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EXPLORING THE FEASIBILITY OF RURAL BROADBAND COOPERATIVES: The NEW New Deal?

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ABSTRACT

The advancement of the internet has been revolutionary in dissemination of information, increasing connectivity, and expanding commerce. However, sufficient access to and utilization of high-speed internet (i.e., broadband) stand in stark contrast in urban and rural areas. New Deal programs in the early 1900s supported the development of rural electric cooperatives to provide electricity to rural residents. Can the development of rural broadband cooperatives similarly address this infrastructural technology barrier? Using a rural region in Northern New York, we consider the investment and operational costs of a rural broadband cooperative and determine service prices to members for which the cooperative is financially viable. Cash flows were highly negative under existing market prices. Indeed, high-speed prices would need to increase nearly 140% for the business to be financially feasible. In a cooperative business setting, and recognizing grant restrictions for a minimum-speed/maximum-price option, the results indicate of a high level of subsidization by high-speed users to low-speed users to support the business. More reasonable feasibility scenarios exist for existing utility cooperatives to expand services into broadband. In particular, areas with a high proportion of high-speed, year-round users suggest existing market prices can support a financially feasible cooperative business approach.

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Exploring the Feasibility of Rural Broadband Cooperatives: The NEW New Deal?

The development of the internet on society has been compared to the growth of the interstate highway system, the construction of the electric grid, and the advancement of the television. However, internet providers are less likely to offer high-speed internet to lesser-populated rural areas as the returns on investment are insufficient. Cooperatives have a history of providing services such as electricity and telephone services to rural communities throughout the United States. Many utility cooperatives were formed in the 1930s when it became apparent that investor-owned utility companies serving urban areas would not extend services to rural areas. Access was deemed a necessity for economic development and as a means to recover from the economic downturn of the Great Depression. New Deal legislation in the 1930s, such as the Rural Electrification and Communications Acts of 1934, channeled low-interest government loans to utility cooperatives to provide power and telephone services to rural communities. Many of these cooperatives continue to exist today.

In this light, can the development of rural broadband cooperatives (RBBCs) similarly address contemporary infrastructural technology barriers? Broadband refers to high-speed transmission of data over the Internet (Dickes, Lamie, and Whitacre 2010). The Hudson Institute (2016) reported that rural broadband (RBB) supported over $100 billion in e-commerce in 2015. However, much of the economic discussions are largely anecdotal and/or supported without rigorous analysis. In addition, the financial feasibility of RBB service companies across different business models remains largely unexplored, particularly when considering long-term rural development goals. If insufficient returns on investment due to low population densities proves a binding constraint to RBB expansion, does the cooperative business model, where users invest, patronize, and govern the business, better address the needs for rural America?

The Homeland Security Act of 2002 provided funding for broadband infrastructure to support the efforts of emergency responders. The Food, Conservation, and Energy Act of 2008 authorized grants, loans, and loan guarantees to improve access to broadband telecommunication services in rural areas. Funding from the American Recovery and Reinvestment Act (ARRA) of 2009 was made available to expand broadband access to unserved and underserved areas, including mandating the Federal Communications Commission's (FCC's) National Broadband Plan. The Connect America Fund (CAF) is a six-year plan (through 2020) financed through a cash infusion of $4.5 billion annually from the Universal Service Fund of the FCC. Funding is directed towards telephone companies to encourage them to provide or expand broadband access to census blocks identified by the FCC.

The United States Department of Agriculture's (USDA's) Rural Utilities Service (RUS) also administers a variety of applicable programs, with most funding made through allocations in the Farm Bill. Recent funded programs have included Community Connect Grants, Distance Learning & Telemedicine Grants, Telecommunications Infrastructure Loans and Loan Guarantees, Rural Broadband Access Loan and Loan Guarantee Program, and USDA Rural Development Block Grants (RDBGs).

Many rural areas have benefited from these sources of funding; however, ongoing funding from many are no longer available. To that end, numerous State and local government agencies continue to encourage and support the expansion of rural broadband. In particular to New York State (NYS), the *New* New York Broadband Program provides financial assistance to support broadband development. The program is administered through the NYS Broadband Program Office, a division of Empire State Development. Incorporated organizations, local government units, cooperatives, private corporations, and limited liability companies are eligible for funding. Applications for the funding must serve 250 units or all eligible unserved and underserved census blocks within a Regional Economic Development Council (REDC) region.[1] Applicants must agree on cost share provisions and offer minimum speeds of 25/4 Mbps download/upload at a monthly rate not to exceed $59.99 (and indexed to the Consumer Price Index).

Commercial lending sources and investors have also served as sources of funds. CoBank is a national cooperative bank that provides loans, leases, and financial services to agribusiness, rural power, water and communication providers throughout the United States. It is a member of the Farm Credit System and is chartered to support the capital needs of U.S. agriculture and rural economies. The U.S. Rural Infrastructure Opportunity Fund is a public-private partnership between CoBank, Capitol Peak Asset Management (CPAM), and the USDA. The fund is designed to complement existing government and grant programs by making capital investments in rural communities for, among other things, rural broadband (CoBank 2016).

The pool of existing RBBCs is relatively small lending some question to the reasonable extent of their ability to address this rural digital divide, but have been developed to address the unique characteristics of geographical areas and targeted subscribers. Recent efforts have included public-private partnerships and/or expansion of existing rural telecom services. For example, RS Fiber (www.rsfiber.coop) is cooperatively owned by residents living in 17 villages and towns in south central Minnesota. It evolved from a publicly owned municipal network to a community-based cooperative through municipal sale of Generally Obligated Tax Abatement Bonds. Spruce Knob Seneca Rocks Telephone (www.spruceknob.net), located in northern West Virginia, utilized funding from USDA Rural Development to bring fiber-to-the-home to all subscribers in its service area in 2012. Custer Telephone Cooperative (www.custertel.net) in Challis, Idaho created Custer Telephone Broadband Services, LLC as a wholly owned subsidiary of the cooperative to provide video, high-speed internet, and high-speed wireless access. They are also part of Syringa Networks, LLC, a joint venture with 12 rural telecoms to improve telecommunication and broadband services.

Valley Telephone Cooperative Inc. (www.vtx1.net) in Lyford, TX is another example where subsidiary companies were established to reach new communities and diversify services. In particular, these subsidiaries provide 1,500 route miles of fiber optic transport service to other telecommunication companies, including eight of the largest telecommunication companies in the United States. Finally, Maryland Broadband Cooperative (www.mdbc.us) works as an open-access transport company to provide universal, open-access to broadband services in Eastern, Southern, and Western Maryland by providing support to members who provide last-mile service. It is organized as a 501(C)(12) organization and has approximately 70 members who are characterized as last-mile providers. Members of the cooperative are service providers, not home or business owners. They do not resell internet services but provide the transport components to connect their members with Tier 1 internet providers.

Given available funding sources and recent RBB expansion efforts, the consideration of both new RBBC feasibility and the feasibility of expanded broadband service offerings with existing rural utility operators is important. Notably, of the nearly 900 rural electric cooperatives (RECs) in the United States, less than 10% are actively pursuing broadband services (Warren 2017), due in large part to state laws that prohibit them from offering this service (Mayberry 2017). Alternatively, nearly all of approximately 850 small, independent, rural telecoms (of which 260 are cooperatives) are providing some level of broadband

[1] NYS contains ten REDCs operated under the support of Empire State Development.

services, up from just 58% in 2000 (Wismer 2017). The ability to spread existing assets and fixed costs (e.g., overhead, trucks, equipment, poles, and skilled employees) over a larger range of services makes economic sense. In some areas of rural America, however, neither RECs nor rural telecoms currently exist. Further, the type of technology to install (e.g., digital subscriber line (DSL), satellite, cable, or fiber) is an important consideration as upload and download speeds and application to particular geographic conditions vary widely (Barnes 2010)[2]. Each comes with different costs and some can utilize existing technology (e.g., cable or dial-up) or infrastructure (e.g., poles).

To address these issues, we develop and apply an economic framework to consider the financial feasibility of a RBBC. We contribute to and extend the existing literature in four distinct ways. First, we consider a rural region in Northern New York (without existing RECs or rural telecoms) and collaborate with an existing broadband service provider in the area to design and cost (investment and operational) the RBB system, including bandwidth capacity and land use restrictions within the study area. Second, we utilize U.S. Census data on household incomes and residential housing to classify subscribers as low- or high-speed broadband users and with seasonal or year-round demands. Third, we adapt existing cooperative feasibility template software developed by Kenkel and Holcomb (2017) to incorporate RBBC-specific inputs; e.g., miles of construction, equipment needs, asset reinvestment, subscriber penetration rates, and investment and operational costs. Within our analytical framework we compare feasibility outcomes for a new RBBC and an existing utility cooperative expanding into broadband service. Finally, we provide a replicable framework for others to use under differing local conditions (broadband capacities, population densities, penetration rates, etc.) for broader application. While the work presented here has a narrow geographic focus, the process and results will be beneficial broadly for rural communities in assessing the potential for RBB infrastructure investments via a cooperative business model.

We continue with a discussion of the study area and the cost and revenue parameters included in our financial feasibility models. The results follow, including financial results under new and expanded cooperative scenarios and sensitivity analysis over a key underlying parameter – the proportion of subscribers demand higher-speed service. We close with the implications of our results and directions for future research.

Northern New York Study Area

We investigate the financial feasibility to expand high-speed fiber ($\geq$ 100 mbps) to unserved and underserved areas in four rural townships in Franklin County, NY (Figure 1). We were assisted in our efforts in design and cost parameters by Slic Network Solutions (SNS), a subsidiary of the employee-owned Nicholville Telephone Company. SNS currently provides high-speed fiber-to-the-home, along with phone service and cable television in Northern New York, but not in our geographical area of focus. The landscape of the area influences the number of people residing in and the density of housing units with interest in broadband access.

The Towns of Fort Covington and Westville are contiguous to the Canadian border. The land is mostly privately owned, relatively flat, and used as farmland or vacant rural land. Many of the residents live in single-family homes. The Towns of Duane and Franklin are located in the center and eastern portion of Franklin County, respectively, and inside the Adirondack Park. Much of the land is mountainous and forest-covered. A significant amount of land in Duane is part of the NYS Forest Preserve. Franklin is a mix of privately held land and the NYS Forest Preserve. The Town of Harrietstown is located in the

[2] See Schmit and Severson (2017) for an explanation of alternative technologies available for internet access.

southeast corner of Franklin County, inside the Adirondack State Park. It includes the Village of Saranac Lake.[3] Land in and around the village is privately owned and partially in the NYS Forest Preserve. Much of the area is mountainous and tree-covered. Many seasonal summer homes exist, as well as privately- and state-owned campsites. Many of the commercial businesses are geared towards supporting tourists and seasonal residents.

Overall, the project area is characterized by low population and housing densities. Each of the towns is similar in population (excluding the Village of Saranac Lake in Harrietstown) ranging from 1,100 to 1,800 people, with the exception of Duane with a population of only 174 (U.S. Census 2010, Table 1). Population densities are much higher in Fort Covington and Westville relative to Duane, Franklin, and Harrietstown. Considerable heterogeneity exists in terms of seasonal and year-round residential housing units, a characteristic not unexpected given the differences in tourism-related environmental amenities and public land across the county. In particular, around 24% and 39% of the housing units in Fort Covington and Westville are classified as seasonal, respectively; while over 85% of the homes in Duane, Franklin, and Harrietstown are seasonal (U.S. Census 2010, Table 2).

Approximately 25% of the households in the study area have children less than 18 years of age and/or persons older than 65 (U.S. Census 2010, Table 1). Nearly three-quarters of the households have incomes below the poverty guideline (Table 1). The Towns of Duane, Franklin, and Harrietstown have significant seasonal and recreational residences. Some of these residences are rustic and designed for seasonal use, while others are single-family homes with access to lakes and ponds or with scenic mountain views that can be used year-round.

A survey conducted by Litynski and Pflumm (2014) to residents in Franklin and Harrietstown (including the Village of Saranac Lake), found that approximately 80% of respondents had internet access, but less than one-half of them were satisfied with the internet speed delivered by their service provider ($N = 416$). Of those who were dissatisfied, 90% would purchase faster speed if available, 8% indicated that internet service was not available, and 2% suggested that internet access was cost prohibitive. Almost all survey participants utilized the internet to connect with family and friends through email and social media platforms, while over 80% utilized the internet for online banking and access to entertainment such as television and music. If available, approximately one-half would use the internet for continuing education, telecommuting, or as a resource to support their home-based business (Litynski and Pflumm 2014).

In May 2016, we interviewed thirteen people representing a range of views from business, education, government, and community perspectives in the study area. Interviews with representatives of the real estate, restaurant, and agriculture industries indicated that issues associated with access and service speeds were mixed. Frustration was expressed that current upload speeds were not sufficient and often time out before the file is sent. Persons spearheading economic development view high-speed internet as a means to strengthen existing cottage industries, such as artisans and crafters, and as a necessary tool to establish new enterprises. Businesses involved in the hospitality industry also need a stronger internet presence to promote their businesses and accept online reservations.

Interviews with representatives from educational industries (K12, college, cooperative extension) indicated efforts were being made to ensure each household with school-aged children has connectivity.

[3] Residents and businesses in the Village of Saranac Lake currently have access to high speed internet access. It is excluded from our analysis.

Currently, some students need to drive to ‘hot spots’ where they can access the internet. College and extension representatives expressed a strong need to improve connectivity for distance-learning opportunities for local youth, adults, and aspiring entrepreneurs. Tourism-based industry representatives expressed they are less competitive compared to other recreational areas because of a lack of consistent and sufficient broadband capacity. Those interested in spending time in the area want the connectivity. One of the questions often asked by buyers interested in purchasing property in the area is about the quality of broadband service, suggesting that a lack thereof will negatively affect real estate markets.

Notably, the Towns of Duane, Franklin, and Harrietstown are located within the Adirondack Park. Any land owned or acquired by the State of New York within these towns must be kept “Forever Wild.” As a result, some regulations can make the extension of utilities such as broadband connectivity a challenge. One way to mitigate this challenge is to install the fiber on existing infrastructure such as telephone and electric poles. Unit management plans in the Park denote that some areas will be maintained specifically for recreation, including skiing, hunting, fishing, hiking, camping, and mountain biking. For the region to remain competitive with other tourism options there is a need for improved connectivity. Tension exists between the desire to preserve the ‘Forever Wild’ nature of the area and balance the needs of persons living, visiting and working in the area.

Financial Analysis

This study focuses on the development of a cooperative to provide high-speed broadband access to unserved and underserved areas in Franklin County. Cooperatively structured businesses involve financial investments and governance responsibilities of the member-user owners. Generally, larger businesses, schools, and government customers have the means (and access) to pay for broadband service; whereas fiber-to-the-home in rural, less densely populated areas is less lucrative to broadband providers. The needs of businesses, institutions, and government have been reasonably met in the study area, leaving this research to focus specifically on fiber-to-the-home or premise. If a competitive alternative providing high quality service such as a broadband cooperative was formed, businesses, institutions, and government entities may opt to become cooperative members.

The lower density of subscribers in rural communities is one of the biggest challenges confronting businesses interested in broadband distribution. Even within rural communities, there can be large disparities in the number of potential subscribers per mile of infrastructure. In our study area, the Fort Covington/Westville area has 9.8 potential subscribers per mile of construction compared to Harrietstown with only 0.9 per mile (Table 2). In addition, the number of member-subscribers may not be sufficient to allow a broadband cooperative to be financially viable at existing market rates, requiring fees that are higher than competitor rates in adjacent geographical areas. An added layer of complexity involves the use of state and/or federal grants for construction or operational expenses that has covenants including maximum service prices for a minimum set of broadband services, and essentially implying a level of cross-subsidization by members to support overall financial operations.

We consider two monthly service-pricing options for high- and low-speed broadband users. First, we use comparable market prices near the study area combined with a common grant covenant. This assesses the financial feasibilities for the cooperative enterprise at existing prices (hereafter referred to as Market Prices or MP). Investigation of existing market prices for internet access near the study area ranged from \$110 for 50/5 mbps (download/upload), \$110 for 100/8 mbps, \$80 for 30/5 mbps, and \$59.99 for 15/1 mbps. For rural broadband projects to be eligible for grant funding under the New New York Broadband Program the provider must offer at least 25/4 mbps at or below \$60. Accordingly, our market pricing scenarios include a high-speed option (\$100) and a low-speed option (\$60). If the cooperative is financially infeasible at market prices, our second pricing option increases monthly service prices until the project cash flows over a ten-year planning horizon (hereafter referred to as Cash Flow Prices or CFP).

In addition to a monthly charge, members must make an upfront equity investment; in our case indifferent across members regardless of service speed demands. The initial capital investment cost is covered 80% by a grant, 10% by a term loan, and 10% by member investments. The individual member investment is computed by dividing the total member investment requirement by the expected number of initial members.[4] Subscribers joining the co-op in subsequent years are expected to make the same upfront equity investment.

Many activities occur when organizing a cooperatively structured business.[5] For the process of this financial analysis, we assume that Year 0 focuses on organizing the cooperative and securing the necessary financing, Year 1 includes the build out of the system, and full system operations and member sales initiated in Year 2 (Table 2). Some operational expenses are prorated in year 1 prior to system operation and covered by the initial grant, loan, and member investment.

Member Subscribers and Infrastructure

Estimating the number of member subscribers, service speed demands (high versus low speed), availability (year-round versus seasonal), and penetration rates (percent of potential subscribers that join) are crucial to the size, type, and cost of infrastructure needed to meet member demands. The baseline assumptions are displayed in Table 3 for the individual town areas and the combined region. The maximum number of subscribers is 1,604. The miles of fiber construction is almost double in the Fort Covington/Westville area compared to Franklin and Harrietstown; however, the number of potential subscribers is significantly higher in the Fort Covington/Westville than in the other locations, as indicated by the subscriber densities.

We assume that 20% of homes are seasonal in all towns except Harrietstown, where all homes are assumed to have year-round occupancy (Table 3).[6] Based on initial penetration rates, the number member subscribers in year 2 is estimated at 992, with 485 high-speed subscribers and 507 low-speed subscribers. With an assumed 2% annual growth rate in subscribers, the total number of members will reach 1,154 by year 10 (Figure 2). Subscriber growth is a key factor in improving the long-run financial condition of the cooperative. Note, that combining individual towns does not affect the miles of construction of the backbone and distribution components (Table 3), suggesting no opportunity for gains in scale economies.

Capital Structure and Operational Parameters

Recently, internet providers in Northern New York have secured grant funding for broadband projects through the New New York Broadband Program. Through this program, up to 80 percent of the project costs have been funded through the grant, with the remaining 20 percent sourced from other funders. Cooperative businesses require members to purchase membership rights, often included as one share of

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[4] Additional options may include differential member investments by type of customer (high versus low speed) or household income level. Since our cash flow pricing scenario computes the differential level of member payments by speed, we leave differential capital investment levels for future research.

[5] For a detailed set of activities and processes involved see Schmit and Severson (2017).

[6] This assumption differs from the seasonal home estimates provided in Table 1, but was suggested by SNS. Increasing the percentage of subscribers that are seasonal will reduce annual sales, as service charges for seasonal homes are limited to six months per year (Table 5). The distribution of seasonal versus year-round homes does not affect upfront member equity investment.

common stock for their ownership investment. Common stock signifies a member's commitment to utilizing the services provided by the cooperative. Funding from commercial lending sources is often necessary to capitalize the cooperative and where lenders often require that business owners, in this case members, have some minimal level of investment in the business. We assume that members provide 10% of the capital required, lenders provide an additional 10%, and grant funds cover the balance (80%).

Construction costs are shown in Table 4. Backbone, distribution, electronics, and subscriber installs are summed across towns. As mentioned above, this implies constant returns to scale in construction; i.e., no scale economies.[7] Total construction costs for the region is nearly $8.3 million. These totals include accounting for year 0 expenses associated with the member capital campaign and legal fees, as well as year 1 expenses for cooperative management and prorated expenses for utilities, pole rental, insurance, property taxes, and other miscellaneous. The total upfront member equity requirement is approximately $929 thousand, implying an individual member equity investment of $836.

Depreciation of capital assets is accounted for in the financial analysis using the modified accelerated cost recovery system (MACRS). Note that the depreciable basis of the initial assets is reduced by the amount of the grant used to purchase them. Fiber is assumed to have a useful life of 20 years, while electronics and subscriber installs are assumed to have a useful life of 7 years. No vehicles are included as maintenance and customer service costs are assumed to be covered under contractual relationships. We also include asset reinvestments each year for electronics and subscriber installs based on 14% (1/7) of the initial capital costs. These assets follow the same depreciation schedule (7-year MACRS).[8]

Numerous assumptions related to annual cooperative operations are necessary to facilitate the financial projections (Table 5). Since customer service and maintenance are assumed to be contracted out, the employees of the cooperative are limited to a General Manager, an Administrative Assistant, and an Accountant (part time). Initial salary/wage and employee benefits costs are included in Table 5, along with an assumed increase in wage rates of 2.5% per year.

When profits are earned by the cooperative, 10% of profits are distributed to unallocated reserves, 25% distributed as cash patronage refunds, and 65% distributed at qualified stock patronage refunds.[9] Retaining portions of current year profits (in allocated or unallocated form) is useful to support future growth and asset reinvestments. Qualified stock is assumed to be redeemed to members on a five-year revolving cycle (subject to the financial condition of the cooperative and approval by the cooperative's Board of Directors).

Financial Results

Recall that years 0 and 1 include organizational activities and system construction. The total cost for these activities are covered by the initial grant, loan, and member funding. System operations begin in

[7] Electronics costs were provided for each town by SNS. The algorithm in calculating them is uncertain to the authors and deserves additional attention. For example, note that the electronics costs for Franklin and Harrietstown are virtually identical, even though subscriber densities are quite different across the two towns. That said, total miles of construction are quite similar.

[8] We do not include asset reinvestments for backbone and distribution fiber. If included, annual costs will increase relative to those presented in the forthcoming sections.

[9] All percentages of profits are related to before tax income. The final allocation to unallocated reserves will be net of income taxes. Distributions to unallocated reserves are taxable to the cooperative in the year of distribution. Cash and qualified patronage refunds are taxable to cooperative member in the year of distribution.

year 2. Accordingly, sales and expense projections are shown for years 2 and 10, along with cumulative cash flows over this time horizon as our primary indication of financial feasibility.[10]

Existing Market Prices

The left-most columns of Table 6 summarize total sales, expenses, and cumulative cash flows for the market price scenarios. Under the new RBBC scenario, gross sales range from $840 thousand in year 2 to $1,057 thousand in year 10. The increase in sales is a result of annual increases in monthly service charges (1%) and number of subscribers (2%). Operating expenses (excluding income taxes) for years 2 and 10 are $1,558 thousand and $1,749 thousand, respectively. In each year, under existing market prices, operating expenses exceed total sales. This is not surprising given the lack of service already in this area and, due in part, to no scale economies in construction from combining the individual towns.

The degree of financial infeasibility at existing market prices is clearly articulated by examining the level of cumulative cash flows by year 10. When accounting for depreciation (non-cash), principle payments on the term debt, and asset reinvestment, net cash flows of nearly $-6.5 million results (Table 6). While not shown, even without asset reinvestment of depreciable assets (a poor strategy), cash flows would still be considerably negative each year. Even under the cooperative expansion scenario (where some costs are reduced, but subscribers and prices are the same), a cumulative cash flow of over $-2.2 million reveals a highly infeasible expansion strategy.

It is worth emphasizing that the high degree of financial infeasibility at existing market prices is NOT due to burdensome capital loan servicing requirements. Recall that we assume that 90% of the capital costs to construct the system are covered by grant and member investment sources. Removing the principle and interest payments on the term loan would still result in large negative cash flows each year (for both cooperative scenarios).

Cash Flow Prices

To determine at what prices the cooperative venture is financially feasible, we increase the year 2 price for high-speed users until the 10-year cumulative cash flows were equal to zero.[11] To maintain consistency with the initial grant restrictions, the low-speed price is kept at $60 in year 2. While not only allowing us to determine prices for which the business cash flows, the price results imply the level of cost subsidization needed by high-speed users (arguably higher income households) to low-speed users (arguably lower income households) in order to have broadband service available to both types.[12] For completeness, we also estimate cash flow prices without the grant restriction; i.e., both speed prices increase proportionally from the existing year 2 market price. Doing so allows us to compare the incidence of that restriction alone on member service prices.

The high-speed price required for the cooperative to cash flow over ten years is $236 (Table 6). Under this scenario, the cooperative's net surplus is positive by year 3 and beyond, implying distributions of patronage refunds (in cash and equity) to members, as well as allocations to unallocated reserves of after tax profits. Given the 5-year revolving cycle, patronage refunds held as member equity begin redemption

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[10] Detailed revenue and costs projections, by year, are included in Schmit and Severson (2017).

[11] Other financial feasibility criterion may also be used; e.g., net present value analysis or setting a rate of return on assets to some predetermined level. We chose the cumulative cash flow criterion for ease of exposition and a clearer transparency of monetary flows over each year of analysis.

[12] As stated earlier, an additional avenue for this type of subsidization is to have high-speed users pay a higher upfront capital investment for membership than low-speed users. We argue that our approach with monthly service charges is more tractable and allows users to choose the speed demanded that may change over time.

in year 8. That said, an increase of 136% in the high-speed price is considerable. Whether these level of prices are acceptable to the potential membership deserves further study. The willingness to pay such prices is of particular concern since the cash flow prices for high-speed users estimated here exceed prices currently existing in nearby areas. Indeed, the price includes a nearly 33% surcharge due to the grant restriction alone (i.e., $236 versus $178, Table 6). The high-speed cash flow price of $149 under the cooperative expansion scenario may be a more reasonably palatable level of subsidization, but still is nearly 50% above existing market rates.

The proportion of users demanding high-speed versus low-speed service importantly affects financial feasibility, particularly when the low-speed price is held fixed per grant requirements. Our analysis assumed that most (90%) of seasonal home owners would demand high-speed service. While these users may well be 'getting away' from the demands of everyday work life to vacation in the county, it is expected that, when connected, they will demand comparable service to what they are used to. Uploading and downloading work-related files, gaming, and music and video capabilities are arguably still important to this set of users. As such, monthly revenues from seasonal subscribers are generally high, albeit for only 6 months of the year. That said, some seasonal residences are seasonal by their very nature and suitable to residence during limited times of the year. This would include such homes more suitable as camping and hunting destinations.

Based on household income distributions in the study area, we estimated that 40% of year-round subscribers would demand high-speed access. To address the sensitivity of this assumption, we evaluated an alternative scenario where we assume that 80% of year-round subscribers would choose the high-speed option, doubling our initial assumption. While this may be extreme given the median household income in the study area, it does provide useful bracketing of the financial results. The resulting (year 2) monthly service prices are shown in Table 7.

Using existing market prices still results financially infeasible results; however, as expected, the prices at which the operation cash flows are substantially reduced. In particular, the new cooperative scenario's high-speed cash flow price is reduced to $157, or 33% less than the base scenario. In so doing, the weighted average price across all users is similar (lower high-speed price but more high-speed users), with comparable levels of financial performance. IN addition, the high-speed cash flow price for the expanded cooperative scenario is only $109, a level close to existing market prices and consistent with the predominance of rural broadband expansions coming from existing rural telecoms in the United States. That said, further investigation is necessary in determining more accurately what service speeds will be demanded by prospective members (including adoption rates), along with an accurate accounting of year-round versus seasonal subscribers.

Conclusions and Implications

This study examined the feasibility of a cooperative-structured business as a vehicle to extend broadband to unserved and underserved people living in Franklin County, New York, in the areas of Fort Covington, Westville, Duane, Franklin, and Harrietstown (not including the Village of Saranac Lake). As with many rural areas, the density of potential subscribers can be a limiting factor in the profitability to businesses providing utility services. Cooperatively structured businesses have a long history of providing electricity and telephone service to rural areas throughout the United States.

Early conversations with community leaders indicated that there is a need for high-speed broadband in the area and an informal market study indicated that people are dissatisfied with current broadband service and accessibility. If an alternative was to emerge, respondents indicated a willingness switch providers. At the same time, established competitors in the market place may become motivated to improve service to existing customers or extend services to new customers if they felt threatened by a new player in the marketplace. Presently, residents have taken a ‘wait and see’ approach to see if current service improves before working through the process to organize themselves as a broadband cooperative. If customers become more satisfied, there will be less desire to switch to another provider resulting in less persons than projected to become a member-subscriber of a broadband cooperative.

Concerns have been raised within the communities considered here about the long-term impact to the area without sufficient broadband service. Tourism is an important economic driver in the area and people visiting the area expect access to broadband to meet their needs. Seasonal-use property owners need broadband of size and speed that allows them to telecommute. Lack of broadband or sub-standard performance of broadband reduces the length of stays and, ultimately, will negatively impact property values. Cottage industries and established businesses need improved connectivity to conduct business and expand sales to allow the region to remain economically competitive and viable.

The number and location of potential subscribers have been identified and the requirements and costs to install a new broadband service system have been identified. The individual towns considered in this study have a wide range of resident densities and household income characteristics, resulting in a capital construction cost of the cooperative of nearly $8.3 million and upfront individual member equity requirements $836. The willingness and ability of potential members to satisfy this requirement is an open question and one that deserves community input.

Market rates for broadband service vary based on download and upload speeds. For the purposes of this study, we assumed one high-speed ($100) and one low-speed option ($60), consistent with market rates in nearby areas and accounting grant stipulations that require a maximum monthly price for a more limited (lower speed) option. Using existing market prices resulted in highly infeasible cooperative business operations. On one hand, losses were to be expected given that no service providers are currently in operation in the study area. On the other hand, the sizes of losses were larger than anticipated and are a reflection of the low population densities, limited to no opportunities for scale economies in construction, and high annual operational and maintenance requirements for the broadband system proposed.

Fixing the low-speed price, the high-speed price was increased until the cooperative venture became financially feasible; i.e., had a cumulative cash flow of zero over ten years. Monthly high-speed prices had to more than double for the project to become financially feasible. Whether high-speed users are willing to pay this price is unknown and deservers further study. The willingness to pay is likely a combination of the need for the high-speed service and the acceptance of high-speed users in subsidizing low-speed users in order to make broadband service available to both groups. The degree to which the high-speed price must increase for the business to cash flow is determined, in part, by the relative number and type of users. By doubling our initial high-speed (year-round) users, cash flow prices were moderated to $149 per month, perhaps a more reasonable level of subsidization by cooperative members. In addition, under the cooperative expansion scenario, cash flow prices approached market prices under the increased proportion of high speed users.

The high degree of financial infeasibility at existing market prices is NOT due to burdensome capital loan servicing requirements. Recall that 90% of the capital costs to construct the system are covered by a grant and member investment. Thus, financial infeasibility has less to do with the high construction costs for broadband services in rural areas, than the annual operational and maintenance costs required to sustain the system long term.

To provide more confidence in the financial projections, clear estimates of the number of potential seasonal versus year-round subscribers is needed, along with the demand speeds and willingness of potential members to pay for them (Whitacre 2010). A closer examination of the annual operating and maintenance costs would also be advised, along with further consideration of any scale economies in construction (none assumed here) that would offset diseconomies in the distribution of services. A careful examination of these issues is a top priority for our continuing research.

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Table 1. Population, housing, and income characteristics of study area, by Town.

Town/Location	Fort Covington	West-ville	Duane	Franklin	Harriets-town (total)[1]	Harriets-town (net)[1]
Population (No.)	1,676	1,819	174	1,140	5,709	1,812
Housing units (No.)	752	843	208	1,013	3,521	1,401
Occupied (%)	88.6	87.5	44.7	50.1	74.6	
Seasonal (%)	24.4	39.0	89.6	90.9	67.0	86.1
Vacancy-for sale (%)[2]	2.2	1.5	4.7	0.9	2.7	
Vacancy-for rent (%)[2]	15.7	3.4	0.0	8.3	8.8	
Total Area (mile^2)	36.8	34.8	78.0	175.2	213.67	211.7
Water Area (mile^2)	0.0	0.0	2.9	5.0	16.8	16.7
Land Area (mile^2)	36.8	34.8	75.1	170.2	196.8	195.0
Population Density (No./mile^2)	45.6	52.2	2.3	6.7	29.0	9.3
Housing Density (No./mile^2)	20.5	24.2	2.8	6.0	17.9	7.2
Average household size[3]	2.6		2.2	2.3	2.1	
Households, total (No.)[3]	1,893		720	840	2,626	
Family households (%)	69.1		64.4	64.6	52.3	
With children < 18	33.1		24.3	26.7	24.7	
With individuals > 65	28.4		30.6	25.4	22.2	
Living alone	25.0		27.8	27.1	38.0	
Household income:[3]						
Median income	$42,287		$56,815	$55,625	$94,997	
Less than $10,000 (%)	9.0		0.0	4.0	4.8	
$10,000 to $19,999 (%)	20.3		15.4	12.8	24.8	
$20,000 to $34,999 (%)	27.9		20.5	29.3	22.7	
$35,000 to $49,999 (%)	19.5		19.7	20.8	21.3	
$50,000 to $74,999 (%)	9.9		19.0	14.5	11.9	
$75,000 to $99,999 (%)	9.0		15.3	15.0	9.6	
$100,000 to $149,999 (%)	1.8		2.2	1.4	1.5	
$150,000 or more (%)	2.7		1.5	2.2	3.3	

Source: 2010 U.S. Census, Summary File #1. Tables H1, H2, H3, H4, and H5; American Factfinder, Selected Economic Characteristics; and 2010-2014 American Community Survey, 5-Year Estimates, DO03. Accessed 16 September 2016.

[1] Harrietstown (total) includes the Village of Saranac Lake, Harrietstown (net) excludes the Village of Saranac Lake. For some statistics only the total Town numbers are available.

[2] Vacancy-for sale is the percentage of non-rental homes vacant and for sale. Vacancy-for rent is the percentage of rental properties that are vacant and for rent, or have been rented but are not yet occupied.

[3] Household statistics based on census tracts that do not necessarily align with municipal boundaries. Fort Convington and Westville are contained within one census tract, while the Harrietstown results combine the two census tracts within its boundaries.

Table 2. Potential member subscribers and infrastructure requirements, by region.[1]					
	Towns				
Descriptor	**Fort Covington & Westville**	**Duane**	**Franklin**	**Harriets-town**	**Combined Region[2]**
Potential subscribers	1,086	146	315	57	1,604
Penetration percent	65%	50%	50%	100%	62%
Total subscribers (year 1)	705	73	157	57	992
Percent homes seasonal	20%	20%	20%	0%	19%
Subscribers – year-round	564	59	126	57	806
Subscribers – seasonal (6 mos.)	141	14	31	0	186
Percent year-round high speed users	40%	40%	40%	40%	40%
Percent seasonal high speed users	90%	90%	90%	90%	90%
Subscribers Year High Speed	225	23	50	22	320
Subscribers Seasonal High Speed	126	12	27	0	165
Subscribers Year Low Speed	339	36	76	35	486
Subscribers Seasonal Low Speed	15	2	4	0	21
Miles of construction - Backbone	11.80	4.40	16.50	45.40	78.10
Miles of construction - Distribution	99.45	16.50	47.40	15.00	178.35
Miles of construction - Total	111.25	20.90	63.90	60.40	256.45
Subscriber density, maximum per mile	9.76	6.99	4.93	0.94	6.26
Subscriber density, actual per mile, year 1	6.34	3.49	2.46	0.94	3.87

[1] All information provided by Slic Network Solutions, but for distribution of subscribers to high- and low-speed customers. High-speed year-round members were estimated by authors based on the distribution of household incomes in the study area (Table 1). Most seasonal users (90%) were anticipated to be high-speed users.
[2] Combined region includes Towns of Fort Covington, Westville, Duane, Franklin, and Harrietstown, excluding the Village of Saranac Lake.

Table 3. Project and financial analysis timeline.			
Year 0	Year 1	Year 2	Year 3 - 10
• Organize public meetings • Secure grant • Member equity drive • File legal papers to organize co-op • Establish initial Board of Directors	• Complete equity drive • System construction • Hire co-op management & staff	• System fully functional • Initial member sales • Net surplus (if any) allocated to unallocated reserves, cash patronage refund, and qualified member stock	• Annual subscriber growth = 2% • Annual monthly service fee growth = 1% • Expense inflation rate = 1.5% • Reinvestment in depreciable assets occurs • Net surplus allocated to unallocated reserves, cash patronage refund, qualified member stock. • Redeem equity when appropriate (5 year revolving period)

Table 4. Construction costs, by town and region.[1]					
	Towns				
Construction Cost Component	**Fort Covington & Westville**	**Duane**	**Franklin**	**Harriets-town**	**Combined Region**[3]
Fiber cost and installation - Backbone	$318,600	$118,800	$445,500	$1,225,800	$2,108,700
Fiber cost and installation - Distribution	$2,436,525	$404,250	$1,161,300	$367,500	$4,369,575
Cost of electronics	$103,574	$42,974	$47,374	$47,375	$241,297
Subscriber installations	$705,000	$73,000	$157,000	$57,000	$992,000
Total capital construction cost	**$3,563,699**	**$639,024**	**$1,811,174**	**$1,697,675**	**$7,711,572**
Supplemental expenses prior to and during construction[2]					$578,637
Total project construction cost					**$8,290,209**
Grant Amount (80%)					$6,632,167
Loan Amount (10%)[4]					$929,021
Member investment (10%)[5]					$929,021

[1] Construction costs provided by Slic Network Solutions.
[2] Supplemental expenses estimated by authors for year 0 expenses (legal fees, capital campaign expenses) and year 1 prorated expenses (cooperative management, utilities, pole rental, insurance, property taxes, and other miscellaneous).
[3] Combined region includes the Towns of Fort Covington, Westville, Duane, Franklin, and Harrietstown, excluding the Village of Saranac Lake.
[4] Term loan, 10 years, 5% interest rate.
[5] Implies individual member investment (common stock) $836. Common stock not eligible for redemption until member leaves the cooperative. Subscribers subsequent to year 2 are assumed to make the same level of upfront member investment.

Table 5. Cost, revenue, and operational parameters for financial feasibility analysis.	
System construction	
System bandwidth capacity	1 gigabyte
Construction cost - backbone fiber, $/mile	$27,000 (useful life 20 years)
Construction cost - distribution fiber, $/mile	$24,500 (useful life 20 years)
Cost of per premise installation	$1,000 (useful life 7 years)
Revenue	
Year round subscriber months per year	12
Seasonal subscriber months per year	6
Annual subscriber growth	2%
Annual subscriber fee increase	1%
Expenses	
Billing and technical support (percent of capital cost)	0.50%
Pole rental (percent of capital cost)	2.98%
Maintenance (percent of capital cost)	3.90%
Insurance (percent of capital cost)	3.00%
Property taxes (percent of capital cost)	2.66%
Annual expense inflation rate	1.50%
Cooperative office facilities (lease & utilities), $/month	$1,550
Cost of bandwidth (supply and delivery), $/month	$3,000
Member/community outreach and supplies, $/year	$5,000
Miscellaneous expenses (mileage, travel costs, meetings), $/year	$10,000
Personnel	
General Manager (annual salary)	$65,000
Clerical/administrative Assistant (annual salary)	$40,000
Accountant, part time (annual cost, no benefits)	$20,000
Payroll	
Benefits = Payroll tax (5%) + Retirement (15%) + Employee Insurance (15%)	35%
Annual wage inflation	2.5%
Financing and loan terms	
Percent capital investment by grants	80%
Percent capital investment by term loan	10%
Percent capital investment by member investment	10%
Operating loan/working capital	$100,000, 8.0%
Term loan	5.0%, 10 years
Income taxes	
Income tax rate (cooperative)	35%
Income tax rate (member)	25%
Profit allocation (all percentages relate to before tax income)	
Percent to Unallocated Reserve	10%
Percent to Cash Patronage Refund	25%
Percent to Qualified Stock Patronage Refund	65%
Miscellaneous	
Upfront legal fees, permits, licenses (Year 0)	$50,000

Table 6. Financial results, by price and cooperative scenario.

	Market prices[1]		Cash flow prices[2]			
			No grant restriction		Grant restriction	
	Year 2	Year 10	Year 2	Year 10	Year 2	Year 10
Financial metric	**New Rural Broadband Cooperative**					
Monthly service price ($), high speed/low speed	100/60	108/65	178/107	193/116	236/60	256/65
Total broadband sales ($000)	840	1,057	1,497	1,882	1,498	1,880
Total broadband expenses ($000)	1,558	1,749	1,558	1,753	1,558	1,753
Cumulative cash flow ($000)	(697)	(6,443)	(41)	0	(39)	0
Financial metric	**Expand Rural Utility Cooperative into Broadband Service**					
Monthly service price ($), high speed/low speed	100/60	108/65	128/77	139/83	149/60	161/65
Total broadband sales ($000)	840	1,057	1,076	1,353	1,077	1,353
Total broadband expenses ($000)	1,123	1,245	1,123	1,249	1,123	1,249
Cumulative cash flow ($000)	(259)	(2,192)	(23)	0	(23)	0

[1] Market prices assume high- and low-speed prices start at $100 and $60, respectively, in year 2. Prices increase each year by 1.5% (annual inflation rate, Table 5.)

[2] Cash flow prices are set in year two such that the 10-year cumulative cash flow is equal to zero for the broadband operations. The no grant restriction scenario increases both the high- and low-speed market prices proportionally, while the grant restriction scenario increases only the high-speed price. Prices increase each year by 1.5% (annual inflation rate, Table 5.)

Table 7. Pricing sensitivity based on proportion of high-speed year-round subscribers.[1]

	Percentage of High Speed, Year-round Users			
	40%		80%	
	New Co-op	Expand Co-op	New Co-op	Expand Co-op
Market price – high speed	$100	$100	$100	$100
Market price – low speed	$60	$60	$60	$60
Market price – weighted average	$80	$80	$93	$93
Cash flow price – high speed	$236	$149	$157	$109
Cash flow price – low speed	$60	$60	$60	$60
Cash flow price – weighted average	$130	$96	$138	$99

[1] Prices are year 2 prices (before annual adjustment), rounded to the nearest dollar.

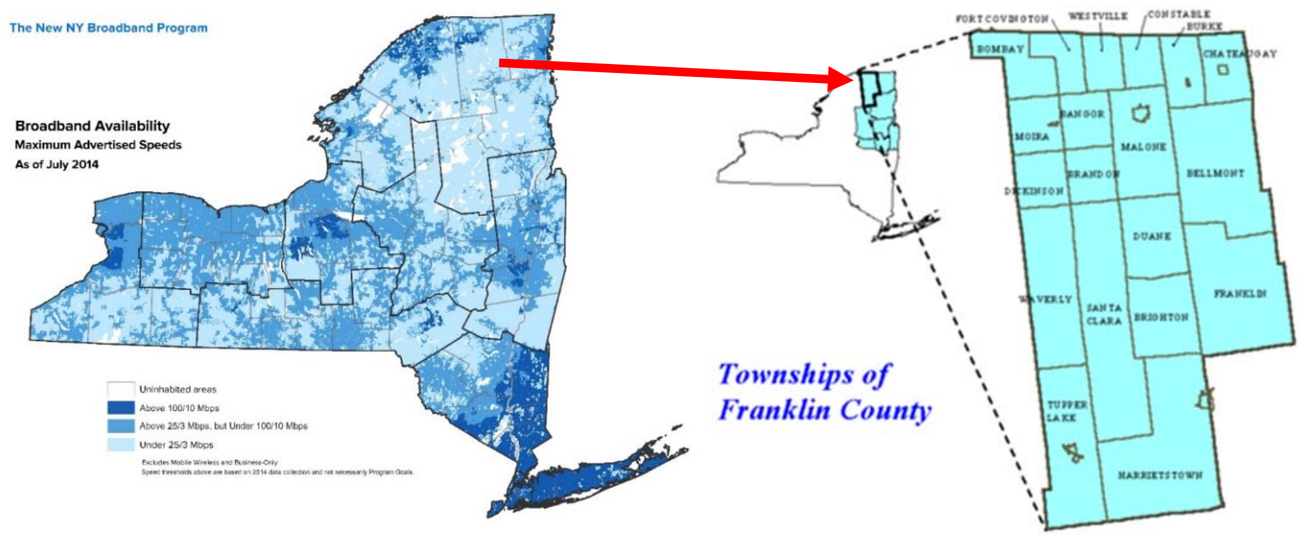

Figure 1. Broadband availability for New York State, and location of study area.

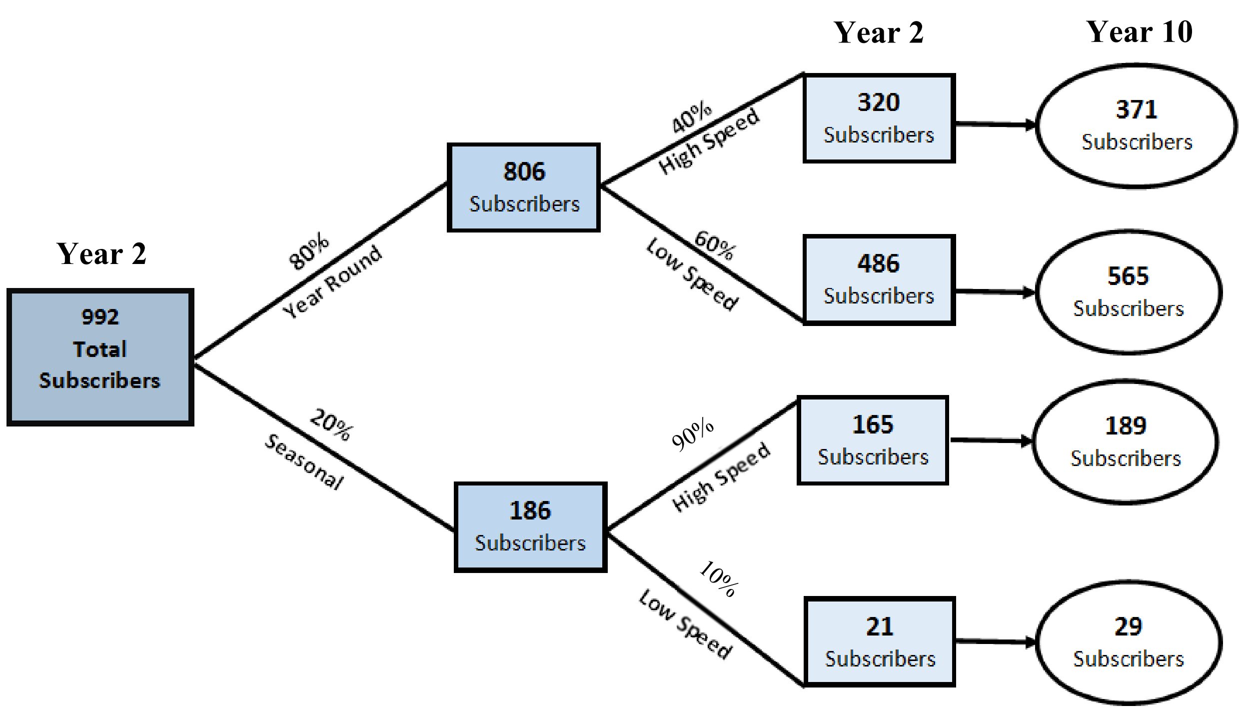

Figure 2. Distribution of subscribers by type of home, broadband speed demand.

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