, and internet services in Canada.

Firm size, in terms of national subscribership, plays an important role in determining the channel costs of cable companies. Various empirical studies of the U.S. cable television industry find larger firms are charged lower "affiliation payments" by channel companies (Ford and Jackson (1997), Chipty and Snyder (1999), Crawford and Yurukoglu (2012)). This is because of vertical integration between large cable companies and channel providers, and because 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 the cost structures of cable companies. Moreover, cost differentials among 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.

Firm size 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, which the basic cable price caps help ensure. 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 involves improved channel offerings in Appendix B.2.

3 Data

The primary data sources are the CRTC Master Files for the 1990-1996 period. They contain detailed information on revenues, costs, and subscriberships of firms 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. The key variables include basic and non-basic prices, channel counts, and subscribership. Importantly, data on the CRTC-approved maximum basic cable price a cable company charge for a given license and year is reported. These maximum approved rates are determined by the basic price regulations outlined above. 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 license demand for the extended basic and specialty cable tiers. I also use annual license-level data on the number of homes passed (i.e., the total number of people connected to the local cable system), total non-basic affiliation payments made from cable companies to upstream channel providers, and non-content cost data on salaries, administrative expenses 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 second data source is the CRTC's Decision and Notices archives. For each license, the CRTC maintains searchable online archives at http://www.crtc.gc.ca/eng/dno.htm for all license-ownership related decisions from 1984 onwards. 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 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, and the licenses involved.

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 Appendix B.2.

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 $x_{1990} = x_{1991}$.

3.1 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.

Table 1 highlights acquisition activity in the industry and among the ten largest cable companies 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 their national subscribership in 1996.[8] 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 acquisitions by large companies result in an increase in their share of national subscribership and license ownership. Over the sample period, national subscribership among the large firms rises from 55.39% to 84.74%, and the share of licenses owned nearly doubles from 21.58% to 41.08%.

[8] 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.

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 consists of 908 Class 1 licenses, 817 Class 2 licenses and 1999 Part 3 licenses. The sample includes 195 license acquisitions.

Table 2 presents basic summary statistics for licenses where both basic and non-basic cable is offered ("two-bundle" licenses), and licenses where only basic cable is offered ("one-bundle" licenses). In one-bundle licenses, 85% of consumers sign-up for basic cable and pay $22.13 for 15 basic cable channels on average. Consumers in two-bundle licenses 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 licenses, monthly non-cable content related costs in terms of labor and operating costs (technical plus administrative expenses) are $3.42 and $12.78 per-subscriber, respectively. The corresponding figures for one-bundle licenses are $1.94 and $15.54 for one-bundle licenses, indicating that additional cable tiers involve additional labor expenses.

The license size and demographics data show that two-bundle licenses are much larger, and have higher average income, income volatility and urban density than one-bundle licenses. The average license 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 licenses.

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 licenses. The differences in channel counts are pronounced, with large firms roughly offering five more basic channels in one-bundle licenses, and two and five more basic and non-basic channels in two-bundle licenses. 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 licenses. In particular, 37% (46%) and 44% (35%) of consumers respectively purchase basic and non-basic cable in two-bundle licenses operated by large (small) firms. Finally, the averages for per-subscriber affiliation payments for non-basic cable in two-bundle licenses is $0.52 higher in licenses served by small firms. This finding suggests firm size effects in non-basic bundle costs since larger firms realize lower marginal costs despite offering more channels in their non-basic bundles on average.

4 Reduced-form analysis of acquisition and firm size effects

In this section, I empirically examine changes in basic and non-basic prices, channel counts, shares and non-basic affiliation payments around acquisitions.[9] The analysis is based on the following regression equation that predicts a dependent variable y_{mkt} (i.e., prices, channels, shares, affiliation payments) for license m served by cable company k at time t:

$$y_{kmt} = \beta_0 + \beta_1 A_{mt} + \beta_2 Q_{kt} + \mathbf{X}_{kmt}\beta_3 + \epsilon_{kmt} \tag{1}$$

For each dependent variable, I separately estimate (1) for two and one-bundle licenses. The covariates of interest are a dummy variable A_{mt} which equals one if license m is acquired in year t and all years thereafter, and the horizontal size of firm k in license m in year t, Q_{kt}. The vector of controls $\mathbf{X}_{kmt}$ 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 year and license fixed effects in $\mathbf{X}_{kmt}$ as well the final term, ϵ_{kmt}, 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.

4.1 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 licenses; 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) yields 3.30 additional basic channels. The insignificant impact of acquisitions on basic prices

[9] I focus on licenses that do not experience a change in the number of bundles offered. Only 18 out of 784 licenses see a change in the number of bundles. None of these changes correspond to an acquisition.

could partly be explained by basic price regulation, if acquiring firms are unable to increase basic cable prices in conjunction with offering more basic channels following acquisitions. There is also a statistically significant relationship between acquisitions and basic license shares; shares are predicted to rise by 5.4% with acquisitions. This likely stems from the fact that basic prices tend not to change with acquisitions, while basic channel counts tend to rise.

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 licenses. Focusing on the column (2) estimates, only non-basic prices have a statistically significant relationship with acquisitions. The estimate indicates a \$3.12 non-basic price increase following an acquisition. The lack of basic price and channel count responses to acquisitions could partly be driven by basic price regulation. If firms are unable to jointly increase basic cable prices and channel counts with acquisitions, they may elect to adjust unregulated non-basic prices and channel counts to generate rents from acquired licenses. The firm size coefficients for basic and non-basic prices and channel counts are all statistically significant at conventional levels. They suggest larger firms charge lower prices, offer more channels, and realize higher license shares. Interpreting the magnitude of the coefficients, a five hundred thousand subscriber increase in a license's cable operator size yields \$0.14 and \$0.97 lower basic and non-basic prices, and 0.084 and 1.08 additional basic and non-basic channels.

The affiliation payment regression coefficient estimates in column (2) are both statistically significant, but have opposite signs. Monthly per-subscriber affiliation payments tend to rise by \$1.48 with acquisitions. To the extent that higher quality (i.e., in terms of television ratings) channels demand higher affiliation payments, this estimate could partly be driven by increasing non-basic bundle quality with acquisitions. A five hundred thousand subscriber increase in a license's cable operator corresponds to \$0.71 lower affiliation payments. Recalling that an equivalent firm size increase is associated with 1.08 additional non-basic channels, the coefficient estimates indicate that larger firms are able to offer more channels in their cable bundles at lower monthly cost per-channel, per-subscriber.

Taken together, the reduced-form acquisition and firm size effects suggest channel counts should rise in licenses where a large cable company acquires a smaller one. The direction and magnitude of price and affiliation payment changes following acquisitions by large cable companies is less clear. The coefficients indicate prices and channel costs should rise with acquisitions, possibly due to an increase in cable bundle quality. The firm size coefficients indicate prices and channel costs should fall, possibly due to the ability of large firms to obtain affiliation payment discounts from channel companies. Large cable operators may also have managerial or operational efficiencies that reduce their license-level labor and operating costs, which would enable them to charge lower cable prices.

It should be evident that there are lot of "moving parts" to consider in evaluating cable company acquisitions empirically. Prices, channel counts, license shares, and costs are jointly determined, and are directly or indirectly affected by license heterogeneity, firm heterogeneity, firm size effects, and basic price regulation. These rich empirical relationships motivate the use of a structural model to examine how firm heterogeneity, firm size, and regulatory factors underly acquisition outcomes.

5 Multi-product monopoly model

This section develops a model of the cable television industry in Canada. Following the CRTC's exclusive licensing and basic cable price regulations, I assume cable operators are local monopolists within their licenses who potentially face basic cable price caps (if they operate in a Class 1 or Class 2 license). The primary motivation for using a structural model is that it allows me to quantify the impact consolidation has on cable prices, bundles, and welfare. A secondary benefit is I can conduct additional counterfactual simulations with the estimated model to measure the economic impact of basic price regulation.

5.1 Demand

The utility consumer i obtains from subscribing to cable bundle j in license m in year t is given by:

$$\begin{aligned} u_{ijmt} &= t_i q_{jmt} - p_{jmt} + z^0_{jmt}\beta_0 + \xi_{jmt} + \epsilon_{ijmt} \\ &= t_i q_{jmt} + \delta_{jmt} + \epsilon_{ijmt} \end{aligned} \tag{2}$$

where $\delta_{jmt} = -p_{jmt} + z^0_{jmt}\beta_0 + \xi_{jmt}$, and content quality and prices for cable bundle j are denoted by q_{jmt} and p_{jmt}. The other components of the utility function include consumer i's vertical preference for cable content t_i, non-cable content related factors that affect consumers' tastes $z^0_{jmt}\beta_0$, and consumer i's idiosyncratic horizontal preference shock for bundle j ϵ_{ijmt}. Importantly, I allow for unobserved heterogeneity in non-content quality, ξ_{jmt}, that both consumers and firms account for when making their decisions. Cable bundles are indexed by $j = 0$ (the outside good), $j = 1$ (basic cable), and $j = 2$ (non-basic cable). The number of bundles offered in license m at time t, J_{mt}, is taken as exogenous. While the number of channels vary over time within-licenses (particularly following acquisitions), the number of bundles offers rarely changes in the sample, so I take J_{mt} as given throughout.

I normalize the deterministic part of the outside option utility to 0 since I do not observe characteristics of the outside good such as the number of over-the-air channels or signal strength. Under this normalization, ξ_{0mt} completely accounts for the outside good quality. The coefficient on bundle prices in the utility function is fixed to one. This normalization defines the level of utility in terms of dollars, and allows me to estimate the variances of the vertical and horizontal preference shocks.

Consumers' vertical preferences for content quality are i.i.d draws from a Weibull distribution with license-specific scale and shape parameters λ_{mt} and ρ_{mt}. The Weibull distribution is attractive because it can flexibly model many single-peak distributions. Further, the Weibull assumption ensures that individuals' marginal utilities for cable quality are non-negative. I directly follow Chu (2010), and restrict λ_{mt} and ρ_{mt} to reasonable ranges by assuming the following functional forms:[10]

$$\lambda_{mt} = \exp(z^1_{mt}\beta_1) \tag{3a}$$

$$\rho_{mt} = 0.1 + 14.9 \cdot \Big(\frac{\exp(z^2_{mt}\beta_2)}{1+\exp(z^2_{mt}\beta_2)}\Big) \tag{3b}$$

The horizontal preference shocks are i.i.d Type 1 Extreme Value distributed with zero mean and scale parameter σ^2. With the mean of the ϵ_{ijmt} distribution set to zero, δ_{jmt} is the mean non-content quality for product j in license m in year t, and ξ_{jmt} is the mean of the unobserved non-content quality.

A key part of the utility function is the cable content quality of bundle j. I specify consumers' perceived quality of basic and non-basic cable bundles as follows:

$$q_{1mt} = (z^3_{1mt}\beta_{31}) \cdot \log(x_{1mt})^2 \tag{4a}$$

$$q_{2mt} = (z^3_{1mt}\beta_{31}) \cdot \log(x_{1mt})^2 + (z^3_{2mt}\beta_{32}) \cdot \log(x_{2mt})^2 \tag{4b}$$

where x_{jmt} is the number of channels offered in bundle j in license m in year t.[11] The vector z^3_{jmt} for $j = 1, 2$ contains dummy variables for individual cable operators (discussed in the next section), and a dummy variable that equals one if the firm serving license m in year t is a multi-system operator (MSO). The bundle-j specific vector β_{3j} for $j = 1, 2$ allows consumers to have different responses to additional channels in basic and non-basic cable bundles offered by large national cable providers (such as Rogers or Shaw), relative to other cable operators. Allowing for firm-specific differences is important if channel quality differs among national cable companies and single-system operators. This specification also accounts for complementarities between firm-specific branding effects and the number of channels in a bundle.

This is an aggregate quality measure since the quality of cable bundle j is a function of the individual qualities of the channels in bundle j. My use of this aggregate measure reflects the main limitation of my data, namely that license- or firm-specific channel identities are not available. This prevents me from estimating channel-specific effects on bundle quality as previous authors have done with U.S. data on channel identities (Crawford (2000), Crawford and Yurukoglu (2012)). An alternative approach to modelling bundle quality in the absence of channel data is to treat quality as an unobservable, and infer the values

[10] My specification of demand heterogeneity keeps with Chu (2010) in two ways: (1) I model the vertical and horizontal preference shocks as Weibull and and Type-1 Extreme Value distributions; and (2) I adopt the same functional forms for λ_{mt} and ρ_{mt}. Keeping my specification close to Chu (2010) facilitates Canada-U.S. comparisons from the 1990s between the two papers. Like Chu (2010), I find this specification of λ_{mt} and ρ_{mt} results in distributions in the scale and shape parameters that are roughly symmetric across license-years.

[11] I keep with Chu's (2010) specification in using the squared log of channel counts in my cable quality measure. This yields diminishing marginal utility in cable quality with non-extreme curvature for small values of x_{jmt} that ensure interior solutions to cable operators' profit maximization problem described below.

of q_{jmt} that rationalize observed cable prices and license shares (see Crawford and Shum (2006) or Byrne (2010a)). However, such an approach significantly complicates the use of Berry, Levinsohn, and Pakes's (1995) share inversion algorithm to recover unobserved non-content cable quality ξ_{jmt}.[12] Recovering this unobserved heterogeneity is necessary for addressing the first-order concern of the impact unobserved non-content quality has on consumer demand, and the pricing and bundle quality decisions of companies. Given these difficulties, and the importance of accounting for unobserved non-content quality in estimation and counterfactuals, I estimate a demand model that uses my channel count data, and allows for firm-specific differences in consumers' marginal utility from additional basic and non-basic channels. In discussing my findings below, I outline the shortcomings of this approach.[13]

Consumers choose the cable bundle that maximizes their utility from their local menu of cable bundles $\{(p_{jmt}, q_{jmt})\}_{j=1}^{J_{mt}}$. Conditional on an individual's vertical type t_i, the license share in license m for bundle j can be computed directly using a standard logit formula:

$$s_{jmt}(t_i) = \frac{\exp\left(\frac{t_i q_{jmt} + \delta_{jmt}}{\sigma}\right)}{\sum_{j'=1}^{J_{mt}} \exp\left(\frac{t_i q_{j'mt} + \delta_{j'mt}}{\sigma}\right)} \tag{5}$$

The license share for bundle j can be computed by integrating (5) over the vertical type distribution:

$$s_{jmt} = \int s_{jmt}(t_i) f(t_i; \lambda_{mt}, \rho_{mt}) dt_i \tag{6}$$

Denoting Q_{mt} at the exogenously given total potential subscribers in license m, license demand for bundle j is the share times license size: $Q_{jmt} = s_{jmt} Q_{mt}$.

5.2 Supply

Turning to the supply-side of the model, the marginal cost of offering cable bundle j to an additional consumer in license m in year t consists of per-channel cable content costs c^x_{jmt}, non-content labor costs c^L_{jmt}, and non-content operating costs c^O_{jmt}:

[12] Specifically, if one treats q_{jmt} and ξ_{jmt} as unobserved to the econometrician, then for any value of q_{jmt} one can find a ξ_{jmt} that equates the model's predicted license shares for bundle j in license m at time t to its empirical counterpart. This implies that ξ_{jmt} cannot be recovered using Berry, Levinsohn, and Pakes's (1995) share inversion algorithm alone if q_{jmt} is treated as an unobservable.

[13] Beyond my lack of data on the identity of channels within bundles, a secondary motive for using a single quality index: it greatly reduces the dimensionality of the firm's profit-maximization problem. Modelling the optimal bundling choices of firms is a high dimensional problem that 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 (2012)), it can be problematic for conducting counterfactual simulations where the solution to firms' optimal bundling problem must be found. Chu, Leslie, and Sorensen (2009) examine how simple pricing rules based on bundle size can serve as a good approximation to firms' optimal bundling decisions that otherwise suffers from a curse of dimensionality. Using a single quality index thus greatly simplifies simulating outcomes with the model, which is sufficiently complex in its own-right in this model, given the need to account for basic cable price regulation.

$$
\begin{aligned}
mc_{jmt}(x_{jmt}) &= x_{jmt} \cdot c^x_{jmt} + c^L_{jmt} + c^O_{jmt} \\
&= \underbrace{x_{jmt} \cdot (\gamma_{xj} w^0_{mt} + \zeta^x_{jmt})}_{\text{content costs}} + \underbrace{\gamma_{Lj} w^1_{mt} + \zeta^L_{jmt} + \gamma_{Oj} w^2_{mt} + \zeta^O_{jmt}}_{\text{non-content costs}} \qquad (7)
\end{aligned}
$$

where $c^x_{jmt} = \gamma_{xj} w^0_{mt} + \zeta^x_{jmt}$, $c^L_{jmt} = \gamma_{Lj} w^1_{jmt} + \zeta^L_{jmt}$, and $c^O_{jmt} = \gamma_{Oj} w^2_{jmt} + \zeta^O_{jmt}$. The covariates that affect content costs, and non-content labor and operating costs are $w^0_{mt}, w^1_{mt}, w^2_{mt}$. The bundle-$j$ specific cost parameters to be estimated are $\gamma_{xj}, \gamma_{Lj}, \gamma_{Oj}$, and $\zeta^x_{jmt}, \zeta^L_{jmt}, \zeta^O_{jmt}$ are unobserved cost shocks. This rich specification of firms' cost function for offering cable services reflects the availability of content and non-content cost information in the data. Like Chu (2010) and Crawford and Yurukoglu (2012), I abstract from fixed costs in providing cable content.[14]

Recall that x_{jmt} is the number of channels in bundle j, and c^x_{jmt} is the marginal affiliation cost per-channel in bundle j (which I observe for non-basic cable). Thus, $x_{jmt} \cdot c^x_{jmt}$ is the *total* per-subscriber affiliation payment for cable bundle j. The findings from Table 4 suggests that the per-subscriber affiliation costs from an additional channel is potentially affected by: (1) firm-specific heterogeneity, possibly due to differences in the average per-channel quality in a company's basic and non-basic bundles; and (2) firm size effects that reduce firms' per-channel affiliation payment conditional on bundle quality.

In specifying the covariates in Section 6.1, I allow for these different factors that affect the affiliation payments of firms. If dominant cable companies offer higher quality bundles, all else equal, I expect they will pay higher affiliation payments per channel. In choosing the number of channels to offer in a bundle, these firms trade-off firm-specific cost effects from the γ_{xj}'s in equation (7) against the additional revenues they can earn from offering higher quality bundles. Recall bundle quality is determined by both the number of channels offered and firm-specific effects (i.e., β_{31} and β_{32}) in equations (4a) and (4b). Since I do not explicitly model the bundling decisions of firms, I carefully interpret and caveat the shortcomings of these firm-specific content cost and bundle quality effects in discussing my results throughout Section 7.

I further assume non-basic per-subscriber labor and operating non-content costs are analogous to their basic cable counterparts, plus an additional per-subscriber cost-premium:

$$c^L_{2mt} = c^L_{1mt} + \gamma_{L2} + \zeta^L_{2mt} \qquad (8a)$$

$$c^O_{2mt} = c^O_{1mt} + \gamma_{O2} + \zeta^O_{2mt} \qquad (8b)$$

where γ_{L2} and γ_{O2} are incremental non-basic non-content labor and operating costs. This is a reasonable specification since consumers must first purchase basic cable before purchasing non-basic cable. This

[14] My labor and operating cost measures may contain some fixed-cost components. However, I find both total labor and operating costs scale with the total number of subscribers in a license. Further, I find virtually no evidence of a negative and decreasing relationship between average labor and operating costs, and the total number of subscribers, as one might expect if labor or operating costs had a large fixed cost component. For these reasons, I treat per-subscriber labor and operating costs as constant marginal costs.

tying requirement implies that per-subscriber non-basic non-content costs necessarily encompass basic non-content costs. These incremental non-basic non-content costs capture the additional labor, administrative and technical costs for serving each non-basic cable subscriber. Since these incremental costs are not observed in the data, I treat them as parameters to be estimated.

5.3 Profit-maximization and regulation

Cable companies know the distributions for t_i and ϵ_{ijmt}, but not individuals' vertical types or horizontal preference shocks. Firms choose prices and quality $\{(p_{jmt}, q_{jmt})\}_{j=1}^{J_{mt}}$, or prices and channel counts $\{(p_{jmt}, x_{jmt})\}_{j=1}^{J_{mt}}$, to maximize expected profits subject to the CRTC's basic price regulation:

$$\max_{\{(p_{jmt}, x_{jmt})\}_{j=1}^{J_{mt}}} \pi_{mt} = \sum_{j=1}^{J_{mt}} \Big[(p_{jmt} - mc_{jmt}(q_{jmt}))s_{jmt}Q_{mt}\Big] \qquad (9)$$

$$\text{s.t. } p_{1mt} \leq \bar{p}_{1mt}$$

where $\bar{p}_{1mt}$ is the price cap that is determined by the CRTC's national basic price regulation formula. Recall that these price caps, as well as basic cable prices, are reported in the CRTC Master Files data.

A richer structural model of basic price regulation would encode the CRTC-defined rules from Section 2 that determine each license's price caps. While the 80% of inflation growth per-year part of the price cap formula is well-defined, the rules related to financial distress and major capital investments are substantially more complicated and far less formulaic. Because I simply use the price-cap data, and do not explicitly model these price-cap rules, I must caveat some of quantitative results over the impact of consolidation and price regulation in Section 7.

6 Empirical implementation

This section motivates the covariates used in the structural model, and develops an estimation strategy. I also informally discuss identification of the demand- and supply-side parameters.

6.1 Covariates

The non-content utility shifters in z^0_{jmt} include a constant ($Const$); year dummies ($Year_t$); province dummies ($Prov_m$), and a dummy variable for basic cable ($Basic_{jmt}$). These covariates allow for differences in non-content utility for basic and non-basic cable, as well as year and province-specific differences in cable demand.[15] The covariates in z^1_{mt} that affect the *scale* of the vertical type distribution include a constant; license-level measures of average household income (Inc_{mt}), and urban density (Urb_{mt}), and a dummy that equals one if license m has two good/bundles in the first year it is observed in the sample ($2Goods_m$). The covariates in z^2_{mt} that affect the *shape* of vertical taste shock distribution include a constant; license-level

[15] I have experimented with specifications that include firm-specific dummies in z^0_{jmt} for the dominant national cable operators. I find these firm-specific non-content utility coefficients are not well-identified when I include firm-specific bundle quality coefficients. Moreover, their inclusion has a negligible impact on my results.

total population (Pop_{mt}); the variance in household income within a license ($IncVar_{mt}$), and the two-bundle license dummy variable $2Goods_m$. The demographics exogenously affect the level and variability of cable demand. I expect licenses with higher average household income and lower urban density to have larger demand for cable.[16] Larger licenses, and licenses with more income variability are expected to have a larger degree of heterogeneity in individuals' vertical preferences for cable. I include $2Goods_m$ in z^1_{mt} and z^2_{mt} to account for any systematic differences in consumer preferences across one- and two-good licenses.

The variables in z^3_{jmt} that affect individuals' marginal utility from additional basic and/or non-basic channels include a constant; a dummy variable that equals one if bundle j is non-basic ($NonBasic_{jmt}$); a multi-system operator (MSO) dummy variable that equals one if a license's cable provider is a MSO (MSO_{mt}), and dummy variables for each of the largest 11 cable companies ($Firm_{mt}$).[17] In estimation, I constrain the coefficient on the constant to equal one, and freely estimate the coefficient on $NonBasic_{jmt}$. This allows consumers' marginal utility from additional basic channels to differ from additional non-basic channels. I expect consumers to value additional non-basic channels more than basic channels. The inclusion of firm fixed effects and the MSO dummy in z^3_{jmt} allows for firm-specific differences in consumers' tastes for additional channels, possibly due to differences in offered channel quality among national cable companies, and small single-system cable operators. I allow firm-specific bundle quality effects to differ for basic and non-basic cable.

Given basic cable channels in Canada mainly consist of local programming and broadcast channels during the sample period, I expect relatively smaller firm-specific effects for basic cable quality; both national cable companies and small locally-owned cable operators tend to offer these types of channels in their basic cable bundles. Conversely, I expect the firm-specific effects to be pronounced for non-basic cable bundles that include popular channel-types (such as sports and movie channels) that generally require higher affiliation payments from cable operators to channel companies. Historically, national cable providers in Canada like Rogers and Shaw tend to offer more diverse non-basic cable programming than small companies. Thus, dominant firms are more likely to have large firm-specific bundle quality effects.

The cable content-related marginal cost shifters, w^0_{mt}, include a constant; the logarithm of the number of subscribers a cable company serves nationally ($FirmSize_{mt}$); the MSO dummy; year dummies, and firm-specific dummy variables for the 11 largest firms. This specification allows firm size to affect affiliation costs at a diminishing rate. The positive relationship between the firm size of a license's cable operator, and the number of basic and non-basic channels offered found in Section 4 suggests that larger firms have

[16] Consumers in cities have more options for entertainment and substitutes to watching cable television than do consumers in rural licenses. I therefore expect consumers' demand for cable to rise as urban density falls.

[17] 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.

lower per-channel costs, thereby enabling them to offer more channels. Apart from any firm size effects, the inclusion of the firm dummy variables for the largest national cable providers captures any per-channel affiliation cost differences among these firms due to differences in cable content quality. For reasons just discussed, I expect the firm-specific effects for per-subscriber basic cable content costs to be relatively muted since all firms offer similar basic cable channels in the 1990s in Canada. Firm-specific effects in content costs are likely more pronounced for non-basic cable since national cable companies historically offer more popular, and hence more expensive, channels than locally owned cable operators

The per-subscriber non-content labor and operating cost covariates for basic cable, w^1_{mt} and w^2_{mt}, both include average household income; urban density; the MSO dummy; channel capacity ($ChanCap_{mt}$); cable system size (the number of homes passed by the system) ($SysSize_{mt}$); total kilometres of cable used by a system ($KmCab_{mt}$); year dummies; firm dummies for the larges 11 cable companies, and province dummies.[18] Licenses with higher average income are expected to have higher wages, and thus higher labor and operating costs. Higher license-level urban density should reduce labor and operating costs if there are economies of scope to serving customers who live closer to each other.

The three cable system covariates account for systematic differences in labor and operating costs across cable systems of different size and density. Note that in addition to firm size, cable system size, channel capacity and total kilometres of cable used are excluded from demand, and serve as demand instruments for prices and quality in estimation. The inclusion of firm-specific fixed effects in the content and non-content related cost functions exploits the availability of data for each of these components of firms' cost functions. Importantly, I allow for different types of firm heterogeneity on the supply-side of the model. In evaluating consolidation effects, these differential firm-specific effects potentially have separate important quantitative implications. Preliminary regression analyses using these data suggest that national cable providers realize lower per-subscriber labor or operating costs on average, suggesting that certain firms are relatively cost-efficient in managing their licenses. The year and province dummies account for any time- or province-specific differences in labor and operating costs across license-years.

6.2 Estimation

Collecting parameters, I denote the parameter vector $\theta = [\beta_0 \; \beta_1 \; \beta_2 \; \beta_3 \; \sigma \; \gamma_x \; \gamma_L \; \gamma_O]'$, where each element stacks all the parameters over all the relevant indices described in Section 5. For a given parameter vector, I first use the contraction-mapping method of Berry, Levinsohn, and Pakes (1995) to find the mean utility $\hat{\delta}_{jmt}$ that equates license shares in the data to those predicted by the model. With these mean utilities, I recover the unobserved non-content quality $\xi_{jmt} = \hat{\delta}_{jmt} + p_{jmt} - z^0_{jmt}\beta_0$.

[18]I have experimented with various other specifications of the non-content cost functions. The inclusion of other demographic controls that account for license-specific cost conditions such as total population or household size have minimal impact on the coefficient estimates without adding much explanatory power.

Given the inferred ξ_{jmt}'s, I turn to the supply-side of the model. Recall that I observe $c^x_{2mt}, c^O_{1mt}, c^L_{1mt}$ in the data, as well as with the exogenous variables that affect these costs. Given values for γ_{x2}, γ_{O1}, and γ_{L1}, I can compute the cost shocks of these cost components directly:

$$\zeta^x_{2mt} = c^x_{2mt} - \gamma_{x2} w^0_{mt}; \quad \zeta^O_{1mt} = c^O_{1mt} - \gamma_{O1} w^1_{mt}; \quad \zeta^L_{1mt} = c^L_{1mt} - \gamma_{L1} w^2_{mt}$$

To recover the remaining cost shocks, I use first-order necessary conditions that characterize firms' optimal price and channel count choice. Consistent with the CRTC's regulatory framework, I assume firms act as local monopolists within each license, and set prices and channel counts to maximize profits, subject to the CRTC's basic price caps. Like Chu (2010), I do not impose the first-order conditions for basic prices to account for any impact of basic price regulation. Let p_{mt}, x_{mt}, ξ_{mt} be licence m's $J_{mt} \times 1$ vectors of cable prices, channel counts, and unobserved non-content quality shocks in year t. Further, let $s_{jmt}(p_{mt}, x_{mt}, \xi_{mt}, \theta)$ be the model's prediction for bundle j's license share in license m in year t. The first-order condition for channel counts in one-bundle licenses is:

$$\frac{1}{Q_{mt}} \frac{\partial \pi_{mt}}{\partial x_{1mt}} = -s_{1mt}(p_{mt}, x_{mt}, \xi_{mt}, \theta) \cdot c^x_{1mt} + \frac{\partial s_{1mt}(p_{mt}, x_{mt}, \xi_{mt}, \theta)}{\partial x_{1mt}} \cdot [p_{1mt} - x_{1mt} c^x_{1mt} - c^L_{1mt} - c^O_{1mt}] = 0 \tag{10}$$

I can recover basic cable content costs c^x_{1mt} for one-bundle licenses from equation (10) since all other terms in the equation are data, or functions of data and parameters. Similarly in two-bundle licenses, I do not impost the first order condition for basic prices. The first-order equations for non-basic cable prices and channel counts in two-bundle licenses are:

$$\begin{aligned} \frac{1}{Q_{mt}} \frac{\partial \pi_{mt}}{\partial p_{2mt}} =& s_{2mt}(p_{mt}, x_{mt}, \xi_{mt}, \theta) + \frac{\partial s_{1mt}(p_{mt}, x_{mt}, \xi_{mt}, \theta)}{\partial p_{2mt}} \cdot [p_{1mt} - x_{1mt} c^x_{1mt} - c^L_{1mt} - c^O_{1mt}] \\ &+ \frac{\partial s_{2mt}(p_{mt}, x_{mt}, \xi_{mt}, \theta)}{\partial p_{2mt}} [p_{2mt} - x_{2mt} c^x_{2mt} - c^L_{1mt} - c^O_{1mt} - c^L_{2mt} - c^O_{2mt}] = 0 \quad (11a) \\ \frac{1}{Q_{mt}} \frac{\partial \pi_{mt}}{\partial x_{2mt}} =& - s_{2mt}(p_{mt}, x_{mt}, \xi_{mt}, \theta) \cdot c^x_{2mt} + \frac{\partial s_{1mt}(p_{mt}, x_{mt}, \xi_{mt}, \theta)}{\partial x_{2mt}} \cdot [p_{1mt} - x_{1mt} c^x_{1mt} - c^L_{1mt} - c^O_{1mt}] \\ &+ \frac{\partial s_{2mt}(p_{mt}, x_{mt}, \xi_{mt}, \theta)}{\partial x_{2mt}} \cdot [p_{2mt} - x_{2mt} c^x_{2mt} - c^L_{1mt} - c^O_{1mt} - c^L_{2mt} - c^O_{2mt}] = 0 \quad (11b) \end{aligned}$$

The unknowns in equations (11a) and (11b) are c^x_{1mt} (basic cable per-channel affiliation payments), c^L_{2mt}, and c^O_{2mt} (non-basic non-content labor and operating marginal costs). The non-content non-basic labor and operating costs, c^L_{2mt} and c^O_{2mt}, are co-linear in equations (11a) and (11b) (as well as in the first order conditions for basic cable prices and channel counts), implying I can only identify their sum: $c^{LO}_{2mt} = c^L_{2mt} + c^O_{2mt}$. I choose to recover c^x_{1mt} and c^{LO}_{2mt} from the non-basic price and channel count first-order equations, as opposed to using the basic channel count first-order equation, because there is more identifying variation in non-basic prices and channel counts across licenses and cable providers, and within-licenses around acquisitions. After recovering c^O_{1mt} and c^{LO}_{2mt} by inverting the first-order conditions for one- and two-bundle licenses, I can solve for the model's remaining cost shocks as follows:

$$\zeta^x_{1mt} = c^x_{mt} - \gamma_{x1} w^0_{mt}; \quad \zeta^L_{2mt} + \zeta^O_{2mt} = \zeta^{LO}_{2mt} = c^{LO}_{2mt} - (c^O_{1mt} + c^L_{1mt}) - (\gamma^L_2 + \gamma^O_2)$$

where recall both c^O_{1mt} and c^L_{1mt} are observed in the data. In estimating the model, I use the reduced-form error for the non-content related operating expenses for non-basic cable, ζ^{LO}_{2mt}, which is the sum of the structural errors ζ^L_{2mt} and ζ^O_{2mt}. Further, γ^L_2 and γ^O_2 are not separately identified, so I estimate their sum $\gamma^{LO}_2 = \gamma^L_2 + \gamma^O_2$, which is the total non-basic non-content cost premium.

I estimate the model by the Generalized Method of Moments (GMM). Collecting the demand-side instruments with the vector Z_{jmt}, I have

$$Z_{jmt} = [Const \;\; Basic_{jmt} \;\; Year_t \;\; Prov_m \;\; Firm_{mt} \;\; Inc_{mt} \;\; Urb_{mt} \;\; Pop_{mt} \;\; IncVar_{mt} \;\; 2Goods_m$$
$$MSO_{mt} \;\; FirmSize_{mt} \;\; SysSize_{mt} \;\; ChanCap_{mt} \;\; KmCab_{mt} \;\; Class2_{mt} \;\; Part3_{mt}]$$

Two sets of instruments are used for cable prices and quality: (1) the cost-side variables that are excluded from the demand equations ($FirmSize_{mt}$ $SysSize_{mt}$ $ChanCap_{mt}$ $KmCab_{mt}$); and (2) the regulatory class dummy variables ($Class2_{mt}$ and $Part3_{mt}$). The cost-side instruments, W_{jmt}, are analogous to Z_{jmt} but exclude the regulatory dummy variables, which I assume do not have a direct effect on content or non-content costs. I estimate the model by assuming that five sets of moment conditions hold:

$$E[\xi_{1mt}(\theta)Z_{1mt}] = E[\xi_{2mt}(\theta)Z_{2mt}] = 0$$
$$E[\zeta^x_{1mt}(\theta)W_{1mt}] = E[\zeta^x_{2mt}(\theta)W_{2mt}] = 0$$
$$E[\zeta^L_{1mt}(\theta)W_{1mt}] = E[\zeta^O_{1mt}(\theta)W_{1mt}] = E[\zeta^{LO}_{2mt}(\theta)W_{2mt}] = 0$$

Denote the error vector as $\omega(\theta) = [\xi'_1 \;\; \xi'_2 \;\; \zeta^{x'}_1 \;\; \zeta^{x'}_2 \;\; \zeta^{L'}_1 \;\; \zeta^{O'}_1 \;\; \zeta^{LO'}_2]'$, where each component stacks all the individual errors across all licenses and years. Let $X'\omega(\theta)$ be the the sample analogues to the five sets of moment conditions. The GMM estimator for θ solves:

$$\hat{\theta} = \arg\min_{\theta} \; \omega(\theta)' X V X' \omega(\theta) \tag{12}$$

where V is a weighting matrix. In Appendix B.1, I discuss how I calculate the GMM objective function, obtain an efficient two-step GMM estimate of θ, and simulate data with the model.

6.3 Identification

Chu (2010) estimates a similarly specified demand model by GMM with similar data on cable bundles. He provides an excellent discussion of identification of the demand-side parameters. Rather than repeat his detailed discussion, I briefly discuss identification of the demand parameters, and refer the interested reader to his paper for additional details.

The demand parameters, $\beta_0, \beta_1, \beta_2, \beta_3, \sigma$, are identified off of variation in the exogenous demand covariates (demographics, dummies for firms, years, and provinces), and observed substitution patterns among cable bundles and the outside good in response to exogenous variation in cable prices and channel counts (induced by the excluded supply-side and regulatory demand instruments). For example, higher values of σ results in less substitution among bundles in response to exogenous price and channel count changes (possibly due to license-level variation in cable operator size, system size, or regulatory status). Thus, observed changes in license shares in response to exogenous variation in prices and channel counts helps identify σ. The demand parameters also affect firms' optimal price and channel count choices (and hence mark-ups, and the degree of product differentiation among bundles) under the assumption that firms are profit maximizing local monopolists in their licenses. Thus, variation in observed prices, channel counts, and mark-ups also help identify the demand parameters.

A key novelty in my demand specification is the firm-specific bundle quality coefficients for basic and non-basic cable, β_{31} and β_{32}. These coefficients govern consumers' relative tastes for additional basic and non-basic channels across the many licenses owned by a given national cable company. For example, if β_{31} increases relative to β_{32} for Rogers, then consumers in Rogers's licenses increasingly prefer additional basic channels to non-basic channels. Thus, the observed rate at which Rogers's licenses' license shares for basic and non-basic cable change in response to exogenous variation in basic and/or non-basic channel counts (induced by the demand instruments) identifies the relative magnitudes of β_{31} and β_{32} for Rogers. Similar identification arguments hold for the 11 large cable companies that I estimate β_{31} and β_{32} for.

Recalling that $z^3_{jmt} = [Const\ MSO_{mt}\ NonBasic_{jmt}\ Firm_{mt}]$, an important normalization in estimation is the coefficient in β_{31} for $Const$ is set to one. That is, I fix the marginal utility of additional basic channels for consumers in licenses run by single-system operators, and freely estimate the remaining coefficients in β_{31} and β_{32}. Thus, differences in the rate at which license shares change in response to exogenous changes in channel counts (again, induced by the demand instruments) *across* licenses operated by different large cable companies, or by MSO and non-MSO operators, helps identify the coefficients in β_3. For example, if large companies like Rogers and Shaw offer higher unobserved per-channel average quality in their bundles than small single-system operators, then, all else being equal, we should see larger increases license shares in response to equivalent exogenous increases in basic and/or non-basic channel counts for Rogers and Shaw than for single-system operators. Such variation in the data is consistent with positive β_{31} and β_{32} values for national cable companies like Rogers and Shaw.

Having license-level data on cable operators' costs makes identification of various supply-side parameters quite transparent. The parameters in γ_{x2}, γ_{L1}, and γ_{O1} are directly identified off of variation in per-subscriber, per-channel non-basic affiliation payments; per-subscriber labor costs; per-subscriber operating costs, and variation in the exogenous cost shifters in w^0_{mt}, w^1_{mt} and w^2_{mt}. The identification of γ_{x1} and γ_{LO} is indirect and relies on the profit-maximization assumption for the licensed cable monopolists. Under this assumption, the parameters in γ_{x1} and γ_{LO} affect cable operators' optimal basic and non-basic price and channel choices. Thus, conditional on the observed non-basic affiliation payments, basic operating costs, and basic labor costs, γ_{x1} and γ_{LO} are identified off variation in prices and channel counts, and the basic cost shifters in w^0_{mt}.

7 Findings

7.1 Parameter estimates

Demand

The demand-side parameter estimates and standard errors are presented in Table 5. The year and province non-content dummies in the left panel of the table do not suggest significant differences in cable demand over time or across provinces. Licenses with more homes passed and higher variance in the household income distribution have more disperse vertical type distributions. Two-bundle licenses have statistically significantly larger scale vertical type distributions relative to one-bundle licenses.

Turning to the right panel of Table 5, the estimate for the constant in β_{32} of \$1.33 is statistically significant.[19] It implies that consumers receive an additional \$0.33 of surplus per-month from an extra non-basic channel relative to the normalized \$1 of surplus they receive from each basic channel. The MSO coefficient for non-basic cable is also significant and implies that MSOs provide \$0.08 more utility per non-basic channels per-month than single system operators. The estimates of the firm-specific coefficients in β_{31} indicate that consumers receive statistically significantly more utility from Videon's and C.F. Cable's basic channels. For these companies, an additional basic channel yields \$0.12 and \$0.23 of additional surplus beyond the \$1 baseline utility from each basic channel. For non-basic cable, seven of the 11 dominant national cable companies offer significantly higher per-channel cable quality. For example, the non-basic MSO and Rogers coefficients together imply that Rogers's non-basic channels yield \$0.32 additional monthly surplus beyond the \$1.33 baseline utility consumers obtain from each non-basic channel. These findings highlight the importance of accounting for firm heterogeneity in per-channel cable quality, possibly due to branding or firm-specific differences in bundle composition.

I can compute various welfare figures and elasticities of interest with the demand parameters. The sample average across all license-years for cable content utility, computed using observed channel counts, is \$16.90, which compares to the sample average of basic cable across license-years of \$19.87. Consumers' expected monthly surplus in one- and two-bundle licenses is \$2.81 and \$6.92 on average. The sample

[19] Recall the price coefficient in the utility function is normalized to one. This implies utility is in 1992 constant dollars.

medians across license-years for the estimated own-price elasticities of demand for basic and non-basic cable are -5.68 and -14.47. The basic own-price elasticity estimate is comparable to estimates from the U.S. of -5.9 (Chipty (2001)) and -4.12 (Crawford and Yurukoglu (2012)).

Supply

The three panels in Table 6 present the parameter estimates and standard errors for the content, non-content labor, and non-content operating cost functions. Firm size and MSO status have statistically insignificant effects on basic per-channel, per-subscriber content costs. The fixed effects for the largest 11 cable companies are also insignificant. As alluded to above, these findings may be due to: (1) large and small cable companies mainly offer local programming and national broadcast networks in their basic bundles; and (2) the cost of offering these channels does not systematically vary across cable companies.

In contrast, the non-basic content cost function parameter estimates highlight economically and statistically significant effects of firm size, MSO status, and firm heterogeneity on non-basic content costs. Large cable companies and MSOs realize lower per-channel, per-subscriber content costs. Controlling for firm size and MSO status, the coefficients in γ_{x2} for the 11 largest cable companies reveal statistically significant firm-specific effects on non-basic content costs, except for C.F. Cable. The four largest companies, Rogers, Shaw, Cogeco and Vidéotron, have \$1.63, \$0.77, \$0.99 and \$1.45 *higher* monthly per-channel, per-subscriber content costs relative to the non-largest 11 companies. To the extent that (1) higher quality (i.e., more popular) channels demand higher affiliation payments, and (2) dominant cable operators offer higher quality non-basic channels, these firm-specific effects reflect compositional differences in large firms' bundle quality. The firm-specific effects for the large cable companies in the rural eastern Canada (Bragg and Fundy) and western Canada (Western Coaxial), imply these firms pay \$0.61, \$0.46 and \$0.83 *lower* content costs. This suggests these firms offer relatively lower per-channel non-basic cable quality.

The parameter estimates for the monthly per-subscriber non-content labor and operating costs in the second and third panels of Table 6 further highlight the impact of firm heterogeneity on cable costs. The second panel shows that eight of the 11 largest cable companies experience statistically significantly lower per-subscriber labor costs. Shaw and C.F. Cable have the largest labor cost savings of \$0.81 per-subscriber per-month, which are large relative to the \$2.05 baseline labor cost (i.e., the constant estimate in γ_L). The firm-specific coefficients in the third panel show that five of the 11 largest cable companies have statistically significantly lower per-subscriber operating costs. Shaw and Vidéotron have the largest operating cost discounts of \$1.94 and \$1.86 per-subscriber per-month, which are more than 15% of the \$10.97 baseline operating cost. Looking across the second and third panels of Table 6, Rogers, Shaw, Cogeco, and MacLean-Hunter have statistically and economically significant cost savings for both labor and operating costs. Some firms only realize significant labor cost efficiencies (Videon, Bragg, C.F. Cable), while others only exhibit operating cost efficiencies (Vidéotron, Bragg, Western Co-axial).

There are a few secondary results from Table 6 worth noting. Labor and operating non-content costs are significantly lower in licenses with higher urban density. This speaks to economies of scope in managing cable systems with dense customer networks. Cable systems with more homes passed have significantly higher labor costs, while cable systems with larger channel capacity have significantly higher operating costs. Quantifying the scale of predicted costs and profits from the model, the sample averages across license-years for predicted monthly per-subscriber content costs for basic and non-basic cable are $3.23 and $5.91. Average predicted non-content costs for monthly labor and operating expenses is $11.49 per-subscriber. The estimated incremental per-subscriber non-content cost for non-basic cable is $2.57. The median (mean) predicted profit margins in one- and two-bundle licenses are 28% (21%) and 30% (32%).

7.2 The impact of consolidation

Using the estimated model, I simulate outcomes with and without consolidation ("C" and "NC"), and with and without basic price regulation ("R" and "NR").[20] This yields four simulations, (C,R), (NC,R), (C,NR) and (NC,NR), which I use to quantify the impact of consolidation and basic price regulation. Throughout, I focus on licenses that were acquired at some point between 1990-1996, where both firm heterogeneity and firm-size effects drive consolidation outcomes.[21] Table 7 lists sample averages and standard deviations across these license-years for various outcome variables of interest for the (C,R), (NC,R), (C,NR) and (NC,NR) simulations.

I first discuss the impact of consolidation by comparing the (C,R) and (NC,R) simulation results in Table 7. In two-bundle licenses, basic prices fall by $0.54, non-basic prices rise by $0.08, and basic and non-basic channel counts rise by 0.61 and 2.8 channels under (C,R) relative to (NC,R). These consolidation-induced changes in prices and product quality result in 3% and 10% higher license shares for basic and non-basic cable. Monthly per-subscriber basic and non-basic content costs are $1.51 and $1.40 lower on average under (C,R), which indicates that the cost-reducing firm size effects tend to outweigh the cost-increasing firm-specific effects of dominant acquiring firms in determining the impact of consolidation on content costs. Basic non-content costs[22] fall by $1.53 per-subscriber per-month under consolidation; this is largely driven by the labor and operating cost efficiencies of dominant acquiring firms. The impact of consolidation on prices reflect the conflicting effects of acquiring firms' cost-reducing scale effects and

[20]Specifically, the consolidation simulations assume market structure evolves as observed in the data. The no consolidation simulations assume that each license's cable operator does not change over time. The regulation simulations assume cable companies maximize profits within each license subject to the CRTC basic price caps observed in the data. The no regulation simulations assume cable companies are unconstrained in maximizing profits in each license. Appendix B.1 provides details on how I find the license-level profit maximizing price and channel counts with and without basic price regulation.

[21]In total, 460 license-years see a consolidation-induced change in their original cable operator. Of these license-years, 381 are two-bundle licenses. Simulation results based on the entire sample are available upon request.

[22]"Basic non-content costs" are the sum of the monthly per-subscriber operating and labor costs. These affect the marginal costs of serving both basic and non-basic customers since the latter group must subscribe to basic cable prior to subscribing to non-basic cable as discussed above (and specified in equations (8a) and (8b)).

non-content cost efficiencies (which reduce prices), and their higher cable quality/channel counts (which put upward pressure on prices). Consolidation increases firms' average profitability by 64%, from \$5.52 to \$9.04 per-subscriber per-month.

The (C,R) and (NC,R) columns in the right panel of Table 7 list analogous predictions for one-bundle licenses. On average, basic prices fall by a negligible \$0.02 under consolidation, channel counts rise by 1.25 channels, and basic license shares increase by 4%. Monthly per-subscriber basic content costs and non-content costs fall by \$0.21 and \$0.61 on average, while profits increase by \$1.35 per-subscriber, per-month. Similar to two-bundle licenses, acquiring firms realize lower content marginal costs, which allows them to offer more basic channels in one-bundle licenses. Although cable quality rises with consolidation, the content and non-content cost efficiencies of the acquiring cable companies mitigates any corresponding price increases with improved cable quality.

Table 8 lists sample averages of mean consumer surplus, and consumer surplus at the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles of the vertical type distribution across acquired licenses. The first two columns of the table show that consolidation is consumer-welfare enhancing on average: mean consumer surplus rises from \$2.95 per-subscriber per-month under (NC,R) to \$6.10 under (C,R). This occurs because acquiring firms improve product quality, but do not drastically increase prices because of their content and non-content cost efficiencies. Consumer surplus rises across the various percentiles of the vertical-type distribution; however, consumers with stronger tastes for cable quality benefit more from the higher quality cable of acquiring firms. For example, consumers at the 10^{th} and 90^{th} percentiles realize an additional \$2.00 and \$4.32 of surplus per-month under (C,R) relative to (NC,R). In short, consolidation tends to increase both average consumer surplus and welfare inequality across consumers.

Table 9 presents sample averages of mean consumer surplus for four mutually exclusive groups of licenses, defined by the quartiles of the urban density distribution across acquired licenses. The main result from the table is that consumer welfare gains are largest in the most urban licenses. Mean consumer surplus rises by \$4.59 per-month on average among the top 25% most urban licenses. This reflects the fact that the two most dominant and active acquiring cable companies in the sample, Rogers and Shaw, tend to acquire licenses in more urban regions of Canada over time as they spread from their largest cable systems in Toronto and Vancouver.[23] These firms realize the largest content cost reducing scale effects, and have relatively large firm-specific labor and operating cost efficiencies. Thus, they are most able to increase channel counts, lower cable prices, and thereby deliver large welfare gains to consumers in relatively more urban licenses.

[23] See Byrne (2010a) and (2010b) for an in-depth analysis of how the dominant cable companies spread their cable systems spatially across Canada from the 1980s to the 2000s. The average urban density of the 460 license-years the simulations are based on is 485 persons per square kilometre (s.d.=560). Rogers's and Shaw's subsets of acquired licenses have average urban densities of 1124 (s.d.=777) and 738 (s.d.=652).

7.3 The effect of basic price regulation

Economic impact of regulation

Revisiting Table 7, I now contrast the (C,R) and (C,NR) simulations to quantify the impact of basic price regulation.[24] An immediate and important point of note is the non-negligible differences in predictions between the (C,R) and (C,NR) simulations. Accounting for basic price regulation in this context is quite important in generating predictions from the structural model and measuring the impact of consolidation.

Comparing the (C,R) and (C,NR) results in Table 7 for two-bundle licenses, I find that removing basic price regulation results in \$1.74 and \$1.62 higher basic and non-basic prices, little change in basic channel counts, and 0.35 additional non-basic channels. In one-bundle licenses, basic prices are \$2.56 higher and 2.53 additional channels are offered without basic price regulation. The net effect of these changes in prices and product quality is a 2% and 3% average decline in basic and non-basic license shares in two-bundle licenses, and a 7% average decline in license shares in one-bundle licenses. Basic and non-basic content costs increase slightly under (C,NR) in two- and one-bundle licenses. Cable companies earn additional profits of \$0.61 and \$1.29 per-subscriber per-month on average in the absence of basic price regulation.

Given the relatively large price increases and small changes in bundle quality under (C,NR) relative to the (C,R) simulation, we should expect consumer surplus to fall without basic price regulation. The (C,R) and (C,NR) columns in Table 8 confirm this intuition: the sample average of mean monthly consumer surplus is \$4.89 under (C,NR), a \$1.21 decline from its \$6.10 value under (C,R). Consumers at each percentile of the vertical type distribution realize similar welfare losses in the absence of price regulation. The last two columns in Table 9 show consumers in more urban dense licenses experience larger welfare losses without basic price regulation. For example, consumers in licenses in the bottom 25% and top 75% of the urban density distribution experience \$1.11 and \$1.41 declines in mean monthly surplus on average. This suggests that basic price regulation is relatively more effective at limiting consumer surplus extraction by dominant firms like Rogers and Shaw who, as discussed, tend to acquire urban licenses.

Regulatory effects on consolidation outcomes

Returning once more to Table 7, I evaluate the impact of basic price regulation on consolidation outcomes by examining the difference in the differences between (C,R) and (NC,R), and (C,NR) and (NC,NR). In two-bundle licenses, the impact of consolidation on prices is larger in the absence of price regulation. On average, acquisitions result in \$0.78 and \$1.12 lower basic and non-basic prices without price regulation. Under price regulation, consolidation results in \$0.54 lower basic prices, and a small

[24] I do not report simulation results for the entire sample to keep the number of tables and reported results manageable. The qualitative conclusions based on the full-sample and the sub-sample of license-years affected by consolidation are similar. The full-sample simulation results are available upon request.

$0.08 increase in non-basic prices. Conversely, the impact of consolidation on channel counts is larger with price regulation. Basic and non-basic channel counts rise by 0.61 and 2.8 channels with consolidation under regulation. Without regulation, consolidation results in a small 0.18 channel decrease in basic channels and 2.54 additional non-basic channels. Taken together, these results suggest that in an unregulated world with higher cable prices, acquiring firms' cost-reducing firm size and firm-specific non-content cost efficiencies play a larger role in reducing cable prices, and thereby increase license-level revenues for acquiring firms. In a world with price regulation, where acquiring firms are restricted in their ability to charge higher cable prices in general, consolidation has less impact on prices, and acquiring firms raise revenues by increasing cable quality vis-à-vis their content cost-reducing firm size effects. [25]

The consumer welfare effects in Table 8 contain two additional results of note regarding the impact of consolidation and regulation. First, the differences in the cross-license averages of mean consumer surplus, and surplus at all percentiles of the vertical type distribution between the (C,R) and (NC,NR) scenarios are large. For instance, average mean per-consumer surplus is $4.11 per month higher under (C,R), a more than 200% increase in mean consumer welfare of $1.99 under (NC,NR). These findings cast the policy choices of the CRTC during the 1980s and 1990s in a favorable light. The combination of the CRTC's choices to (1) regulate basic prices; and (2) take a laissez-faire stance in promoting acquisitions that generate cost efficiencies, together yield considerable welfare gains to cable subscribers.[26] Second, the magnitude of the consolidation-induced consumer surplus changes are slightly larger under basic price regulation. Thus, the ability of price regulation to encourage acquiring firms to generate additional revenues by offering higher product quality rather than through cutting prices indirectly benefits consumers.

7.4 Firm heterogeneity, firm size, and consolidation outcomes

This section presents results from three additional simulations, each of which is analogous to the (NC,R) counterfactual, except that either the firm specific content cost and quality dummies, the firm-specific non-content cost dummies, or firm sizes are set to their consolidation values. I label these the "content heterogeneity", "non-content heterogeneity", and "firm size" simulations.[27] The content heterogeneity simulation is intended to jointly account for the impact firm-specific bundle quality (either due to differences in bundle composition or branding) has on acquiring firms' costs and consumers' perceived changes in cable

[25] Similar findings emerge for one-bundle licenses. The consolidation-induced average basic price cut without regulation ($0.18) is larger than what it is under regulation ($0.02). In contrast, the consolidation-induced average channel count increase with regulation (1.25 channels) is large compared to the negligible -0.08 channel count change without regulation.

[26] This conclusion takes as given the CRTC's policy of licensing local monopolists. It is unclear what the welfare effects would be had the CRTC not originally pursued this policy, and instead allowed for competition in local cable television markets without imposing basic price regulation. Measuring the welfare gains from this alternative competition-based policy is well beyond the scope of this paper.

[27] To be precise, each simulation starts by setting all covariates to their values under no consolidation. "Content heterogeneity" additionally sets $Firm_{mt}$ to its values under consolidation in z^3_{1mt}, z^3_{2mt} (content quality covariates) and w^0_{mt} (content cost covariates). "Non-content heterogeneity" additionally sets $Firm_{mt}$ to its values under consolidation in w^1_{mt} and w^2_{mt} (labor and operating cost covariates). "Firm size" additionally sets $FirmSize_{mt}$ to its values under consolidation in w^0_{mt}. Throughout, the basic cable price caps observed in the data are a constraint in cable operators' profit maximization problems.

quality in acquired licenses. By analyzing the *changes* in the model's predictions between the (NC,R) counterfactual and each of these simulations, I can assess the relative importance of firm heterogeneity and firm size effects in driving consolidation outcomes.

Table 10 presents means and standard deviations for the simulated differences in cable bundles, costs, and profits between the (NC,R) simulation, and the baseline (C,R) simulation, content heterogeneity, non-content heterogeneity, and firm size simulations. Looking across the columns for two-bundle licenses, the magnitude of the differences are largest for the firm size simulation, highlighting how firm size effects on content costs simultaneously reduces prices and costs, and increases channel counts. Relative to the (NC,R) scenario, the content cost reducing firm size effects yield basic and non-basic prices reductions of $0.32 and $0.35; 0.19 and 3.98 more basic and non-basic channels; $1.45 and $6.03 lower basic and non-basic monthly per-subscriber content costs; and $2.86 higher profits per-subscriber, per-month.

Firm heterogeneity among the dominant acquiring cable companies also plays an important role in shaping consolidation outcomes. Firm-specific content cost and demand heterogeneity primarily affects non-basic cable; non-basic prices and content costs are $0.36 and $1.63 higher, and non-basic channel counts are 0.85 channels lower under the content heterogeneity simulation. Higher per-channel non-basic content costs of dominant acquiring firms cause them to charge higher cable prices and offer fewer channels. Further, the positive impact of large firms' demand-side firm-specific non-basic bundle quality effects (particularly for Rogers and Shaw) allows them to charge higher non-basic prices, offer less non-basic channels, and still maintain license share.[28] Under the non-content heterogeneity simulation, I find dominant acquiring firms' labor and operating cost efficiencies result in $1.53 lower monthly per-subscriber non-content costs. On average, these cost savings translate into $0.25 and $0.20 lower basic and non-basic prices, and $0.99 additional profits per-subscriber, per-month relative to the (NC,R) predictions.[29]

The change in consumer welfare relative to the (NC,R) scenario for the content heterogeneity, non-content heterogeneity, and firm size scenarios are listed in Table 9. The table reveals that the content heterogeneity effects of acquiring firms are largely responsible for consumer welfare gains from consolidation. The average change in mean consumer surplus relative to the (NC,R) scenario under the content heterogeneity counterfactual is $2.54 per-month. This is 81% of the overall $3.15 change in consumer surplus between the (C,R) and (NC,R) simulations. This change in mean consumer welfare is large relative to its predicted $0.21 and $0.40 changes under the non-content heterogeneity and scale effects simulations. Similarly, the magnitude of predicted changes in consumer welfare across the percentiles of the vertical type distribution are largest under the content heterogeneity simulation. The ability of dominant acquiring

[28] In fact, the content heterogeneity column in Table 10 for two-bundle licenses shows non-basic license share is 2% *higher* relative to the (NC,R) counterfactual.

[29] For one-bundle licenses, consolidation effects are mainly driven by the content cost reducing firm-size effects. Relative to (NC,R), the firm size simulation predicts content costs fall by $0.11, channel counts rise by 0.84, and prices rise by $0.10.

firms to improve per-channel quality through their firm-specific effects (either due to branding or bundle composition) is thus the main source of consumer welfare gains from consolidation.

7.5 Caveats

There are two important caveats of note. First, the parameters that govern the firm-specific content quality and cost effects in equations (4a), (4b), and (7) are “reduced-form.” They capture quality and content cost differences among the dominant firms that arise from: (1) dominant firms’ optimal choice of which channels to offer; and (2) bargaining between cable companies and channel providers over affiliation payments. Because I do not model these two decision processes (due to a lack of data on within-bundle channel identities), I cannot account for year-to-year changes in firm-specific bundle quality or content costs, nor can I examine how consolidation or price regulation affects bundling decisions of firms or how affiliation payments are bargained over. The firm-specific effects should thus be interpreted as short-run differentials in bundle quality and affiliation payments of dominant firms for the 1990-1996 period, where regulation, technology in the cable television industry, and the universe of channels available are relatively unchanged. These parameters would likely be change over longer time horizons due to technological change in telecommunications or new channel entry into the Canadian cable television market.

The second caveat pertains to potential interactions between acquisitions and the basic price caps. Acquisitions sometime result in acquiring firms investing in the cable infrastructure of acquired licenses. Under the price-cap rules, firms are granted higher basic price caps by the CRTC to help subsidize such investments on a case-by-case basis. This implies that, to some extent, acquisition events and price-caps cannot be assessed in isolation. This undermines my (NC,R) simulations where I assume no acquisitions occur, yet basic price caps are set to their values from the data. For those acquired licenses where capital investments resulted in loosened price caps, basic price caps would be lower/tighter under no consolidation than what is reported in the data. My reading of the individual CRTC acquisition files in constructing the dataset suggests that price-caps were loosened in some instances because of acquisition-related capital investments; however, price caps continue to be based on inflation follow acquisitions for the most part. While this is a caveat to my analysis, I suspect it has a relatively small impact on my quantitative results.[30]

8 Conclusion

This paper uses new data on cable bundles, license shares, and costs from the Canadian cable television industry to study the economic consequences of consolidation. I use complementary reduced-form and structural approaches to evaluate acquisition effects and investigate which demand- and supply-side features

[30] A further caveat regarding interactions between acquisitions and basic price regulation is that the observed acquisition process may be a function of basic price regulation. This would compromise my (C,NR) simulations since the market structure would change in absence of basic price regulation. Modelling the consolidation process and accounting for these interactions is well-beyond the scope of this paper, and is a topic I am currently working on (see Byrne (2010b)).

of the industry drive consolidation outcomes. I find large acquiring cable companies increase cable quality, reduce costs, and charge lower or similar prices in licenses they enter through acquisition, which ultimately results in non-negligible increases in profits and consumer welfare. Content cost reducing firm size effects are the main driver of consolidation outcomes quantitatively, while firm heterogeneity in demand and costs play a smaller but important role. Basic price regulation is consumer welfare enhancing overall, and plays a central role in shaping consolidation outcomes. In particular, acquiring cable companies tend to generate additional profits in acquired licenses by cutting prices from their relatively higher levels in the absence of price regulation. Under price regulation, acquiring firms tend to increase channel counts to generate additional revenues. Consolidation-based increases in consumer surplus is higher under the latter scenario, which points to an indirect benefit of price regulation from the perspective of consumers.

This article focuses on consolidation during a seven-year period from the 1990s because of the empirical convenience of studying local monopolies and the accessibility of rarely available on data on firms' costs and price caps imposed by the national telecommunications regulator. While this facilitates a uniquely rich evaluation of media mergers and regulation, it implies that the results must necessarily be viewed as capturing short-run effects of consolidation. Horizontal mergers among cable companies potentially have long-run consequences for negotiations over affiliation payments with upstream channel providers. If downstream cable companies become sufficiently dominant and are able to negotiate increasingly lower affiliation payments, channel providers potentially may exit the industry. In the long-run, this would result in less competition among channel providers, restrict programming variety, and thereby offset downstream consumer welfare gains derived from the cost efficiencies of large cable companies. An examination of the long-run impact of cable company mergers on vertical relations with channel providers is an area for future research. It is particularly important given the continued evolution of market structure in the cable television industry, as telecommunication service providers experience technological convergence.

A Tables

Table 1: Acquisitions and License 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.

Table 2: Estimation Sample Summary Statistics

	Two-Bundle Licenses		One-Bundle Licenses	
	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 License Share	0.43	0.30	0.85	0.18
Non-Basic License 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. Labor 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.

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

	Two-Bundle Licenses			One-Bundle Licenses		
	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 License Share	0.37	0.46	$< 0.01^{**}$	0.85	0.85	0.786
	(0.30)	(0.30)		(0.14)	(0.19)	
Non-Basic License 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. 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.

Table 4: Reduced-Form Relationship Between Acquisitions and Firm Size, and Cable Bundles and Costs

One-Bundle Licenses ($N = 844$)	Basic Prices (1)	Basic Prices (2)	Basic Channels (1)	Basic Channels (2)	Basic Share (1)	Basic Share (2)		
A_{mt}	-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)		0.460		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 Licenses ($N = 2692$)	Basic Prices (1)	Basic Prices (2)	Basic Channels (1)	Basic Channels (2)	Basic Share (1)	Basic Share (2)		
A_{mt}	-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 Licenses ($N = 2692$)	Non-Basic Prices (1)	Non-Basic Prices (2)	Non-Basic Channels (1)	Non-Basic Channels (2)	Non-Basic Share (1)	Non-Basic Share (2)	Affil. Payments (1)	Affil. Payments (2)
A_{mt}	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. 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 (a cable company's total number of subscribers across all of its licenses). All dollar amounts are in 1992 constant dollars.

Table 5: Demand-Side Parameter Estimates and Standard Errors

	Non-Content Utility, Vertical and Horizontal Preference Parameters				Content Utility Parameters		
	Covariate	Estimate	Std. Error		Covariate	Estimate	Std. Error
β_0	Constant	8.962**	1.291	β_{31}	MSO Dummy	0.052	0.157
	1990	0.527	1.465		Rogers	0.013	0.146
	1991	1.333	1.404		Shaw	0.018	0.117
	1992	0.843	1.412		Cogeco	0.230	0.849
	1993	1.232	1.396		Vidéotron	0.067	0.051
	1994	1.715	1.453		Bragg	0.003	0.055
	1995	1.097	1.490		Regional	0.181	0.679
	Nova Scotia	0.999	5.076		MacLean-Hunter	0.244	0.934
	New Brunswick	0.225	1.507		Videon	0.120**	0.043
	Québec	-0.706	1.146		C.F. Cable	0.233**	0.018
	Ontario	0.964	1.056		Western Coaxial	0.001	0.758
	Manitoba	0.865	1.510		Fundy	0.031	0.088
	Saskatchewan	1.001	1.041	β_{32}	Non-Basic Dummy	1.330**	0.063
	Alberta	0.168	2.773		MSO Dummy	0.076**	0.020
	British Columbia	-0.816	1.016		Rogers	0.238**	0.035
	Basic Bundle Dummy	1.525**	0.215		Shaw	0.153**	0.038
β_1	Constant	2.175**	0.262		Cogeco	0.150**	0.023
	Average Income	0.142	0.088		Vidéotron	0.064	0.053
	Urban Density	-0.094	0.136		Bragg	0.178**	0.040
	2-Good License	0.639**	0.071		Regional	0.133**	0.056
β_2	Constant	1.515*	0.752		MacLean-Hunter	0.036	0.031
	Homes Passed	0.481**	0.162		Videon	0.120+	0.073
	Variance in Income	0.357*	0.163		C.F. Cable	0.005	0.038
	2-Good License	0.378	0.540		Western-Coaxial	0.166**	0.011
σ_ϵ		1.216**	0.076		Fundy	0.001	0.011

Notes: Number of observations is 3723. All nominal amounts are in 1992 constant dollars. **, *, + indicate statistical significance at the 1, 5, and 10 percent levels. Average income and income variance are demeaned. Urban density and homes passed are divided by their sample means. Efficient 2-step GMM standard errors are reported in parentheses.

Table 6: Supply-Side Parameter Estimates and Standard Errors

	Covariate	Estimate	Std. Error		Covariate	Estimate	Std. Error		Covariate	Estimate	Std. Error
γ_{x1}	Constant	0.257**	0.052	γ_L	Constant	2.055**	0.337	γ_O	Constant	10.971**	0.998
	Firm Size	-0.101	2.778		Average Income	0.016	0.058		Average Income	0.285	0.193
	MSO Dummy	-0.024	1.456		Urban Density	-0.056^{+}	0.031		Urban Density	-0.173*	0.081
	1990	0.005	2.500		MSO Dummy	-0.167	0.117		MSO Dummy	-0.501	0.352
	1991	-0.002	2.189		Channel Capacity	-0.001	0.003		Channel Capacity	0.024**	0.010
	1992	-0.021	2.273		Homes Passed	0.253**	0.060		Homes Passed	-0.098	0.162
	1993	-0.015	2.120		Total KM of Cable	0.073	0.061		Total KM of Cable	-0.170	0.166
	1994	-0.015	1.960		1990	-0.047	0.156		1990	-0.806^{+}	0.461
	1995	-0.020	1.806		1991	-0.228	0.151		1991	-0.705	0.460
	Rogers	0.020	5.941		1992	-0.075	0.157		1992	-0.512	0.464
	Shaw	-0.005	3.982		1993	-0.072	0.151		1993	-0.328	0.460
	Cogeco	0.017	3.494		1994	0.008	0.151		1994	-0.267	0.461
	Vidéotron	-0.020	5.116		1995	0.038	0.152		1995	-0.095	0.462
	Bragg	-0.008	1.167		Rogers	-0.413**	0.173		Rogers	-1.162*	0.567
	Regional	0.007	5.526		Shaw	-0.812**	0.107		Shaw	-1.948**	0.312
	MacLean-Hunter	0.003	3.423		Cogeco	-0.368**	0.132		Cogeco	-1.150**	0.357
	Videon	0.016	3.480		Vidéotron	0.142	0.130		Vidéotron	-1.866**	0.341
	C.F. Cable	-0.020	2.531		Bragg	-0.380	0.239		Bragg	-1.312^{+}	0.696
	Western Coaxial	-0.019	1.918		Regional	-0.375	0.259		Regional	0.941	1.275
	Fundy	0.007	9.694		MacLean-Hunter	-0.649**	0.159		MacLean-Hunter	-1.171**	0.342
γ_{x2}	Constant	1.420**	0.104		Videon	-0.764**	0.234		Videon	-1.404	1.037
	Firm Size	-0.921**	0.068		C.F. Cable	-0.812^{+}	0.450		C.F. Cable	0.068	1.409
	MSO Dummy	-0.302**	0.093		Western Coaxial	-0.431	0.314		Western Coaxial	-1.465**	0.491
	1990	0.004	0.091		Fundy	-0.406	0.286		Fundy	-0.359	0.882
	1991	-0.039	0.090		Nova Scotia	-0.581**	0.226		Nova Scotia	-1.619**	0.646
	1992	-0.096	0.089		New Brunswick	-0.488^{+}	0.294		New Brunswick	-0.942	0.928
	1993	-0.224**	0.085		Québec	-0.522**	0.208		Québec	-1.275**	0.540
	1994	-0.250**	0.085		Ontario	-0.206	0.202		Ontario	-1.532**	0.555
	1995	-0.162^{+}	0.085		Manitoba	-0.292	0.238		Manitoba	-0.343	0.899
	Rogers	1.632**	0.134		Saskatchewan	-0.512*	0.253		Saskatchewan	-0.735	0.675
	Shaw	0.766**	0.092		Alberta	-0.501**	0.212		Alberta	-1.295*	0.639
	Cogeco	0.987**	0.129		British Columbia	-0.091	0.208		British Columbia	-0.690	0.598
	Vidéotron	1.450**	0.114	γ_{LO}		2.575^{+}	1.362				
	Bragg	-0.613**	0.041								
	Regional	0.963**	0.342								
	MacLean-Hunter	0.716**	0.107								
	Videon	0.642**	0.270								
	C.F. Cable	0.707	0.646								
	Western Coaxial	-0.834**	0.051								
	Fundy	-0.462**	0.101								

Notes: Number of observations is 3723. All nominal amounts are in 1992 constant dollars. **, *, + indicate statistical significance at the 1, 5, and 10 percent levels. Average income and income variance are demeaned. Urban density, homes passed, and per-subscriber labor cost and operating cost are divided by their sample means. Firm size is in terms of 250,000 subscribers. Efficient 2-step GMM standard errors are reported in parentheses.

Table 7: Consolidation and Regulation Effects on Cable Bundles, Costs and Profits

	Two-Bundle Licenses				One-Bundle Licenses			
	C,R	NC,R	C,NR	NC,NR	C,R	NC,R	C,NR	NC,NR
Basic Price	22.78	23.32	24.52	25.30	23.38	23.40	25.94	25.78
	(7.13)	(7.45)	(6.25)	(6.09)	(5.59)	(6.17)	(5.39)	(5.59)
Non-Basic Price	34.37	34.29	35.99	37.11				
	(8.56)	(9.12)	(8.37)	(7.48)				
Basic Channel Count	20.05	19.44	20.03	20.21	16.28	15.03	18.81	17.48
	(4.42)	(4.62)	(4.22)	(4.44)	(4.96)	(3.94)	(5.65)	(5.44)
Non-Basic Channel Count	8.31	5.51	8.66	6.12				
	(5.62)	(5.11)	(5.63)	(5.19)				
Basic Share	0.31	0.28	0.29	0.30	0.84	0.80	0.77	0.73
	(0.29)	(0.27)	(0.29)	(0.28)	(0.17)	(0.22)	(0.14)	(0.19)
Non-Basic Share	0.46	0.36	0.43	0.31				
	(0.39)	(0.37)	(0.38)	(0.36)				
Basic Content Cost	2.14	3.65	2.21	3.83	3.28	3.49	3.78	4.06
	(1.50)	(1.05)	(1.58)	(1.14)	(0.97)	(0.97)	(1.12)	(1.31)
Non-Basic Content Cost	5.46	6.86	5.74	7.46				
	(3.67)	(2.53)	(3.89)	(2.84)				
Basic Non-Content Cost	10.78	12.31	10.78	12.31	11.53	12.14	11.53	12.14
	(1.10)	(0.92)	(1.10)	(0.92)	(1.33)	(0.88)	(1.33)	(0.88)
Per-subscriber Profit	9.04	5.52	9.65	6.25	7.27	5.92	8.56	7.10
	(7.24)	(6.02)	(7.12)	(5.94)	(4.46)	(4.48)	(4.56)	(4.53)

Notes: Number of observations is 460 license-years, 381 of which are two-bundle Licenses. Sample averages and their corresponding standard deviations (in parentheses) across license-years are reported. All amounts are in monthly, per-subscriber terms except for license shares. All dollar amounts are measured in terms of 1992 constant dollars. "C", "NC", "R", and "NR" represent the Consolidation, No Consolidation, Regulation and No Regulation scenarios as described in the body of the paper. The columns (C,R), (NC,R), (C,NR), and (NC,NR) correspond to combinations of the model's predictions with and without consolidation and/or basic price regulation.

Table 8: Consolidation and Regulation Effects on Consumer Welfare, by Vertical Preference Type

	C,R		NC,R		C,NR		NC,NR	
Mean CS	6.10	(1.72)	2.95	(0.51)	4.89	(1.64)	1.99	(0.39)
CS p10	2.25	(1.31)	0.25	(0.42)	1.35	(1.23)	-0.50	(0.36)
CS p25	3.91	(1.53)	1.46	(0.45)	2.80	(1.45)	0.55	(0.36)
CS p50	5.94	(1.76)	2.79	(0.51)	4.69	(1.68)	1.77	(0.38)
CS p75	8.24	(1.97)	4.44	(0.59)	6.89	(1.88)	3.41	(0.46)
CS p90	10.25	(2.14)	5.93	(0.70)	8.84	(2.05)	4.87	(0.56)

Notes: Number of observations is 460 license-years, 381 of which are two-bundle Licenses. CS pn refers to the sample average of Consumer Surplus at the n^{th} percentile of the vertical type distribution across license-years. The corresponding sample standard deviations to these averages are reported in parentheses. All amounts are in monthly, per-subscriber terms, and are measured in terms of 1992 constant dollars. "C", "NC", "R", and "NR" represent the Consolidation, No Consolidation, Regulation and No Regulation scenarios as described in the body of the paper. The columns (C,R), (NC,R), (C,NR), and (NC,NR) correspond to combinations of the model's predictions with and without consolidation and/or basic price regulation.

Table 9: Consolidation and Regulation Effects on Consumer Welfare, by License Urban Density

	C,R		NC,R		Difference (C,R)-(NC,R)		C,NR		Difference (C,R)-(C,NR)	
Urb p0-p25	6.62	(1.58)	3.67	(0.59)	2.96	(1.55)	5.58	(1.61)	1.04	(0.32)
Urb p25-p50	5.93	(1.77)	2.71	(0.48)	3.21	(1.71)	4.66	(1.65)	1.27	(0.45)
Urb p50-p75	5.40	(1.34)	2.66	(0.48)	2.73	(1.26)	3.96	(1.06)	1.44	(0.50)
Urb p50-p100	8.03	(1.82)	3.44	(0.57)	4.59	(1.76)	5.84	(1.46)	2.19	(0.66)

Notes: Number of observations is 460 license-years, 381 of which are two-bundle Licenses. Urb p$n1$-p$n2$ refers to the sample average of mean consumer surplus across licenses between the $n1$ and $n2$ percentile of the urban density distribution across acquired licenses. The corresponding sample standard deviations to these averages are reported in parentheses. All amounts are in monthly, per-subscriber terms, and are measured in terms of 1992 constant dollars. "C", "NC", "R", and "NR" represent the Consolidation, No Consolidation, Regulation and No Regulation scenarios as described in the body of the paper. The columns (C,R), (NC,R), and (C,NR) correspond to combinations of the model's predictions with and without consolidation and/or basic price regulation.

Table 10: Determininants of Consolidation Effects: Firm Heterogeneity and Firm Size

	Two-Bundle Licenses				One-Bundle Licenses			
	Consolidation (C,R)	Content Hetero.	Non-Content Cost Hetero.	Firm Size	Consolidation (C,R)	Content Hetero.	Non-Content Cost Hetero.	Firm Size
Δ Basic Price	-0.54	-0.00	-0.25	-0.32	-0.01	-0.05	-0.03	0.10
	(3.97)	(3.76)	(0.81)	(1.11)	(1.30)	(1.38)	(0.23)	(0.33)
Δ Non-Basic Price	0.08	0.36	-0.20	-0.35				
	(4.75)	(3.21)	(2.72)	(3.50)				
Δ Basic Channel Count	0.60	0.22	0.10	0.19	1.25	0.54	0.14	0.84
	(3.24)	(2.31)	(1.72)	(2.36)	(3.36)	(2.30)	(0.45)	(2.61)
Δ Non-Basic Channel Count	2.80	-0.85	0.07	3.98				
	(5.29)	(4.71)	(1.83)	(5.46)				
Δ Basic Share	0.02	0.01	0.02	0.00	0.04	0.03	0.01	0.01
	(0.19)	(0.13)	(0.11)	(0.12)	(0.11)	(0.10)	(0.04)	(0.02)
Δ Non-Basic Share	0.10	0.02	0.02	0.07				
	(0.24)	(0.19)	(0.11)	(0.19)				
Δ Basic Content Cost	-1.51	-0.03	0.01	-1.45	-0.21	-0.03	0.03	-0.11
	(1.40)	(0.49)	(0.32)	(1.36)	(0.39)	(0.45)	(0.11)	(0.26)
Δ Non-Basic Content Cost	-1.40	1.63	0.02	-6.03				
	(3.45)	(3.31)	(0.97)	(7.24)				
Δ Basic Non-Content Cost	-1.53	0.00	-1.53	0.00	-0.60	0.00	-0.60	0.00
	(1.17)	(0.00)	(1.17)	(0.00)	(0.86)	(0.00)	(0.86)	(0.00)
Δ Per-subscriber Profit	3.52	0.73	0.99	2.86	1.35	0.57	0.50	0.19
	(4.93)	(4.34)	(1.02)	(4.41)	(2.60)	(2.20)	(0.71)	(0.39)

Notes: Number of observations is 460 license-years, 381 of which are two-bundle Licenses. Sample averages and their corresponding standard deviations (in parentheses) across license-years are reported. All amounts are in monthly, per-subscriber terms except for license shares. All dollar amounts are measured in terms of 1992 constant dollars. All values are changes in outcome variables relative to a baseline scenario of No Consolidation and Regulation (NC,R) as described in the body of the paper. "Consolidation" is the change from going to the Consolidation and Regulation (C,R) scenario. "Content Hetero" is the change from allowing consolidation-induced changes in firm-specific cable quality heterogeneity and content cost heterogeneity. "Non-Content Hetero" is the change from allowing consolidation-induced changes in firm-specific non-content labor and operating costs. "Firm Size" is the change from allowing consolidation-induced changes in firm size on content costs.

Table 11: Determininants of Consolidation Effects on Consumer Welfare: Firm Heterogeneity and Firm Size

	Consolidation		Content Hetero		Non-Content Hetero		Scale Effects	
Δ Mean CS	3.15	(1.67)	2.54	(1.67)	0.21	(0.49)	0.40	(1.04)
Δ CS p10	1.51	(1.24)	1.34	(1.24)	-0.02	(0.19)	-0.01	(0.88)
Δ CS p25	2.19	(1.48)	1.88	(1.48)	0.04	(0.34)	0.16	(0.96)
Δ CS p50	3.17	(1.71)	2.54	(1.71)	0.22	(0.58)	0.43	(1.14)
Δ CS p75	4.05	(1.91)	3.20	(1.91)	0.35	(0.77)	0.63	(1.34)
Δ CS p90	4.75	(2.08)	3.73	(2.08)	0.44	(0.94)	0.77	(1.51)

Notes: Number of observations is 460 license-years, 381 of which are two-bundle licenses. Δ CS pn refers to the sample average of the change in Consumer Surplus at the n^{th} percentile of the vertical type distribution across license-years. The corresponding sample standard deviations to these averages are reported in parentheses. All amounts are in monthly, per-subscriber terms, and are measured in terms of 1992 constant dollars. All values are changes in outcome variables relative to a baseline scenario of No Consolidation and Regulation as described in the body of the paper. "Consolidation" is the change from going to Consolidation and Regulation. "Content Hetero" is the change from allowing consolidation-induced changes in firm-specific cable quality heterogeneity and content cost heterogeneity. "Non-Content Hetero" is the change from allowing consolidation-induced changes in firm-specific non-content labor and operating costs. "Firm Size" is the change from allowing consolidation-induced changes in firm size on content costs.

B Supplemental Appendix (Not for Publication)

B.1 Computational details

I numerically evaluate the integral in equation (6) that defines each cable bundle's license share using 100 draws from a Halton sequence with a different prime number seed for each license-year. Halton sequences have substantially better coverage properties than machine-generated pseudo random number generators (Train (2003)). This reduces the variance of the simulated license share estimates, and enables me to use fewer draws in computing license shares to speed up computation.

The unobserved heterogeneity in non-content quality ξ_{jmt} is recovered using the contraction mapping algorithm from Berry, Levinsohn, and Pakes (1995). Let s_{mt}, p_{mt}, q_{mt} and δ_{mt} be the $J_{mt} \times 1$ vectors of license shares, prices, channel counts, and mean non-content qualities for license m in year t. Further define $\hat{s}_{mt}(p_{mt}, q_{mt}, \delta_{mt}, \theta)$ as the model's predictions for license shares for a given δ_{mt} and parameter vector θ. Berry, Levinsohn, and Pakes (1995) show the δ_{mt} that solves the non-linear system of equations $\hat{s}_{mt}(p_{mt}, q_{mt}, \delta_{mt}, \theta) = s_{mt}$ can be found using the following contraction mapping:

$$\delta_{mt}^{h+1} = \delta_{mt}^{h} + \ln(s_{mt}) - \ln(\hat{s}_{mt}(p_{mt}, q_{mt}, \delta_{mt}, \theta)) \tag{13}$$

I iterate on this mapping until convergence, defined where $\|\delta_{mt}^{h} - \delta_{mt}^{h+1}\| < 1 \times 10^{-6}$. For a given set of demand parameters, I find the mapping converges rapidly, and that the value of the fixed point is similar if stricter convergence tolerances are used. With the fixed point of (13) in hand, I can compute the unobserved non-content quality for $j = 1, 2$ as $\xi_{jmt} = \delta_{jmt} + p_{jmt} - z_{jmt}^{0}\beta_0$.

I obtain the GMM estimate of θ defined in equation (12) in several steps. First, I obtain starting values for the structural demand estimates $\theta_d = [\beta_0\ \beta_1\ \beta_2\ \beta_3, \sigma]'$ by minimizing a GMM objective function based on the demand moments only. That is, I solve for: $\hat{\theta_d} = \arg\min_{\theta_d}\ \xi(\theta_d)' X_d V_d X_d' \xi(\theta_d)$ where $X_d'\xi(\theta_d)$ consists of the sample analogs of the demand-side moment conditions $E[\xi_{1mt}(\theta) Z_{1mt}] = E[\xi_{2mt}(\theta) Z_{2mt}] = 0$, as defined in Section 6.2. For a weighting matrix, I use $V_d = (N^{-1} \sum_{i=1}^{N} X_i' X_i)^{-1}$ where X is 2×1 block-diagonal matrix, where both diagonal elements is Z, the matrix of demand instruments from Section 6.2. Second, I obtain starting values for the parameters of per-subscriber per-channel content cost function (γ_{x2}) by regressing c_{2mt}^{x} on $w_{mt}^{0} = [Const\ \ FirmSize_{mt}\ \ MSO_{mt}\ \ Firm_{mt}]$. Similarly, I obtain starting values for the parameters of the per-subscriber basic labor and operating costs (γ_{L1} and γ_{O1}) by separately regressing c_{1mt}^{L} and c_{1mt}^{O} on the covariates that determine their value in the structural model, $w_{mt}^{1} = w_{mt}^{2} = [Inc_{mt}\ \ Urb_{mt}\ \ MSO_{mt}\ \ SysSize_{mt}\ \ ChanCap_{mt}\ \ KmCab_{mt}\ \ Year_t\ \ Prov_m\ \ Firm_{mt}]$. Finally, using these starting values for $\beta_0, \beta_1, \beta_2, \beta_3, \sigma, \gamma_{x2}, \gamma_{L1}, \gamma_{O1}$, I solve the optimization problem from equation (12). I have experimented with various starting values for the other structural parameters (γ_{x1} and γ_{LO}) to ensure robustness of the estimation routine. The reported parameter estimates and standard errors in the paper correspond to optimal 2-step GMM estimates. I obtain these estimates and standard errors by following standard procedures outlined in Wooldridge (2010), section 14.3 p. 532-535. In computing the asymptotic variance of the efficient GMM estimator, I use 300 Halton draws to simulate license shares, and evaluate the numerical derivatives equations (10),(11a), and (11b) . I use the Differential Evolution (Storn and Price (1997)) global optimization routine to minimize the GMM objective function in equation (12). I also use Differential Evolution to minimize the GMM objective function based on demand moments to obtain starting values for $\beta_0, \beta_1, \beta_2, \beta_3, \sigma$.

When simulating data with the model, I use (constrained) Simulated Annealing to find the prices and channel counts that maximize cable operators' profits defined by equation (9), both under basic price regulation and without regulation. The choice of starting values has little effect on the profit-maximizing price and channel count vectors in each license-year.

All calculations are performed on a Linux Workstation with 8 Xeon X5620 processors, and 24 GB of RAM. Where possible, I parallelize my code for any calculations that can be independently performed across license-years. This includes the contraction mapping iterations to recover the ξ_{jmt}'s, and solving for cable operators' (constrained) profit-maximizing prices and channel counts.

B.2 Example CRTC acquisition file

Figure 1: 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

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