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The rural telecommuter surplus in Southwestern Ontario, Canada

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ABSTRACT

This paper asks the question: what kind of economic benefits do rural telecommuters experience in Southwestern Ontario? This is a relevant question in Canada where, according to Statistics Canada (2017) one in 14 people work from home. This paper presents an overview of the current literature on telecommuting. We estimate the telecommuter surplus in Southwestern Ontario where the region is currently deploying one of Canada's largest publicly-funded ultra-high-speed broadband initiatives known as SouthWest Integrated Fibre Technology Inc. (SWIFT). The analysis is based on SWIFT residential and farm surveys (n = 3948) conducted in 2017. We find that an average telecommuter's surplus in terms of costs saved, including opportunity cost ranges from $8820 to $23964 per annum per telecommuter, depending on the number of days telecommuted per week for home and primary residence dwelling type. The social net benefits of telecommuting differ from its private net benefit (the focus of our paper) since the former includes both positive and negative externalities associated with telecommuting such as reduced traffic congestion, reduced probability of road accidents, as well as some workers shirking their duties (a negative impact). We leave this for future work.

1. Introduction

Canada is a commuting nation. Since 1996, the number of commuters increased nearly threefold, from 3.7 million to 15.9 million in 2016. More than 50% of Canadians report that they regularly engage in “flexi work” which includes fully or partially working from home (telecommuting) or from working remotely (teleworking) (Statistics Canada, 2017a,b). The terms “teleworking” and “telecommuting” are closely related but are not the same. The former refers to “… [the] use of telecommunications to work anywhere other than the home office. [While the latter refers to] the use of telecommunications to allow employees to work from their homes and avoid the use of transportation to commute to and from work” (Fuhr & Pociask, 2011, p. 2).

The introduction of the internet to North American households in the 1990s created a new era of telework and telecommuting. The price of personal computers decreased while capabilities of home computing have increased, which contributed positively to the idea of working from home (Kizza, 2013). The spread of faster internet connections typically referred to as “broadband” has completely changed the way many Canadians work and network; this is the “triple revolution” of the proliferation of the internet, life in multiple, partial, virtual social networks and the connectedness afforded by mobile technologies (Rainie & Wellman, 2012). Higher speed data transfer, video, and voice communications via broadband connections spurred the development of communication software like Skype and CISCO's WebEx applications which revolutionized traditional office meetings even if physical distance is not an issue (Dimitrova & Wellman, 2015). Enabling real-time, cloud-based file sharing means the internet connects data, devices and

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participants from different towns, cities and even countries in different continents. It also means that certain jobs may be done outside of primary offices, working from home or from remote locations; the key ideas behind telecommuting and teleworking.

The objective of this paper is to examine the influence of the current state of connectivity in Southwestern Ontario on rural telecommuting because residential access to higher-speed connectivity makes working from home possible. Drawing on data collected by the broadband investment program known as the SouthWest Integrated Fibre Technology Inc. (SWIFT) network, this paper establishes a baseline for tracking the phenomenon of telecommuting within and across the region of Southwestern Ontario, Niagara and Caledon.

This paper first provides an overview of literature on the residential-level economic benefits of telecommuting followed by an estimate of annual telecommuter surplus in the Southwestern Ontario (herein SW Ontario) using residential and farms surveys conducted by SWIFT from July to December 2017. The paper is organized as follows: Section 2 reviews the relevant literature. Section 3 presents the context of SWIFT including the data used and the results. Section 4 is the discussion of findings and Section 5 concludes the paper.

2. Literature review

Initially, the term, telework, came into use in the 1970's during the global oil crisis when gasoline prices skyrocketed, and consumers sought ways to save on household expenditures while taking advantage of telecommunications (Scholefield & Peel, 2009). Reducing the commuter's dependence on foreign and expensive fuel preceded the more contemporary focus of using information and communication technologies to offer telecommuters the benefits of a flexible work-life balance as well as the opportunity to reduce one's carbon footprint (Cox, 2011).

Telecommuting may not only benefit workers, but also, employers, who seek increased worker productivity, office space savings, utility bills or energy savings, reduced turnover rates, etc. (Allen, Golden, & Shockley, 2015). According to Allenby and Roitz (2003), companies such as Siemens, Compaq, Cisco, Merrill Lynch, Nortel and American Express have experienced between an increase of 10%–50% in their productivity due to flexi-work.

While modern telecommunications have facilitated workplace connectivity, telecommuting has not reached the levels once expected by analysts such as Doherty, Andrey, and Johnson (2000) who estimated that between 25% and 65% of all jobs in North America could be entirely telecommuted and/or teleworked. According to Lister and Harnish (2011,2011a), 40% of all jobs in Canada are compatible to working from home or from a remote office (telecommuting and teleworking). In 2010, Statistics Canada reported that 1.7 million Canadians work from home, not including those who are self-employed. Recent policy literature has linked transportation infrastructure to improving connectivity in communities. A case in point is the Ontario Ministry of Infrastructure's *Building Better Lives: Ontario's Long-Term Infrastructure Plan 2017*, in which Minister Brad Duguid states.

“the plan is about building roads and highways and modernizing transit to ease the stresses of everyday travel; it is about providing essential services such as water, gas, and broadband Internet to homes in a safe, reliable and timely manner. And it is about ensuring that Ontarians have access to modern, world-class health care, education and community services.” Indeed, equitable access to the Internet for all Ontario residents and businesses will yield positive impacts on all of these utilities and services (iv).”

2.1. Benefits of telecommuting

It can be expected, however, that the residential benefits of telecommuting vary across and within regions because of the influence of opportunity costs and other economic variables such as the price of fuel, weather, economic and financial opportunities. For all workers, regardless of the distance travelled, being able to work from home instead of driving to and from work reduces the use of the commuter's vehicle and fuel. A 2015 report prepared by Texas Transportation Institute examined 85 metropolitan areas in the United States and found that annual rush hour road congestion costs over US$160 billion worth of fuel and drive time. A case study by Mitomo and Jitsuzumi (1999) in Tokyo, Japan, have estimated the benefits from the relief of mass-transit congestion to be between 23 and 75 billion Yen. This benefit alone, the authors argue, is enough to justify and support the idea of more frequent telecommuting and that “… there can be no doubt that, from the viewpoints of maximizing social welfare or contributing to the sustainability of global society, there is considerable need for some level of pro-telecommuting policy support” (p8).

There are other pecuniary savings to telecommuters. For example, families with children may, for example, save money on elder or child care services. Other indirect private benefits include a better balance between work and personal time, job satisfaction, a distraction-free environment, improved time management or better work-life balance as individuals or households (Duxbury, Higgins, & Neufeld, 1998; Fuhr & Pociask, 2011).

Studies show that telecommuting offers societal benefits. Turcotte (2011) reported that in many sub-urban metropolitan areas of North America commute times continue to increase, while the vast majority of workers perceive their commute as a waste of time and a significant source of stress. Moreover, telecommuting of workers reduces road congestion and (therefore) could significantly reduce fatal road accidents (Zukowski, 2015). Furthermore, less road maintenance and construction costs mean that more resources could be available for other social investments such as education and other infrastructure. Table 1 summarizes some of the common advantages and disadvantages of telecommuting for employers, employees and society.

2.2. Challenges for telecommuting analysis

Data to support the analysis of the telecommuting and connectivity is an ongoing challenge. In 2018, the United States will

Table 1
Advantages and disadvantages of telecommuting identified in the literature.
Sources: Arnold, 2006; Duxbury et al., 1998; Fuhr & Pociask, 2011; Gajendran & Harrison, 2007; Hinds & Kiesler, 2002; Koenig, Henderson, & Mokhtarian, 1996; Niles, 1998; Picu & Dinu, 2016; Scholefield & Peel, 2009; Zukowski, 2015.

	Employers	Employees (telecommuters)	Society/Government
Advantages	- Recruitment and retention - Reduced absenteeism - Increased productivity - Cost savings from reduced office space - Cost savings from lower utilities expense - Office decentralization - Reduce the cost of complying with disabilities, environmental and office safety regulations - Better/positive company image - Expand the talent pool beyond geographic boundaries	- Savings in costs by not commuting - Flexibility in hours and improved work/life balance - Increased job satisfaction - Greater ability to participate in the workforce - Flexibility of housing location - Overcome lack of public transportation barriers - More effective time management	- Reduced traffic congestion and infrastructure demand - Reduced probability of fatal road accidents - Potential reduction in rural-urban wage gap - Savings on oil (non-renewable energy) - Raise the standard of living in rural and disadvantaged areas
Disadvantages	- Imperfect substitute for workplace face-to-face interaction - Workplace culture issues and trust - Communication and management costs - Confidentiality and security concerns - Not every job can be telecommuted - Technical feasibility/costs	- Worker isolation - Exclusion from workplace decisions - Inhibited career progression - Lack of technical assistance - 'Role blurring' between work and personal life - Precarity in home-shoring or outsourcing of jobs - Lack of monitoring of employees	- Limited evidence on the overall cost-benefit of telecommuting - Travel demand management (TDM) transportation planning does not coincide with broadband investment planning

publish the results of the 2017 National Household Travel Survey (NHTS) providing important longitudinal data (2001, 2009, 2017) on urban-rural commuting. The earlier NHTS datasets on the residential-level economic benefits of telecommuting have been studied extensively (Singh, Paleti, Jenkins, & Bhat, 2013). Using data from the 2009 National Household Travel Survey (NHTS), researchers at the University of Iowa found that broadband connectivity had a decisive impact on the decision to telecommute from rural areas (Song, Orazem, & Singh, 2006). Connectivity was responsible for two-thirds of the difference between urban and rural telecommuting.

In comparison with the US NHTS, data analysis specific to rural telecommuting has not featured in recent studies in Canada. The nearest effort is Statistics Canada's *Journey to Work: Key Results from the 2016 Census,* which outlines general trends of working from home (not necessarily via the internet) and general commuting and transit patterns (Statistics Canada, 2017a,b).

Furthermore, to the best of our knowledge, Lister and Harnish (2011,2011a) is the only Canadian study that provides a comprehensive estimate of cost savings and benefits generated from telecommuting in Canada. For instance, they found that benefits to employers amount to over CDN$10,000 per annum for each telecommuter who works out of his/her home two days a week. The benefits are computed in terms of increased productivity, reduced real estate costs, lower absenteeism and turnover rates. Estimated benefits from reduced turnover rates alone are over $400 per person. The study suggests, on average, a medium sized firm with 250 telecommuters could save over $3 million per year. Lister and Harnish (2011,2011a) estimate that the aggregate savings for Canadians from telecommuting amounts to $53 billion annually, composed of $44 billion, $8.5 billion and $578 million for the employer, the employee and the community, respectively. These savings include benefits from reduced automobile emissions and traffic accidents.

In an American teleworking study by the same authors, Lister and Harnish (2011,2011a), their analysis of various census and national labour data found significant benefits from telecommuting. The study includes the reduction in the road depreciation as a community-level benefit. The total savings of telecommuting is estimated at US$645 billion annually, tenfold the benefit reported in the Canadian study. While Canada's population is 10-times smaller than the United States, Canada leads the G-7 nations in its 11.7% population growth rate (Statistics Canada, 2016). Canada may still have some way to go to realize the economic benefits of telecommuting.

2.3. Models of telecommuting analysis

The review of literature also sheds light on the theoretical models that have attempted to explain the economics of telecommuting. Kim (1997) uses a partial equilibrium approach to explain city growth as telecommuting becomes an option for workers. The model, however, has two major downsides. The total hours worked, including telecommuting, are assumed to be fixed, meaning that the model cannot explain optimal choices among the options.

Safirova (2002) builds a general equilibrium (as oppose to partial equilibrium) model to explain the effects of telecommuting on the urban economy and land use pattern. The model assumes that land is used in production, housing and roads. Telecommuters and traditional office workers are treated as imperfect substitutes in production. The model shows telecommuters can increase the social

welfare when (in Safirova's description) the diversity of inputs effect is high and the agglomeration reduction effect is low.

The environmental benefits of telecommuting seem straightforward; however, the literature provides some mixed results. In general, most studies of environmental benefits find modest results for the environmental impact of telecommuting (Nelson, Safirova, & Walls, 2007). The difference in the estimate is mainly due to variation in the location of study, because factors such as the costs of congestion and environmental impacts (i.e., the Marginal Damage Function) may differ significantly across regions. It is likely that the environmental benefits of telecommuting may converge to zero over time due to further technological advancements in automobiles (e.g., hybrid and electric vehicles) in conjunction with stringent fuel emission standards. Fuhr and Pociask (2011) conducted one of the more enthusiastic studies of environmental benefit. Their comprehensive study of the environmental impact of telecommuting in the United States suggests that telecommuting can reduce greenhouse gas emissions over a 10-year period by 588.2 million tons. This represents a reduction in energy consumption by businesses (53%), less driving (42%) and reduced construction of office spaces (5%).

In contrast to the uncertainty of environmental benefits from telecommuting, there is compelling evidence that employers may gain from their workers' telecommuting in the form of increased productivity of the workers (Allenby & Roitz, 2003; Caudron, 1992). Allenby and Roitz (2003) show that, on average, IT-based companies allowing their workers to telecommute have reported an increase of 25% in overall productivity. The companies include Siemens, Compaq, Cisco, Merrill Lynch, Nortel and American Express. Some studies further show that telecommuting may contribute to decreases in absenteeism and presenteeism. The idea is that telecommuting allows individuals who are on “sick leave” to be somewhat productive at home. Also, it creates positive externality by not spreading the contagious illness, therefore not hindering the productivity of other workers. Balaker (2005) estimates the benefit to companies from a reduction in absenteeism (from telecommuting) at around US$2000 per year per worker.

Studies also show that savings for companies from avoided real estate costs can be significant. For example, according to Allenby and Roitz (2003), IBM saved about US$1 billion. Other study shows more modest savings of US$69 million for Sun Microsystems (Arnold, 2006). Other pecuniary benefits include energy savings and building maintenance costs. Using a case study of Ireland, Fu, Kelly, Clinch, and King (2012) estimate that telecommuting provides a net value in energy savings, which includes increased energy consumption at home (working at home) and energy savings from office spaces, to be 9.33 kWh per day per telecommuter.

Overall, the literature strongly suggests that telecommuting provides a positive net benefit for workers, employers and society, including some possible environmental benefits. The literature specific to rural telecommuting and connectivity is, however, limited and there are no recent studies conducted in Ontario. This is a gap in the current academic literature that can be filled and used to respond to policy development. Ontario's Long-Term Infrastructure Plan (2017) presents an opportunity to link transportation and broadband infrastructure. We now turn to discuss our case study on the telecommuter surplus in SW Ontario.

3. Measuring telecommuter benefits: residential and farm user data

3.1. Description of data

SWIFT is in the process of developing an ultra-high-speed broadband network across Southwestern Ontario, Niagara Region and Caledon. This is an area of 42,000 km^2 encompassing over 3.5 million people, which is 25% of Ontario's population or 10% of Canada's population. SWIFT's strategy commits to using scarce rural broadband subsidies to deploy ubiquitous fibre (i.e. “deep fibre” versus upgrading old and slow copper and fixed wireless facilities) in addressing the rural-urban “digital divide”. SWIFT has asked the Canadian Radio-television and Telecommunications Commission (CRTC) to do the same in the design of its rural broadband subsidy regime of speed targets set at 50 Mbps (download) and 10 Mbps (upload) (SWIFT, 2017). In 2016, SWIFT received CDN$180 million from federal and provincial governments for the first five-year investment phase estimated at $288 million. In this study, we utilize residential and farm user surveys (n = 3948) collected by SWIFT as of November 14, 2017. The SWIFT surveys are on-going over the duration of the investment program in order to generate longitudinal data for outcome analysis.

The SWIFT user needs analysis surveys started in July 2017. Participants include residential dwellings and farms within the SWIFT area. The long-form survey asks several socio-demographic questions, including questions pertaining to telecommuting such as the number of telecommuters at premise, the number of days worked and telecommuted, the average time and distance saved or avoided by telecommuting and the place (closest urban area) to which one would normally have to commute. The survey collects information on types and costs of internet service at premise, and asks respondents to run a speed test which is linked from the Canadian Internet Registration Authority (CIRA) platform to the MLab Network Diagnostic Tool. The speed test measures average download and upload speeds and latency rate of the current internet connectivity.

3.2. Findings

The results of our initial analysis find that daily commute distances can be as high as 115–152 km (return). Fig. 1 provides the average number of kilometres travelled per day by telecommuters and the number of survey responses (in parentheses) in the shaded areas of the map.

The data indicate that, on average, there are 1.5 telecommuters per dwelling, regardless of the dwelling type (residential, seasonal or farm). Dwelling types are a relevant variable in the analysis because telecommuters may be seasonal residents within remote and rural communities. The SW Ontario region also has the largest number of farms in the Province (Statistics Canada, 2016).

For areas such as Caledon, located in Peel Region, where over 57% of the surveyed households report at least one telecommuter, this is particularly relevant. Table 2 provides the summary statistics on total distance saved, total hours saved, average number of

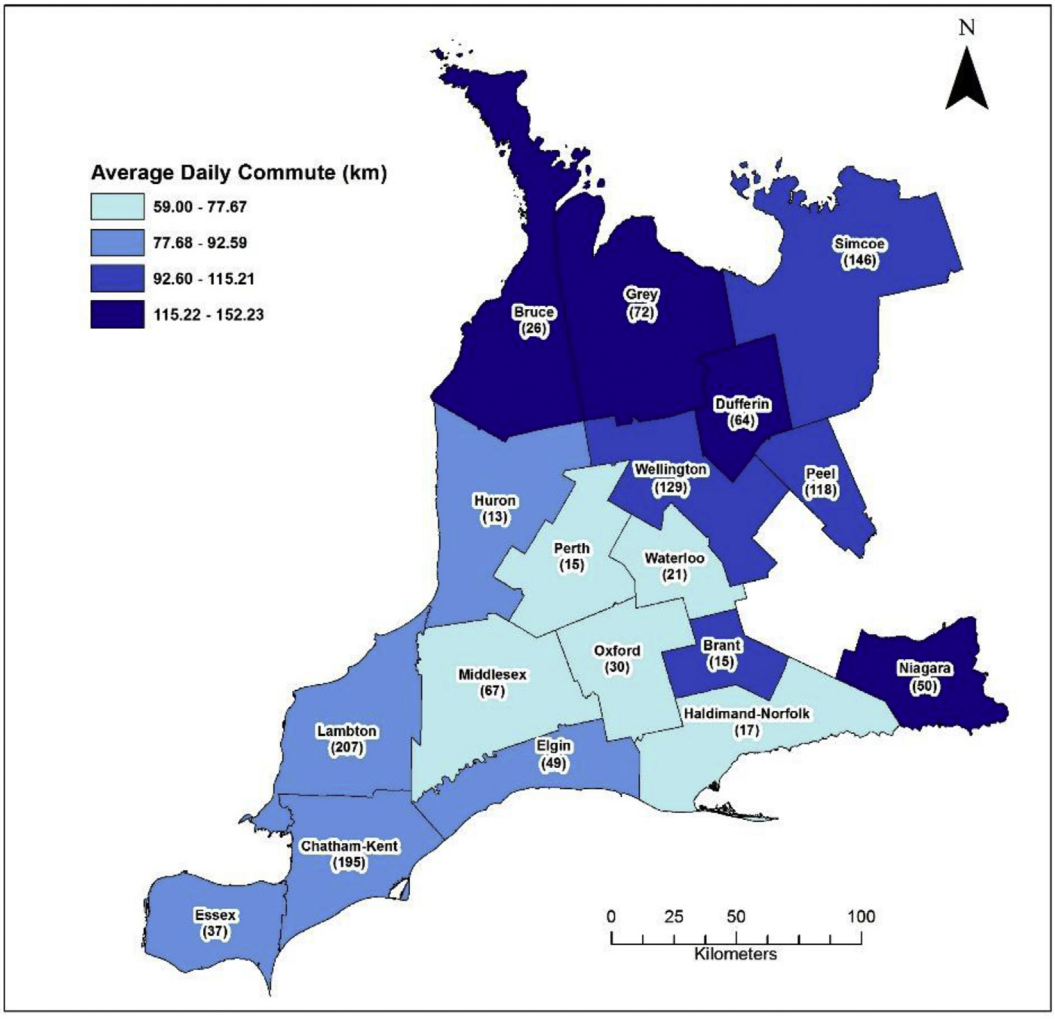

Fig. 1. Average commute distance (in km) per telecommuter.

telecommuters per dwelling by the survey respondents. Fig. 2 shows the total number of responses by type of internet connection in the SWIFT region reported by the survey respondents.

The speed tests indicate an average of approximately 13 Mbps (download) and 4 Mbps (upload) for the connection. The "ping" or average latency is 34.7. Please refer to Table 3 for the results. The comparison to the entire 2017 CIRA dataset for Southwestern Ontario (for the fourth quarter of 2017) is 16.5 Mbps (download) and 7.3 Mbps (upload).

As of November 2017, our findings suggest that the typical savings to a telecommuter from three days of telecommuting a week ranges from $13,956 to $20,568, depending on the dwelling type. The detailed results and the modelling used are explained, as follows.

According to the Canadian Automobile Association (CAA),[1] the cost per km of driving a mid-size vehicle with an average consumption of 8.34 L/100 km is $0.52. We used the average hourly wage rate in Ontario as $22.02[2] as proxy for opportunity cost of time. The estimate of annual savings of telecommuting, hence, its benefits, were estimated by the avoided cost of travel (i.e. working at home via internet) using the following formula

*Annual total benefits per telecommuter per year (ABPTPY) = (cost per km of driving a car * total distance saved per day + total hours saved by not commuting per day * average hourly wage rate) * Total number of days telecommuted per year.*

Next, we calculated the telecommuter surplus by subtracting the total cost from the ABPTPY calculated above:

[1] http://caa.ca/car_costs/. The cost per km includes annual fuel, insurance, license and registration, depreciation and maintenance costs.
[2] https://www.gov.mb.ca/jec/invest/busfacts/workforce/wages_all.html.

Table 2
Average number of telecommuters, total hours and distance saved by first two telecommuters, if any by dwelling type.

	Average Number of Telecommuters (persons)	Total km saved per day by first telecommuter	Total hours saved per day by first telecommuter	Total km saved per day by second telecommuter	Total hours saved per day by second telecommuter
Home and Primary Residence (n = 2899)	1.4	78.6	2.5	63.4	2.3
Farm and Residence (n = 624)	1.5	94.4	2.7	91.9	2.8
Business and Residence (n = 310)	1.5	105	2.9	92.0	2.6
Secondary or Seasonal Residence (n = 77)	1.5	115	2.1	159.3	2.5
Other (n = 38)	1.5	119.4	3.5	77.2	2.5

Note: n represents total sample size. This number does not represent the total number of observations used to calculate the columns because some respondents did not answer all the survey questions.

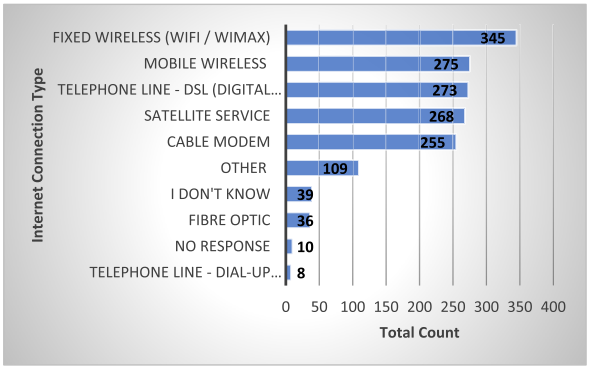

Fig. 2. Total number of responses by type of internet connection.

Table 3
Average download, upload and ping (latency) for dwellings with at least one telecommuter.

	Average Download Speed	Average Upload Speed	Average Ping
Mbps[a]	13.25	4.27	34.75

[a] Megabits per second.

$$Telecommuter\ Surplus\ (Herein\ TS) = ABPTPY - total\ cost$$

where the total cost is equal to the average annual internet subscription cost by dwelling types.

Finally, we computed the telecommuter surplus for different numbers of days telecommuted per week and the findings are summarized in Table 4 and Table 5.

In plain language, our findings indicate that in the SWIFT area, telecommuters can enjoy at least $12,000 more in savings (based on telecommuting three days a week) at the end of the year (2017). This finding, in and of itself, is a significant benefit to the individual telecommuter.

3.3. Limitations

The formula in section 3.2 uses average wage as a proxy for the opportunity cost of time. We fully acknowledge that the time spent traveling to work may not equal to the time not worked. Moreover, estimating the actual value of time not spent on commuting may involve variables that are not observable, such as an increase in the overall utility of a worker from reduced stress, better time management as well as some workers shirking their duties (a negative impact). The average wage may also vary by dwelling types, thus, using a single average for all dwelling types may be an over generalization. Our choice of variables in the formula, including average wage as a proxy for the opportunity cost of time were purely based on the availability of data, thus, fully acknowledge the limitations of our results. We hope to address these issues in future if data becomes available. Also, total net benefits from the social point that includes all externality impacts of telecommuting (both positive and negative) would be another interesting and relevant topic. We leave this for future research.

4. Discussion

Three factors contribute to the measurement here of telecommuter surplus: total commute distance, the number of days telecommuted per week, and the total time it takes to complete the round trip. Total commute distance is important since it directly impacts out-of-pockets costs such as fuel, car maintenance and insurance. Total time to complete the commute (round trip) is also

Table 4
Annual telecommuter surplus for various telecommuting days per week for the first reported telecommuter by dwelling types.

	2*	3	4	5
Home and Primary Residence (n = 2899)	$8820	$13980	$18972	$23964
Farm and Residence (n = 624)	$10062	$15984	$21652	$27320
Business and Residence (n = 310)	$10581	$17050	$23238	$29426
Secondary or Seasonal Residence (n = 77)	$9406	$14868	$20120	$25372
Other (n = 38)	$10389	$16704	$21768	$28872

Note: * 2, 3,4, and 5 represent the total number of days telecommuted per week. All measurements in CAD$. The “n” represents total sample size and not the total number of observations used to calculate each column because some respondents did not answer all the survey questions.

Table 5
Annual telecommuter surplus for various telecommuting days per week for the second reported telecommuter by dwelling types.

	2*	3	4	5
Home and Primary Residence (n = 2899)	$7542	$12108	$16476	$20844
Farm and Residence (n = 624)	$10160	$16140	$21860	$27580
Business and Residence (n = 310)	$9216	$14866	$20326	$25786
Secondary or Seasonal Residence (n = 77)	$13176	$20640	$27816	$34992
Other (n = 38)	$8172	$13272	$18212	$23152

Note: * 2, 3,4, and 5 represent the total number of days telecommuted per week. All measurements in CAD$. The "n" represents total sample size and not the total number of observations used to calculate each column because some respondents did not answer all the survey questions.

equally important since it directly relates to the opportunity cost of time. Hence, greater is the commute distance and longer is the time it takes to complete the commute, greater will be the benefit to a worker from telecommuting.

For dwellings in SW Ontario which responded to the SWIFT surveys which had more than one telecommuter, a typical savings to the first reported telecommuter telecommuting 3 days a week ranges from $13,980 to $17,050 per year. The second telecommuter saved $12,108 to $20,640. These results vary depending on the dwelling type. We can hypothesize that as more remote residents and farms as well as seasonal dwellings gain improved access to broadband, the telecommuter surplus may increase.

It is important to note that the estimates of the benefits above are strictly private net benefits to a telecommuter. There are numerous reasons why social benefit of telecommuting may exceed the private benefit of telecommuting. In Table 1, above, we summarized possible advantages of telecommuting based on the review of literature. For example, telecommuting directly reduces the use of automobiles on the roads. This in turn means, in social terms, less road congestion which helps other drivers for whom telecommuting is not an option, or not an option each day of a work week.

In this paper, we have not included detailed data analysis of current connectivity across the region, and considered, for example, if access to a specific type of internet connection (e.g. fibre) correlates to telecommuting. This will be addressed in future study of the SWIFT surveys. As well, the literature supports the need for further and updated research on the social benefits of telecommuting in SW Ontario, particularly as rural connectivity improves across the region. Lister and Harnish (2011,2011a) estimated that the aggregate savings for Canadians from telecommuting amounts to $53 billion annually. Our findings do not yet include worker productivity and firm profitability. Thus, the savings from telecommuting could be much higher.

Finally, the benefits estimated in our paper and noted above are what current subset of broadband users (i.e. telecommuters) are experiencing in SW Ontario. To determine the net return (i.e. social benefits) of additional investment in broadband in SW Ontario, we will need to focus on the potential benefits for currently unserved/underserved population in the region and weight it against its costs. We hope that this paper has established a strong baseline for tracking the economic impact of telecommuting within and across the region of Southwestern Ontario and serve as a useful benchmark for our future research on economic impact of broadband.

5. Conclusions

The focus of this paper was to examine the economic benefits for rural telecommuters in SW Ontario. We present preliminary analysis of the telecommuter surplus based on data collected by ongoing SWIFT surveys which include a range of variables that will, in time, deepen the analysis of the relation between improved internet connectivity and telecommuting, as well as other economic and social benefits for residents and farms across SW Ontario. While we recognized that there is recent and relevant policy literature which identifies the positive impacts of telecommuting within Ontario's economy, there is a need for further analysis. While worker productivity and firm profitability are correlated to telecommuting, we lack comprehensive assessment of the economic benefits of telecommuting in SW Ontario. Although telecommuting is not without any costs, we would argue that there is still room for greater benefits to be realized from telecommuting. In this paper, we have focused on the worker's benefits of telecommuting as private net benefits, which we refer to as the telecommuter surplus. As SWIFT continues to develop its dataset, we recommend further analysis of the residential/farm use of the surplus.

In conclusion, as the SWIFT initiative continues to bring connectivity to one of Canada's most densely populated regions we expect telecommuting to be of private net economic benefit with an opportunity for substantial social benefit. Future analysis to incorporate externality benefits of telecommuting as well as its full costs (such as construction costs if broadband investment decision is to be made in an area) is necessary to fully understand the total impact of telecommuting. We intend this for a future research topic as we move forward in the identification of economic outcomes of rural broadband infrastructure in SW Ontario.

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