Improving the Fiscal Transparency and Sustainability of Public-Sector Transportation Infrastructure

by

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A thesis
presented to the University of Waterloo
in fulfillment of the
thesis requirement for the degree of
Master of Applied Science
in
Civil Engineering

Waterloo, Ontario, Canada, 2017

Author's Declaration

This thesis consists of material all of which I authored or co-authored: see Statement of Contributions included in the thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Statement of Contributions

This thesis contains sections that have been previously incorporated in journal articles and conference proceedings, noted below:

"Origin Revenue Sources for Infrastructure Funding: A Case Study for Waterloo, Ontario"

To be published in late 2017 in the Transportation Research Record. This paper was co-authored by myself and my supervisors Dr. Bachmann and Dr. Casello. I was the primary author on this article.

- **Chapter 2: Literature Review**: Some references and literature discussion concerning the benefit model and existing contribution quantification studies.
- **Chapter 5: Static Origin Revenue Sources Analysis**: Original methodology (without FIR or AFR contributions), original results for Waterloo, and some of the discussion.

"Sustainability Analysis of Transportation Infrastructure in Waterloo, Ontario"

Published in the Canadian Transportation Research Forum 52nd Annual Conference proceedings, which took place in May 2017. This paper was co-authored by myself and my supervisors Dr. Bachmann and Dr. Casello. I was the primary author on this paper.

- **Chapter 2: Literature Review**: Some references and literature discussion concerning the key performance indicators.
- **Chapter 6: Temporal Fiscal Sustainability Analysis**: Key performance indicator methodology, indicator comparisons for Waterloo, and some of the discussion.

Abstract

Public-sector infrastructure funding is a complex and often unclear process. Cities operate most efficiently if there is an adequately-funded transportation network with which residents and visitors can easily travel from origin to destination. Building these networks comes with challenges, which are often rooted in funding concerns. Part of this may be due to deficient understanding among the public and in governments about how transportation is truly funded, due to the opaque nature of many elements of government funding flows.

This research addresses a need for methods that improve the transparency and fiscal sustainability of transportation infrastructure. Financial flows across governments are disaggregated and mapped across four tiers of infrastructure – federal, provincial, regional, and local – using the circular flow diagram as the base framework, to provide an understanding of how governments receive and spend funds. Origin revenues for water and transportation infrastructure in Waterloo, Ontario are determined, then the benefit model, which links revenues with effective expenditures, is used to evaluate whether the origin revenue sources being used to pay for each infrastructure system is effective. A sustainability analysis is then conducted for Waterloo and Toronto, comparing road and transit funding against the rate of infrastructure growth.

The results suggest that water revenue in Waterloo is well-linked to the infrastructure, roads and active transportation are somewhat well-linked, and transit is not linked as well. Roads could be better linked if technology is implemented that allows better tracking of independent vehicles in urban settings. Roads in Waterloo and Toronto were found to be somewhat sustainably funded, although they trended in opposite directions, and transit funding was found to be less sustainably funded in Toronto, and somewhat sustainably funded in Waterloo pending the completion of the ION rapid transit system.

Acknowledgements

Like most things in life, a student's grad school experience can range wildly from one person to the next. I was fortunate to be able to have an incredibly positive experience over the past two years, and it was thanks to many people who made my work (and my time outside of it) very enjoyable.

I would like to start by thanking my two supervisors: Prof. Chris Bachmann and Prof. Jeff Casello. Jeff bridged the gap between my passion for transit and being able to speak intelligently about it, and I am thankful for his excellent teaching, optimism, and wise perspectives, which pushed me in a direction from which I have never looked back. Chris was a constant force of positive motivation, whose relentless work ethic and confidence in his own abilities inspires me every day. His openness and attentiveness nurtured my ambition and an admiration for research I never knew I had, and I will always be grateful for his encouragement to work harder and perform my best.

My research was in part an effort in understanding the thought processes of governments, and that would not have been possible without guidance from others along the way. I am thankful for the assistance provided from Erin Gray and Craig Dyer from the Region of Waterloo, and from Filipa Reynolds from the City of Waterloo, who helped fill in the gaps in municipal finances with patience and kindness. I'd also like to thank John Cicuttin and Blair Allen from Grand River Transit, Eric Chu from the Toronto Transit Commission, Andrea Buckley and Geoff Keyworth from the Region of Waterloo, Jeff Little and Philip Hewitson from the City of Waterloo, and Mark Berkowitz from the City of Toronto for hunting down infrastructure data for me, making my research possible. I'm also grateful to Prof. Bruce Hellinga and Prof. Jeff West for reviewing my thesis.

I would like to thank the cluster of transportation graduate students and other friends that kept me motivated throughout my studies. My close friends in my research groups, my housemates, my friends from undergrad still going to Waterloo have made sure that my time outside my office was memorable and enjoyable. I would be remiss if I did not also acknowledge the transportation advisor in SimCity 2000, who taught me the importance of not cutting back on funding at an early age. One could say I was exposed to transportation economics before I knew what it was.

Finally, I would like to thank my family, who provide endless unconditional love and pride in what I do, even before I tell them what I'm doing. I have learned to never take for granted the foundation of care and support they have given me, from which I am able to do whatever I dream to do.

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List of Abbreviations

CIRRF Capital Infrastructure Reinvestment Reserve Fund.

CPI consumer price index.

CRA Canada Revenue Agency.

FIFO first-in first-out.

FIR Financial Information Return.

GDP gross domestic product.

GRT Grand River Transit.

KPI key performance indicator.

LOTT local option transportation tax.

LRT light rail transit.

OAS Old Age Security.

OE operating expenditures.

PA-C Public Accounts of Canada.

PA-O Public Accounts of Ontario.

TE total expenditures.

TTC Toronto Transit Commission.

Chapter 1

Introduction

A primary function of many local governments in Canada is to build and maintain public infrastructure and social services. While private infrastructure, like houses and corporate offices, is intended for a subsection of the population, public infrastructure is intended to be used by all residents under a local government's jurisdiction. With respect to transportation infrastructure, local governments may take responsibility for building and maintaining the finances of sidewalks, trails, local roads, parking and public transit. Municipalities are placed under various political structures and fiscal arrangements, which provide context to how transportation infrastructure is funded in different jurisdictions. This research examines how municipalities fund transportation infrastructure, with the objective of assessing the transparency and sustainability of funding mechanisms in Ontario municipalities.

1.1 Municipalities in Ontario

As a federation, Canada allows its provinces to independently make decisions in a series of portfolios, and municipal structures fall under their jurisdiction (Department of Justice Canada, 1867, s. 92). This leads to great differences in municipal government structures and laws between provinces. Consequently, there are large differences in how transportation infrastructure is managed at the municipal level. Of all the provinces, Ontario has one of the most complex transportation networks, due to its status as the largest province by population and as one of the only provinces with significant transportation links in both east-west and north-south directions.

Ontario is divided into geographic areas, which consist of territorial districts and

municipalities, following Ontario Regulation 180/03. Northern Ontario is divided into districts, which do not operate as local governments but provide provincial and judicial services. Within each district, each organized community operates as a single-tier municipality. The only area that is not a district in Northern Ontario is Greater Sudbury, which is a single-tier municipality. Southern Ontario is divided into single-tier municipalities and two-tier municipal structures. Single-tier municipalities contain residents which are not part of another municipality, and do not contain multiple municipalities. Two-tier municipal structures consist of an upper-tier municipality containing multiple lower-tier municipalities.

In two-tier municipal structures, upper-tier municipalities are commonly called regional municipalities or counties, and lower-tier municipalities are usually referred to as cities, towns, townships or villages. These names usually no longer hold any legal meaning (Ontario Ministry of Municipal Affairs and Housing, 2014), but generally indicate the structure of the municipality before 2003 (Government of Ontario, 2001, c. 25, s. 455). Regional municipalities, or regions, tend to provide a larger share of municipal services like public transit and water services, while counties tend to delegate most services to local governments. Cities, towns, townships and villages are mostly population or status identifiers for lower-tier municipalities (Association of Municipalities Ontario, 2013). This is commonly in the form of a region or county as the upper-tier municipality, and a city, town, or village as the lower-tier municipality. There is much focus in existing literature on the financial structure of single-tier municipalities, particularly for Toronto, likely because its the largest city in Canada. 49% of Ontario residents live in two-tier municipal structures (Statistics Canada, 2012), of which 80% live in regions, so research in these municipalities impacts many Ontario residents.

1.2 Public-Sector Project Funding

Transportation infrastructure tends to be one of the main pillars of a municipal government's expenses. Using Ontario's nine largest single- or lower-tier municipalities as an example, transportation networks were responsible for a median 20% of their operating and capital expenses in 2015, representing a range from 12% to 42%[1]. Municipalities with expense shares below 20% tended to be lower-tier municipalities with no responsibility for transit, which was delegated to their respective upper-tier

[1]Calculations are derived from municipal reports for Brampton, Hamilton, Kitchener, London, Markham, Mississauga, Ottawa, Toronto, and Vaughan. Specific sources for each city can be found in the references.

municipalities, where the expense share of transportation was closer to 20% (Deloitte LLP, 2016, p. 24; Emmerson, Macgregor, Hughes, & KPMG LLP, 2016, p. 71). In essence, the transportation network is often one of the top fiscal priorities of a municipality.

The revenue used to pay for transportation networks at the municipal level can be unclear. Revenue refers to money received from governments, residents, and businesses, and expenditures are the goods and services provided by the government. Municipalities are limited to a select set of revenue sources (Government of Ontario, 2001, s. 391-398): property taxes, user fees, development charges, debentures (or loans), and transfers from higher tiers of government (or intergovernmental transfers). At this level of detail, it is generally understood that roads rely more heavily on property taxes and transit relies more heavily on user fees, with both systems requiring investment from the other sources of income, particularly intergovernmental transfers. The composition of these intergovernmental transfers is not specific, with a few notable exceptions like the federal and provincial gas tax funds. Additionally, municipalities make frequent use of reserves and reserve funds, which are intended for saving revenues until a later date. While some reserve funds are mandated to receive specific types of revenue to be spent on specific expenses, many other reserves and reserve funds have unclear contributions. The combination of the use of reserves, reserve funds, and generalized intergovernmental transfers introduces uncertainty into the funding mix for infrastructure projects.

The uncertainty behind how municipal projects, and even higher tier government projects, are truly funded plays out in public discourse and in political spheres. National news articles written about the federal equalization program, where some provinces receive federal transfers if they are unable to raise revenues to the same level as more successful provinces (Finance Canada, 2011), tend to focus on the idea of one province 'paying' for another (Wiebe, 2016), even if that is not how the program operates. In turn, the concept of some provinces paying for others to operate trickles down into municipal funding mechanisms, since municipalities will receive transfers from provinces with unclear mixes of revenue sources, some of which may include equalization payments. This can contribute to skepticism of the funding model as a whole. Furthering this skepticism is concern about the nature of political cycles. Since representatives tend to be elected on a four-year basis, there is incentive for them to focus on projects that can show progress within their four-year term. Consequently, there tends to be greater promises of funding around election cycles, and in some municipalities, a trend of incumbent members overestimating revenue and underestimating expenditures to put themselves in a more favourable position (Benito, Guillamon, & Bastida, 2015, 1).

At the municipal level, the way funding is described can obscure the true costs of funding and the sources used to pay for them. For example, the use of the farebox recovery ratio, which measures the percent that transit fares cover the operating cost of a system, is often simplified as a representation of how much a transit rider pays for the transit system to exist in its entirety. However, capital costs for a transit system in a given year can be equal to, if not more than, the operating costs. One study evaluating rail systems estimated capital costs for a variety of American rail transit networks in 2008, which averaged out to be a few percentage points higher than the operating costs (Guerra, 2011). Reliance on the farebox recovery ratio as a measure of how much a transit rider contributes to the system would therefore be inaccurate, assuming the data for this year are representative of normal years, because on average the rider is contributing half of the farebox recovery ratio with their fares. The capital costs then need to be covered via other means, sometimes through intergovernmental transfers, reserves, and reserve funds, which have generalized sources of revenue. At first, it seems simple how transportation infrastructure is funded, because of the limited funds available to a municipality. By realizing the opacity of these funding sources, the true funding mechanisms of infrastructure becomes unclear.

1.3 Problem Statement

At the crux of many decisions concerning local transportation infrastructure is the source of revenue used to pay for these projects. Unfortunately, these revenue sources are described quite broadly and are obscured by the budgeting methods used by all levels of government, leading to confusion and misunderstanding of funding models among the public. Public infrastructure funding is often opaque, both for politicians who decide where revenue is sourced and the public who need to understand these funding mechanisms. In the long-term, this leads to erosion of public confidence in the government, and damages the ability of governments to build future infrastructure projects.

1.4 Research Objectives

This research has two primary objectives, which aim to improve the public understanding of government funding. The first objective is to improve the transparency of funding, and the second objective is to develop new methods for tracking fiscal sustainability.

By improving funding transparency, it becomes easier for one to see where their money goes once it has entered the government cycle. At some point, the revenue a

government receives becomes abstracted to the point that any segment of the population can make their own interpretation of how that money is raised and spent. The abstraction of revenue is a factor in the argument made that one segment of the population subsidizes another, whether it's between provinces, municipalities, or even neighbourhoods. In reality, determining which residents within provinces are subsidizing others is hard to determine with accuracy, so the first goal of the research is to build a statistically-driven model to allocate revenues to expenditures, across all tiers of government. Revenue-expenditure linking models enable governments to make more intelligent decisions concerning the use of their available revenues, and enable residents to more easily understand how their finances are used.

The connection between fiscal sustainability and public understanding of finances may appear less immediately obvious, but debate over whether an infrastructure project or network makes fiscal sense arises often enough that this issue is not resolved. Existing mechanisms of measuring fiscal sustainability are explored in previous literature, then a suite of measurement techniques are proposed that would better enable sustainability measurement. These metrics enable governments to better monitor funding and prepare for long-term infrastructure needs, with the potential for shifting away from reliance on transfers from higher tier governments. Improved measurement techniques could also help residents better understand if their public projects will damage their ability to spend in the future.

1.5 Research Scope

This research uses the City of Waterloo and the City of Toronto as the case study areas. The City of Waterloo is a lower-tier municipality within a two-tier municipal structure, where the Regional Municipality of Waterloo is the managing upper-tier municipality. The City of Toronto is a single-tier municipality. For brevity, the municipalities are shortened as follows throughout this thesis:

- City of Toronto: Toronto
- City of Waterloo: Waterloo
- Regional Municipality of Waterloo: Region of Waterloo

Waterloo is the smallest city in the Region of Waterloo with a population of 133,700 in 2015 (V. Martin & Parkin, 2016), but has a larger transit-captive population than the Region's

other municipalities due to the presence of two large universities: the University of Waterloo and Wilfrid Laurier University. Notably, the Region of Waterloo began construction of the ION in 2014, a 19-km light rail transit (LRT) system connecting Kitchener and Waterloo. The approval and construction of the system has fuelled debate in the Region of Waterloo concerning who pays for different modes of transportation and who deserves the limited space available for transportation networks (Neufeld, 2014; W. Martin, 2016), so research that increases the transparency of transportation funding is timely in this region.

As a single-tier municipality, Toronto is the largest city in Canada with a population of 2,826,498 in 2015 (St Amant, Rossini, Wallace, & PricewaterhouseCoopers LLP, 2016, p. 143), and is the capital of Ontario. The city was formed in 1998 from six lower-tier municipalities and one upper-tier municipality as part of a larger initiative to merge two-tier municipalities into single-tier municipalities. Toronto's history with transportation infrastructure has been relatively dramatic and intertwined with the city's politics. The system of municipal highways proposed in the mid-20th century was ultimately only half-constructed due to opposition by frustrated residents, including notable urban activist Jane Jacobs. One of the remaining highways, the Gardiner Expressway, is now undergoing controversial and expensive rebuild processes (Rider & Kalinowski, 2015). In the transit network, Line 3 Scarborough is a medium-capacity rail system undergoing replacement that has been at the forefront of recent Toronto municipal elections. Similar to the issues raised by the ION in Waterloo, the debate around the Gardiner and Line 3 Scarborough replacements are, in essence, about cost and transparency of funding. The true cost paid by road users versus transit users, which reflects the degree to which each party believes they deserve the construction and operation of their desired network, is not simple to derive. This is because the funding mechanisms for allocating revenue to municipal programs is not simple.

1.6 Structure of Thesis

The first two chapters of this thesis discuss the research area. Chapter 1 introduces the research. An outline of the structure of Ontario governments is provided, along with context of the cities used as study areas. The problem of a lack of funding transparency is stated, leading to the objectives of the research and the scope of the project. Chapter 2 covers the existing literature, and where there are potential areas for future research.

The next two chapters describe the theory behind this research. Chapter 3 describes the data sources used, which fall into three general categories: financial, infrastructure, and

other. Chapter 4 describes how funding flows into, between, and out of governments. A framework is introduced based on circular flow diagrams of the economy to provide clarity in how governments receive and spend funds.

The last three chapters cover primary outputs of this research. Chapter 5 outlines a static analysis of origin revenue sources. Chapter 6 conducts a temporal analysis of fiscal sustainability using a new key performance indicator. Chapter 7 concludes the thesis and discusses the areas for future work.

Chapter 2

Literature Review

Before exploring the mechanisms of government finances, a review of existing literature is necessary to understand the intricacies of public economics. Topics reviewed in this chapter include the differences between unitary states and federations, municipal governance structures and funding mechanisms, current literature concerning effective road pricing, and existing fiscal sustainability measures. A review of these findings are presented at the end of the chapter, focusing on the area of literature to which this research aims to contribute.

2.1 Governance

Canada is a federation, which is a less common form of national government. Other federations include the United States, Russia, Brazil, and Australia. Most nations are unitary states, where the national government is the ultimate authority concerning how the land is governed. In unitary states, subnational units are created and dissolved at the national government's pleasure. In federations like Canada, subnational units like provinces have power over some aspects of governance, and the national government has power over other aspects, but the national government is unable to autonomously dissolve the provinces. This fundamental difference leads to different approaches and views about how infrastructure is funded, because the responsibility for that infrastructure shifts to some degree. Each federation chooses to use fiscal transfers in their own ways. In Canada, fiscal capacity of subnational units (provinces) plays a strong role in which areas get more transfers (Bird & Tarasov, 2004).

The importance of understanding the fiscal patterns of federations can not be

understated. Aside from some of the largest countries in the world operating through a federal model, previous studies suggest the idea that federal models, or at least some sort of decentralization, will become more common (Cerniglia, 2003; Rosen, 1988). Across multiple indicators, decentralization was found to most strongly correlate with increased population and less strongly with urbanization, so if the world population continues to grow and concentrate in cities, there may be a higher likelihood of further decentralization.

2.1.1 Municipalities

Municipalities are the main operators of Canadian infrastructure, so understanding the fiscal patterns of various municipalities is also essential. Alongside the single and two-tier municipal structures present in Ontario, there are special-purpose districts, which are single-purpose governments common in the United States, and voluntary co-operation agreements, where municipalities self-organize to provide select services (Bird & Slack, 2006).

Many municipalities are undergoing fiscal crises, as they take on new infrastructure responsibilities but are stuck with a limited set of revenues with which to pay for these projects. After the 2008 recession, American cities face indirect pressures as the country's population ages, leading to rising costs in state governments for Medicaid and other social security programs (Kiewiet & McCubbins, 2014). This results in less assurance that transfers can be made to cities that undergo financial problems like Detroit, which was forced to declare bankruptcy in 2013. Transfers from the federal level are less secure revenue sources than in the past as well, since the federal government has struggled with its own ability to raise revenue (Schank & Lewis, 2013), leading to calls for municipalities to be allowed to develop their own methods for charging users for roads to make up for the expected losses in transportation funding transfers. Toronto recently tried to make up for a gap in funding by implementing road tolls on its expressways, but this was rejected by the province (Benzie, 2017).

2.2 Benefit Model

The connection between revenue sources and expenditures has been well explored in a series of studies and reference literature from the University of Toronto (Bird, 2003; Kitchen & Slack, 2003; Slack, 2009). These works suggest that local governments should adopt

the "benefit model" of financing, where the type of good being funded – private, public, spillover, or redistributive – is indicative of what funding scheme may be most appropriate as the primary revenue source of infrastructure systems. More widely, a resident paying a fee or tax should be able to correlate the need for that revenue source with a government good. Spillover goods are defined as those that provide benefits to residents of other municipalities. Redistributive goods are defined as those that redistribute income from richer residents to poorer ones.

This model shares roots with the user pay principle, a concept that people should pay for the goods and services that they use. In this principle, taxes should be levied on public goods, and user fees on private goods, where an end user can be identified. This is traditionally presented as a solution to the free-rider problem, where some users pay for a good and others take advantage of their good fortune (Groves & Ledyard, 1977, 4).

A resourceful government will leverage various forms of revenue to accomplish different goals, following guidelines like the ones summarized in Table 2.1. The ideas here reflect the benefit model and user pay principles: each revenue source has a more effective expenditure with which it can be linked than if it were spent on something else. For example, debentures, also referred to as bonds, are collected mostly from future residents, since they are paid back over a long period of time. They would therefore be most effective for assets that will last for many years, since it makes less sense to make future residents pay for existing short-term expenditures like income support.

Table 2.1: Sample guidelines for targeted revenue sources, adapted from Slack, 2015.

Revenue	Collected From	Linked Expenditure
Debentures	Future generations	Goods with long service lives
Development charges	Developers	Growth-related costs
Gas tax	Road users	Roads
Income tax	Wealthy residents	Redistributive goods
Intergovernmental transfers	Residents of province/Canada	Spillover goods
Property taxes	Residents of an area	Public goods
Sales tax	Visitors to an area	Public goods with spillover effects
User fee	Users of good	Excludable goods (e.g., private)

Revenue-expenditure linkage has important connections to transportation infrastructure. If a revenue source is ineffective at capturing revenue from the people who actually use the system, the system will lose public support.

2.3 Transportation Pricing

One of the most extensively covered fields of literature covering the junction of government finances and transportation infrastructure is road pricing. Much of this research is oriented around the United States and the level to which road users cover the cost of their road infrastructure. Transportation pricing literature can be broadly categorized into three subsections: gas taxes, alternatives for road pricing, and transit pricing.

2.3.1 Gas Tax

Gas taxes are, at a glance, the most obvious way that road users pay into the road network. In many locations in the United States, gas taxes collected at the federal and state levels are the largest funding source for highways (Fackler & Niemeier, 2014), and have been for many years. Many in the public assume that gas taxes cover the full cost of roads, but numerous studies have proven this to be untrue, with one study finding that gas taxes, tolls, parking charges, and traffic fines account for 80% of the revenue used to pay for the road network in the United States in 1997 (Morris & Decicco, 1997), and a similar study finding the revenue share to stay between 80-90% over the following decade (Delucchi, 2007). This contrasts with European road networks, which generally take in more revenue than they cost to operate (Gomez & Vassallo, 2013, 3), and tend not to allocate this revenue directly to roads.

The distinction between the fee-like nature of gas taxes in the United States and the more general tax-like nature of gas taxes in European and Canadian governments is important for purposes of research in this field and for understanding the context of relevant literature. Like European countries, gas taxes in Canada do not follow the same principle as American gas taxes. User fees generally are fees applied directly on a good or service, that go back into that good or service. In Ontario, neither the federal nor the provincial gas taxes should be considered a proper user fee under this definition. At the federal level, gas taxes are grouped together with the rest of Canada's revenue, and for the most part, expenditures are paid through one consolidated budget, as almost all taxation revenue is received through the Canada Revenue Agency (CRA) (Receiver General of Canada, 2017). The federal gas tax is partially redistributed to municipalities across Canada through the federal Gas Tax Fund, which distributes about $2 billion annually from over $4 billion in annual federal gas tax revenue. The remaining gas tax revenue is applied generally to Canadian expenditures. Notably, none of the remaining revenue is directly applied to roads, which are maintained by provinces and

municipalities (Department of Justice Canada, 1867, s. 92). The Gas Tax Fund transfers to municipalities are not necessarily earmarked for roads either, as the federal government allows the funds to be distributed to water, transit, and tourism, among other possible outlets (Infrastructure Canada, 2017).

Provincial gas taxes in Ontario undergo a similar process to federal gas taxes. Taxes are collected on diesel fuel and traditional gasoline separately (Ontario Treasury Board Secretariat, 2017), and are put into the general Ontario budget. Ontario recently launched a provincial gas tax transfer program, which redistributes about $330 million of the provincial gas tax annually towards municipal public transit systems from an annual revenue of nearly $2.5 billion. The remaining revenue is allocated generally across the province's budget, but there is potential for linkage between the remaining revenue and provincial transportation systems. Ontario's highway system in 2015 cost approximately $1.3 billion, to which the gas tax likely contributes.

In both countries, the usefulness of the gas tax in the long-term is in question. Vehicles are moving away from internal combustion engines and the use of gasoline, meaning taxes on gas-powered vehicles will no longer be an effective way of capturing revenue from all road users. There is a shared view in most literature that distance-based user charges on roads will replace or augment the gas tax system at some point (King & Fox, 2015; Duncan & Graham, 2013; Zhao, Guo, Coyle, Robinson, & Munnich, 2015, 2).

2.3.2 Alternative Road Pricing Methods

The most common road funding strategies proposed in recent studies tend to be variations of a distance-based user charge. These charges would be based on how far a vehicle travels, instead of the amount of gas it consumes. A 2014 model of the Washington-Baltimore region found that replacing the Maryland gas tax with a distance-based user charge would provide the best improvement in traveler welfare and travel time savings (Welch & Mishra, 2014). In Vancouver, the close proximity to the United States, where gas tends to be cheaper, has accelerated the decrease in gas tax revenues even though vehicle registrations have increased. This decoupling results in a less effective relationship between the gas tax and road usage, straying from the concepts of the benefit model, leading to the conclusion that a distance-based user charge may be preferable (King & Fox, 2015). Furthermore, annual distance travelled was shown to decrease as a car ages, so more efficient cars are able to put more strain on the road system without paying as much as an older car.

One method for implementing distance-based user charges is through electronic systems.

One of the earliest proposals for electronic road pricing in cities was in Hong Kong in the mid-1980s, which would have used electronic plates on the vehicles and loop detectors connected to computers in the road with backup roadside cameras to monitor when vehicles enter or exit the central business district (Borins, 1988). Despite the high share of non-auto modes, the proposal was assumed to have failed due to pressure from special interest groups, long implementation timelines, and concerns about surveillance. Other countries began to implement forms of electronic road pricing on toll highways at this time, which had the benefit of already being tolled, so the backlash was less severe. Since then, automated tolling has been implemented in many other countries. In 1997, Highway 407 in Ontario was the first highway with fully automated toll collection in the world (Plant, 1998). The usage of automated tolling in highways and the general improvement in technology over the last 30 years should generally make it easier for electronic road pricing in urban environments to exist. Proliferation of social media and the increased use of distance and GPS trackers by auto insurance companies and manufacturers also would generally reduce concerns over surveillance. Combined with a self-reported system with tax-like audits and other opt-in options, distance-based user charges would likely have an easier time gaining political acceptance (Duncan & Graham, 2013).

Another common road pricing method that has already been enacted in many cities already is congestion charging. One of the most famous examples of this is in London, where the central business district is only accessible by car if a fee is paid. The implementation of congestion pricing in London and other cities has provided valuable lessons about the benefits and drawbacks of congestion pricing. Using observed data in Stockholm, introduction of a congestion charge was found to decrease consumer surplus, which represents the financial satisfaction of residents, but improve government revenues and reduce negative externalities to the point that there was a net social benefit (Eliasson, 2008). The Hong Kong electronic road pricing proposal was also a form of congestion pricing, but the implementation method in London had key differences that enabled it to move forward. Compared to Hong Kong and another proposal for congestion charging in Cambridge in the United Kingdom, London was demonstrated to have a clear and unarguable need to curb congestion, the planning process clearly indicated that revenues would be put back into transportation projects, and the technological design was simple enough for residents to quickly understand (Ison, 2004). Conversely, the London's congestion pricing system administration and operation of the toll network originally cost half of the system's total revenue (Transport for London, 2005), but this has improved over the following decade to a third of the system's revenue (Transport for London, 2015), mostly due to increased revenue.

2.3.3 Transit Pricing

Finding the most effective method of funding transit systems is also important, as this has impacts on the road and active transportation modes as well. Apart from a select few transit systems in Asian cities and London (Lindquist, Wendt, & Holbrooks, 2009), transit agencies operate with some form of subsidy to make public transit competitive with driving. Subsidies have been found to generally increase the welfare of individuals even at high levels (Parry & Small, 2009), although this changes if parking subsidies are also removed (Proost & Van Dender, 2008). Transit is able to move more people in less space than automobiles can, and provides reductions in the amount of parking needed in a city, so this behaviour is generally encouraged. However, subsidizing transit is considered a second-best option, as pricing on automobiles was found to better capture the externalities of automobiles (Parry & Small, 2005), and the pricing of each mode without subsidy would better reflect their cost.

As municipalities experience heavier strains on their general property tax levies or higher tier governments change spending priorities, transit systems risk budget and service cuts (Hess & Lombardi, 2005). Many systems can not raise revenue solely through user fees, at risk of having a large loss in ridership, which would result in a loss in service. Similar to road networks, revenues outside of property tax and user fees have been explored as payment options.

In the United States, a stable method for raising revenues is through local option transportation taxes (LOTTs), or taxes that are managed either locally or regionally that are earmarked for transportation projects (Goldman & Wachs, 2003, 1), typically enacted through a local referendum. LOTTs can consist of any form of revenue, including sales taxes, licence and registration taxes, and gas taxes. Their popularity lies in part because of their transparency. It is clear to a resident that a 1% sales tax for transit projects will work as it sounds: the local government will intake a 1% sales tax, and will spend it directly on transit. The type of revenue used for proposals has a large role in the success of a government's ability to pass a LOTT referendum. Referenda that proposed funding through debentures had a higher chance of passing than those that used taxes, perhaps due to the shift in responsibility to future generations to pay off the transit project (Dixit, Rutstrom, Mard, & Zielske, 2010). A 2015 proposal to implement a sales tax LOTT for transit in Vancouver was unsuccessful, but after the governing provincial party lost a large number of seats in the region, the requirement for a referendum for new transit funding was dropped (Britten, 2017).

2.4 Fiscal Sustainability

A government that can spend in a sustainable manner is one that can spend money on infrastructure with the comfort of knowing that when the infrastructure reaches the end of its useful life, the infrastructure can be replaced affordably to provide the same net benefit to future generations. Governments and various monitoring agencies make use of key performance indicators (KPIs) to verify if a government is operating in a fiscally sustainable manner. A selection of some more notable KPIs is provided in Table 2.2.

Table 2.2: Existing infrastructure growth key performance indicators.

KPI	Definition	Characteristics	Sample Usage
Debt-to-GDP ratio	Debt held as a percent of GDP	Ties debt to economic health of jurisdiction, ignores population and infrastructure supply	IMF (International Monetary Fund, 2016), literature (Hiraga, 2015)
RE/$1000 PI	Revenue and/or expenditures per $1000 of personal income	Ties revenue and spending levels to wealth of jurisdiction, ignores infrastructure supply	Literature (Chapman, 2008)
RE per capita	Revenue and/or expenditures per person	Ties revenue and spending levels to population, ignores infrastructure supply	Literature (Chapman, 2008)
OE per lane km	Operating expenditures per lane kilometre (roads)	Ties spending levels to infrastructure supply, ignores population	Ontario Financial Information Returns (Ontario Ministry of Municipal Affairs, 2017)
OE per trip	Operating expenditures per passenger trip (transit)	Ties spending levels to infrastructure demand, ignores infrastructure supply and population	Ontario Financial Information Returns (Ontario Ministry of Municipal Affairs, 2017)

One of the most commonly referenced KPIs, which is used by the International Monetary Fund and higher tier governments, is the debt-to-GDP ratio (International Monetary Fund, 2016). The debt-to-GDP ratio measures how much debt a government incurs against the gross domestic product (GDP), or the value of all goods and services purchased for final use in the government's jurisdiction. This indicator is frequently used by federal, and sometimes provincial, governments to determine whether the government is solvent (i.e., if the government is capable of paying back its debts). The ratio has also been used in the political realm to attack or defend budget deficits. For example, in the most recent Canadian federal election, the Liberal platform included a plan to introduce large deficits, but at a rate that kept the debt-to-GDP ratio shrinking (Liberal Party of Canada, 2015). In 2011, Ontario's Finance Minister argued that the province's escalating

debt and annual deficits were of low concern (Gazze, 2011), referencing the moderate debt-to-GDP ratio and comparing it to the recent debt crises in Europe.

In municipal finances, debt-to-GDP ratios can prove challenging to use, and in some ways can be ineffective. Some sustainability measurements that make use of debt-to-GDP ratios acknowledge that this metric alone is not always appropriate, since the debt-to-GDP ratio does not necessarily relate to the need in many governments to pay for future expenditures, particularly those concerning old age and health care (Auerbach, 2016). Municipalities are also more economically and socially interdependent than countries or provinces, and generally do not individually track their GDP, so KPIs tend to be chosen that use more accessible variables. As a result, much literature and municipal financial documents point to other KPIs, which try to better correspond to what the municipality aims to measure.

Some literature references revenue and/or expenditures per capita (Chapman, 2008), which links the ability to raise or spend revenue to the population of the municipality. The concept of this indicator is that one can track how much is spent on a per-person basis over time, which in principle would identify infrastructure that is becoming more expensive per user.

A related proposed KPI is revenue and/or expenditures (RE) per unit income, used in a study to acknowledge that wealthier jurisdictions have different needs than poorer ones, and to reinforce the connection between government revenues and taxpayer incomes (Chapman, 2008). RE per unit income does not appear to be as widely used in government literature as the per capita indicator, but could provide an interesting contrast if residential income values are available.

In Ontario, municipalities publish reports to the provincial government on an annual basis, referred to as Financial Information Returns (FIRs). From 2000-2013, FIRs included a selection of performance measures with which the province could evaluate the fiscal performance of a municipality. The KPIs used for transportation infrastructure in these documents were operating expenditures per lane kilometre and operating expenditures per trip, for roads and transit, respectively (Ontario Ministry of Municipal Affairs, 2017). The selection of these two indicators together is of interest, since they do not quite perform the same measurements. Lane kilometres are a measure of infrastructure supply, which represents the ability of a driver to use a road, independent of the congestion level of that road. Transit trips, in contrast, are a measurement of infrastructure demand, or a transit rider's usage of the transit network.

Since each of these indicators measures something somewhat different, it is essential

for this research to begin at first principles, to develop a measure of what makes an infrastructure project fiscally sustainable with respect to a municipal government's ability to raise revenues and control costs.

2.5 Literature Gaps and Commonalities

As the United States is one of the largest countries in the world by population, it is understandable that much of the existing literature focuses on funding dynamics and government relationships within its borders. Canada, where this research is focused, is a federation like the United States, so some aspects of the transportation financing studies previously conducted can apply to Canadian governments, since they operate under the same principle: states (or provinces) have a high level of control over their municipalities and their own transportation networks when compared with the federal government. There is an opportunity for more research specific to the unique characteristics of Canadian governments to contribute to the discussion of infrastructure funding. One example of this is the gas tax, which is treated much differently in Canada than in the United States.

A strong element in public economics is the benefit model, which links revenue sources with expenditures that logically relate to one another. Taxpayers who can see the relationship between a tax or fee they pay and the destination of that revenue are more likely to support it than if the destination of the tax or fee is lost due to how governments tend to allocate revenue. An analysis of the revenue sources used to pay for infrastructure can provide insight into whether the benefit model is applied effectively for a given infrastructure network, but may be limited by available technology or costs. Roads, for example, are often congested in urban areas, but pricing mechanisms are challenging to implement outside of tolled highways and central business districts in cities with the political acceptance for congestion pricing.

Existing KPIs for fiscal sustainability measure different aspects of sustainability, since the term can be somewhat loosely defined. Some account for changes in population, some account for infrastructure supply, but each indicator is unable to include one of the variables that may be important when measuring fiscal sustainability. The lack of clarity in measuring sustainability suggests there is room for more indicators to be proposed, that may be able to more comprehensively measure fiscal sustainability.

Given that existing literature does not quantitatively identify the origin revenue sources in transfers and reserves, there is a potential niche for additional studies of the

funding mechanisms for specific jurisdictions, and for studies that apply similar methodologies to municipality-level expenditures, across all modes. Hence, this thesis develops two analyses: a static transparency analysis of water and transportation infrastructure funding across four tiers of government in Waterloo, and a temporal fiscal sustainability analysis of transportation infrastructure funding in Waterloo and Toronto.

Chapter 3

Data

The research in this thesis requires large quantities of data, the nature of which is outlined in this chapter. The majority of the presented data are financial, which was used in every stage of the research. A combination of different sources were used to generate a more accurate estimate of a municipality's finances, using a prioritization system that balanced accuracy with specificity, which tends to have a negative correlation among the various sources of data. Infrastructure supply values are presented for roads and transit in Waterloo and Toronto, which were used to provide comparisons between changes in infrastructure and changes in revenue and expenditures. Other data sources are also included that were used for a variety of purposes, such as population estimates.

3.1 Financial Data

Financial data were the most important source of data for this research, and in some ways was the most challenging to properly gather. Financial data covered in the scope of this research included detailed municipal finances (local and regional), and more aggregate provincial and federal finances. Detailed provincial and federal information was collected on an as-needed basis when it related to a municipality's finances.

3.1.1 Financial Information Returns

Each Ontario municipality is required to submit an annual filing, or FIR, to the Ontario Ministry of Municipal Affairs. This report is standardized across municipalities so that the provincial government can easily compare finances between municipalities and generate

statistics. Appendix B provides detailed listings of the information found in FIRs and how their structure has changed over the time frame analyzed in this thesis.

FIRs are assumed to have high levels of accuracy, since they are official filings to the provincial government, but there were occasions where the municipality either mistyped values or appeared to misinterpret the fields in the sheet. A fair assumption for why these errors appeared is because the filings are somewhat rigid, forcing municipalities to find more creative ways to represent their results in order to fit the standardized spreadsheet, and the filings may not be thoroughly reviewed, since some of the smaller typing errors would be noticeable even if one was not familiar with a municipality's finances. For example, provincial gas tax transfers are counted under "Ontario conditional grants," but there were multiple instances where some municipalities had a higher provincial gas tax contribution than the sum of all of their conditional grants from Ontario, which is mathematically impossible. The same municipalities would have other years where these two numbers were even, implying that the gas tax was the only contribution to their Ontario conditional grants and that they were included in the total, resulting in inconsistent behaviour. Even with these oversights, the data in FIRs were assumed to be some of the most reliable data available, due to its consistent nature and reliance on actual spending amounts instead of predicted spending, as is used in capital budgets.

3.1.2 Annual Financial Reports

While the FIR is intended for viewing by the provincial government and other municipalities, most municipalities publish an annual financial report that is published publicly for residents and other interested parties. A sample annual financial report and FIR are shown in Figures 3.1 and 3.2. These annual financial reports are audited or include an auditor's report. The information inside is somewhat general, but tends to be reliable since the reports are tailored to each city and the data must go through auditors before they are published. The main downside of these files with respect to this research is that all transportation network spending and revenue are aggregated. Hence, the files are most useful for verifying the sum of road and transit infrastructure values, and for finding other information that might not be in an FIR, such as city-specific reserves.

3.1.3 Operating and Capital Budgets

The most easily accessible and obvious locations to look for financial data related to infrastructure spending are municipal operating and capital budgets. Libraries and

THE CORPORATION OF THE CITY OF WATERLOO

Consolidated Statement of Operations

Year ended December 31, 2015, with comparative information for 2014

	Budget 2015 (note 17)	Actual 2015	Actual 2014 (note 2)
Revenue:			
Taxation (note 12)	$ 66,237,433	$ 66,426,463	$ 64,475,015
User charges	66,755,930	67,422,556	69,132,894
Grants:			
Province of Ontario	669,876	1,454,617	4,974,699
Government of Canada	2,860,000	3,965,276	744,401
Other municipalities	1,548,750	1,410,318	1,691,881
Other:			
Lot levies and development charges	11,884,841	8,468,174	1,688,012
Investment income	4,187,263	4,575,305	4,349,898
Other	11,402,914	4,405,027	6,257,181
Equity basis net income in Waterloo North Hydro Holding Corporation (note 5)	1,709,000	3,976,685	3,313,110
Total revenue	167,256,007	162,104,421	156,627,091
Expenses:			
General government	8,552,794	6,086,665	4,541,427
Protection to persons and property	25,282,743	23,833,714	22,879,154
Transportation services	15,247,504	24,805,616	28,003,261
Environmental services	41,933,154	44,545,931	38,855,939
Health services	1,607,773	1,593,975	1,494,291
Social and family services	1,659,609	1,789,708	1,628,630
Recreation and cultural services	39,589,719	43,874,504	42,154,984
Planning and development	7,436,723	7,001,847	6,324,731
Other	-	941,782	596,230
Total expenses	141,310,019	154,473,742	146,478,647
Annual surplus	25,945,988	7,630,679	10,148,444
Accumulated surplus, beginning of year (note 2)	797,359,389	797,359,389	787,210,945
Accumulated surplus, end of year	$ 823,305,377	$ 804,990,068	$ 797,359,389

The accompanying notes are an integral part of these consolidated financial statements.

Figure 3.1: Sample annual financial report.

2008-V01

FIR2008: Toronto C

Asmt Code: 1999

MAH Code: 01106

Schedule 12

CURRENT REVENUE FOR SPECIFIC FUNCTIONS

for the year ended December 31, 2008

		Ontario Conditional Grants 1 $	Canada Conditional Grants 2 $	Other Municipalities 3 $	User Fees and Service Charges 4 $
0299	**General government**	51,767,751	23,185	0	12,471,992
	Protection services				
0410	Fire	594,454	0	0	7,806,757
0420	Police	10,101,013	0	11,200,984	6,280,156
0430	Conservation authority	0	0	0	0
0440	Protective inspection and control	150,547	0	0	2,907,679
0450	Emergency measures	0	0	0	0
0460	Provincial Offences Act (POA)				
0498	Other POA	0	0	0	355,608
0499	**Subtotal**	10,846,014	0	11,200,984	17,350,200
	Transportation services				
0610	Roadways	0	0	0	13,395,792
0620	Winter control	0	0	0	26,286
0630	Transit	191,600,000	0	0	840,888,000
0640	Parking	0	0	0	5,280,120
0650	Street lighting	0	0	0	267,161
0660	Air transportation	0	0	0	0
0698	Other IWES Support	0	0	0	1,979,526
0699	**Subtotal**	191,600,000	0	0	861,836,885
	Environmental services				
0810	Sanitary sewer system	0	0	0	364,680,946
0820	Storm sewer system	0	0	0	0
0830	Waterworks system	0	0	18,978,931	270,819,252
0840	Waste collection	6,460	0	0	26,338,964
0850	Waste disposal	10,767	0	0	55,350,763
0860	Recycling	9,107,888	0	0	17,566,586
0898	Other	0	0	0	0
0899	**Subtotal**	9,125,115	0	18,978,931	734,756,511

Figure 3.2: Sample FIR.

municipal websites are more likely to store these than other financial documents. Budgets list revenues and expenses in the greatest detail, so it can easily be seen where money flows on a per-department basis. For the utmost accuracy, operating budgets are taken from the year following the one that is being analyzed, because there is typically an estimate of what was actually spent versus what was projected. Earlier capital budgets can be estimated by taking the projection from one year, and subtracting the carry forward value from the following year. Carry forward values represent how much of the allocated capital budget was pulled forward into the new budget year, or in other words, how much was not spent. Carry forward values tend not to be reported in later budgets, so this method can not be used for later budgets. These files tend to be less accurate because they are primarily a reporting of projected spending, but are useful for finding which revenue sources are applied to each department of a municipality.

3.1.4 Provincial and Federal Finances

Since municipalities receive transfers from provincial and federal governments, financial data were gathered for these levels as well. All verified financial data were collected from the Public Accounts of Ontario (PA-O) and the Public Accounts of Canada (PA-C), the provincial and federal data sources, respectively. These files state the revenues allocated to various departments and have itemized lists of transfer payments. The main use of these files was for determining the revenue composition of any federal or provincial transfer to a municipal government.

3.1.5 Prioritization and Combination of Data Sources

A hierarchy of how financial data were prioritized is given by Figure 3.3. Annual financial reports were assigned first priority, since the financial portions of the reports are audited. FIRs were assigned second priority, since the data are intended to be listed in an accurate return, but was empirically found to be prone to small errors. Where possible, annual financial reports were used to cross-check data from the FIR if there was suspicion of errors in the FIR. In practice, the FIR was used more frequently than the annual financial reports, since the FIR's level of detail fit closer to the needs of the research. After the first two data sources were used, the Public Accounts files for Canada and Ontario were assigned third priority, and were used to check the values of government transfers to municipalities. These were prioritized below the municipality's own records, because a municipality tends to deal with dollar values at much lower orders of magnitude. A sum of money that would

be rounding error for the federal government could be the difference between funding or not funding a project for a smaller municipality. The final piece of the puzzle for clarifying government transfers came from official press releases, which were assigned fourth priority in the prioritization hierarchy. These are often published by the federal or provincial government, who advertise funding partnerships made between all tiers of government to pay for a new infrastructure project. The press releases were most useful for verifying the total amount each government will contribute to a project. The municipal operating budget from the year after the one being analyzed was assigned fifth priority, since they included estimations of the prior year's true spending. Finally, the municipal capital budgets were used for determining the types of revenue sources applied to departments. An important caveat in this prioritization hierarchy is that some data were not easily accessible. In the case where data were inaccessible, they were dropped from the hierarchy for the given year.

3.1.6 Consumer Price Index

The last part of financial data used is the consumer price index (CPI). This was used to convert all values into 2017 dollars, so that increases and decreases in revenue and spending are corrected for inflation. The CPI tracks the changes in prices for a fixed set of goods and services that consumers would be expected to purchase (Statistics Canada, 2017). The weight of each good or service in the CPI calculation changes every other year, to reflect the general purchasing power of a consumer in a given year. Values from Statistics Canada are depicted in Figure 3.4. The CPI is indexed to 100 in 2002, and since then has increased to a value of 130. The increase in CPI means $1 in 2002 would be worth $1.30 now.

Statistics Canada collects multiple indices under the CPI banner, but the general one was chosen for the purposes of this thesis, instead of a more specific index like transportation or public transit. The primary reason for using general CPI was to reflect the consumer-centric objectives of the research. The general CPI reflects the purchasing power of a resident, since it is share-weighted to reflect a basket of goods typically purchased in that jurisdiction. If all transit systems were to increase their fares by 200% in one year, the CPI for public transit would increase by a similar ratio to the fare increase. When the CPI is used to correct the revenues and expenditures for inflation in sustainability analyses, it would appear that the per capita cost of using a system has not changed that greatly, when in practice, the average consumer would be paying a great deal more of their annual income on public transit. By using the general CPI, it is easier to track the sustainability of road and transit funding over time with respect to the purchasing power of an everyday consumer in Ontario.

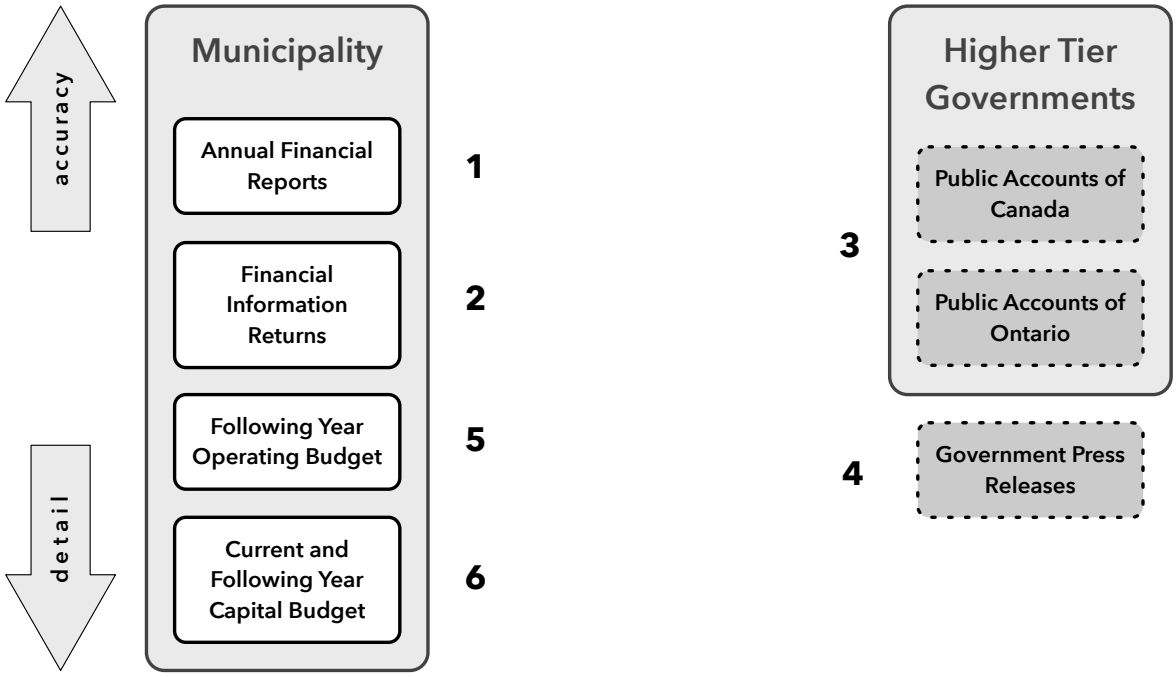

Figure 3.3: Financial data prioritization hierarchy.

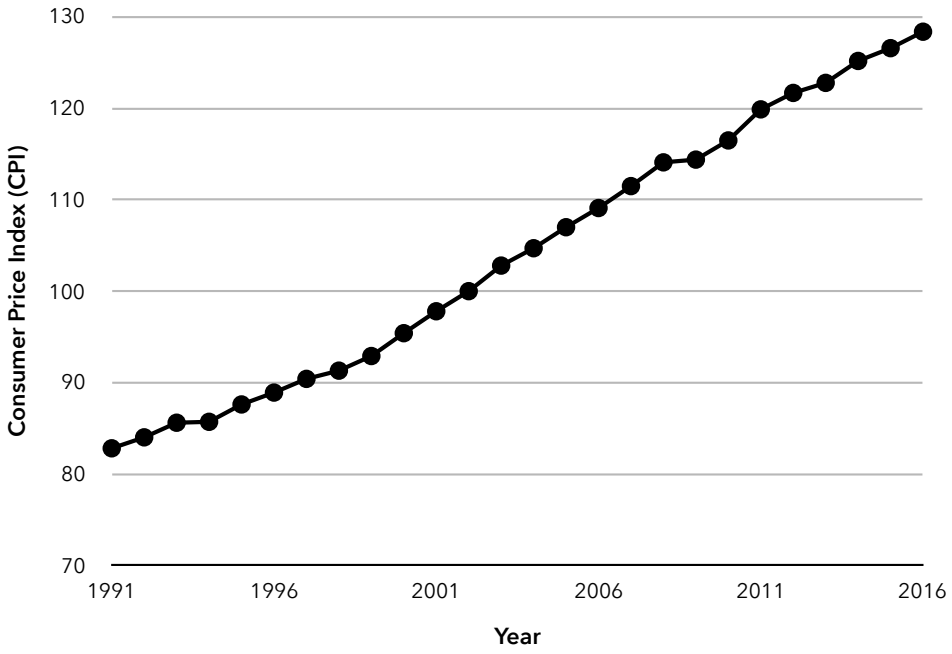

Figure 3.4: Consumer Price Index values from 1991-2015. (Statistics Canada, 2017)

3.2 Infrastructure Data

To provide contrast with the growth and decline in transportation funding over the study period, infrastructure supply data were collected to track the changes in supply of transportation infrastructure in Waterloo and Toronto. Transportation infrastructure covered in the scope of this research include local roads, regional roads, and public transit.

Road supply was measured in lane kilometres, an accepted measurement for road supply in existing provincial statistics (Ontario Ministry of Municipal Affairs, 2017). Road supply values were provided for 1970-2016 from Waterloo, 2000-2015 from the Region of Waterloo, and 2005-2015 from Toronto. Toronto's values include all roads managed by the seven municipalities that amalgamated into Toronto in 1998. Road supply values collected were truncated to years between 2000 and 2015, as depicted in Figure 3.5, since it was desired to conduct analyses for Waterloo only when data for both Waterloo and the Region of Waterloo were available. Road supply in Waterloo and the Region of Waterloo increased at a low rate over the 11-year study period. Road supply for Toronto was adjusted to account for anomalies in the provided data. Supply values from 2005-2006 and from 2008-2009 were assumed to be equal, and road supply values before this dates were estimated using the absolute change in value between years. The magnitude of the Region of Waterloo's road supply is twice that of Waterloo, and one-tenth that of Toronto.

Transit supply was measured in revenue vehicle kilometres per year, which was chosen as it was the closest equivalent to the use of lane kilometres in roads. Values for earlier data were provided in revenue vehicle miles per year, so was converted into kilometres for comparison. Transit supply values were provided for 1991-2015 from Grand River Transit (GRT), the transit operator for the Region of Waterloo, and 1966-2015 from the Toronto Transit Commission (TTC), the transit operator for Toronto. GRT was created in 2000 as a merger of smaller agencies in the region, so transit supply values for Kitchener Transit were used for years prior to 2000. The increase in infrastructure supply is due to the increased scope of GRT, as after 2000 it covered not only Kitchener and Waterloo, but Cambridge as well. Transit supply values collected were truncated to show between 1991 and 2015, as depicted in Figure 3.6. Transit supply in Waterloo oscillated under Kitchener Transit, and increased consistently under GRT. Transit supply lowered in Toronto until the late 1990s, then began rising consistently. At GRT's inception, Toronto's supply magnitude was 20 times larger than the Region of Waterloo's. GRT's rate of increase was higher than the TTC's, and now Toronto's supply magnitude is 15 times larger.

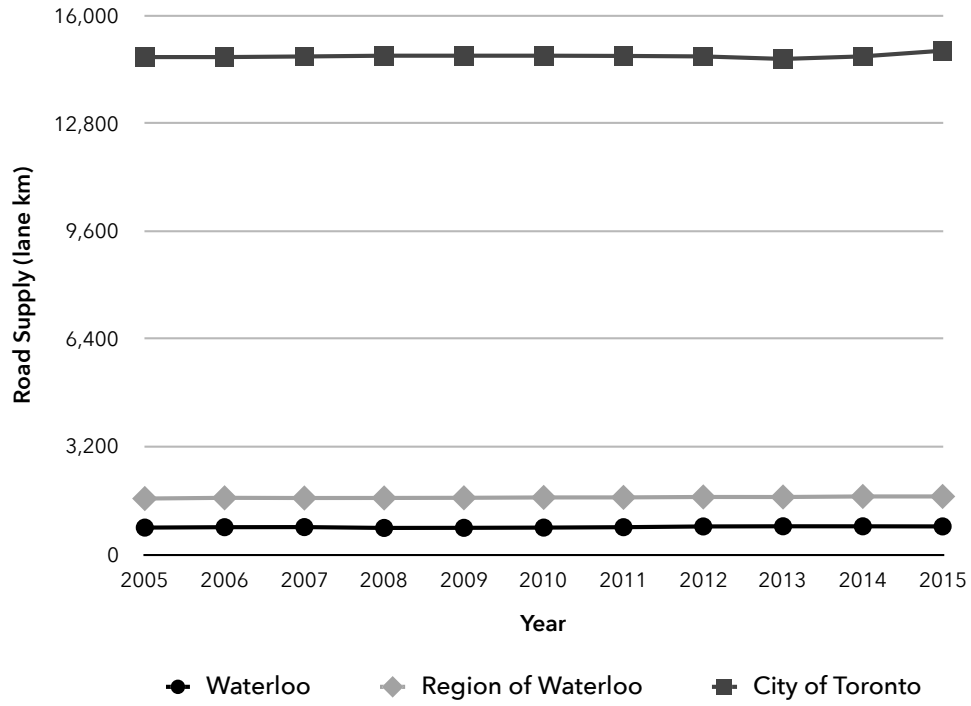

Figure 3.5: Road supply values in lane kilometres from 2000-2015.

3.3 Other Data

Population data were required from each government for per capita analyses. Canada and Ontario population estimates were collected from Statistics Canada. Population data for Waterloo and the Region of Waterloo were collected from a report generated by the Region of Waterloo containing demographics statistics separated by lower-tier municipality. Population data for Toronto were collected from the Canadian census in 5-year increments. For years in between census reports, the population was estimated using linear interpolation. Population data were also collected from the City of Kitchener, for one particular set of calculations related to the years Kitchener Transit operated Waterloo's transit system, by using estimates from Kitchener's annual financial reports. All population values are depicted in Figure 3.7. Missing values were linearly interpolated in the same way as Toronto. In 1991, Toronto was 27.5 times larger than Waterloo, and is now 20 times larger.

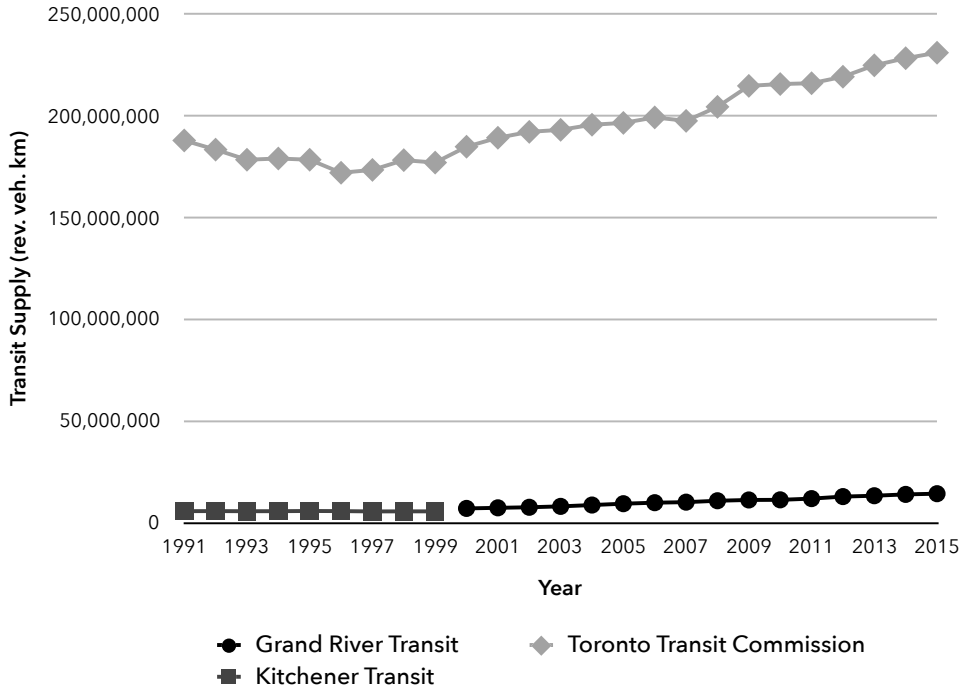

Figure 3.6: Transit supply values in revenue vehicle kilometres from 2000-2015.

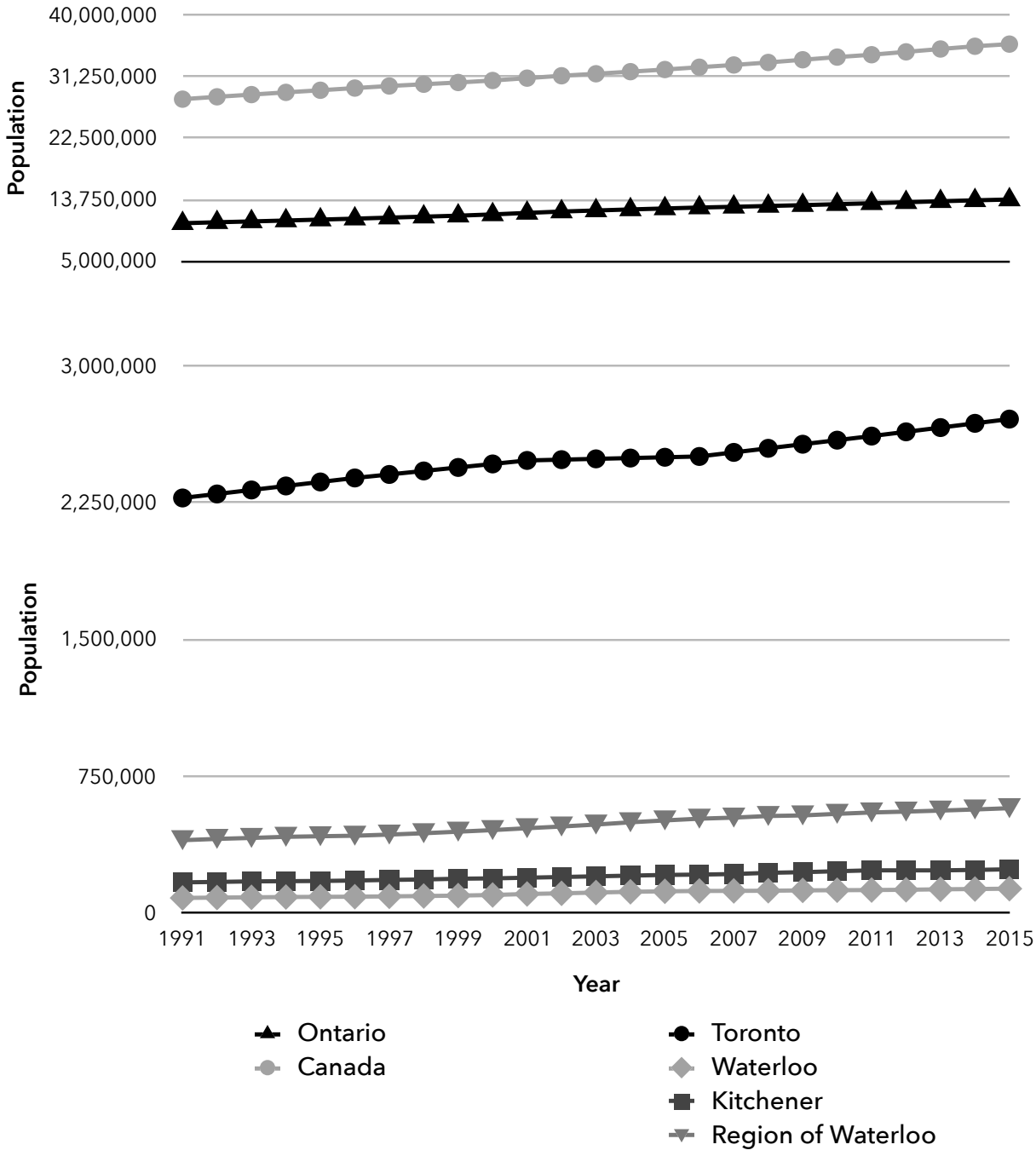

Figure 3.7: Population for various governments from 1991-2015.

Chapter 4

Disaggregating Government Financial Flows

Before doing any analysis of the financial flows of governments, it is essential to understand the nature of how governments receive revenue, how revenue makes its way through the government cycle, and how this revenue is applied to expenditures. This chapter begins with an overview of the basic understanding of how municipalities perceive receipts and allocation of revenue. There are many elements of municipal funding that even municipalities may not fully understand or statistically track, so a framework is presented that represents a standard model for any government, derived empirically from the four bodies governing Waterloo: local, regional, provincial and federal. Toronto also fits this model, without the regional element. This framework forms the basis for a loose understanding of financial flows between levels of government. A detailed analysis of the general funding model and priorities at each level of government follows, concluding with a thorough examination of the whole model, depicting financial relationships between all levels of government and the most notable related parties, including residents and businesses.

4.1 Review of Municipal Revenue

Municipalities have a variety of programs and infrastructure projects they may desire to fund, but have limited sources of revenue to pay for these projects. Using the data introduced in Chapter 3, one can make insights about what governments are responsible for and how they pay for their projects. Annual financial reports are useful for a quick summary

of what revenue governments receive in a given year, and where that revenue is allocated in broad terms. These documents will be used to introduce the current understanding of how municipalities receive funding, as they are excellent at describing the municipality's perspective of their finances in clear terms.

For any Ontario municipality, property taxes are arguably their most important locally-administered revenue source. Except for Toronto, this is the only tax that a municipality can levy, since they are explicitly restricted from implementing income taxes or other common taxes (Government of Ontario, 2001, s. 391-398). Property taxes are levied by multiplying the assessed property value of a property against a tax ratio specified by the municipality by zone. Hence, a multi-storey residential property may have a different tax ratio than an industrial warehouse.

User fees are the other significant locally-administered revenue source in municipalities. User fees constitute any direct fee on a good or service, which is intended to pay for the cost of delivering that good or service. A common example in transportation is a transit fare, which is intended to cover at least a portion of a rider's trip. The distinction between these two revenue sources is valuable. Municipalities tend to separate operating and capital budgets into two sub-budgets: tax-supported and fee-supported. Tax-supported budgets fund expenditures that rely in any degree on the property tax, which tends to constitute the majority of a municipality's expenditures. Each department will determine their net deficit, subtracting their departmental income, including user fees, from their total expenditures, and will fill the gap with the property tax. Fee-supported budgets tend to support only a few departments, which are able to be funded without any contribution from the property tax (Braan, 2015). These units are sometimes referred to as enterprises, since they operate under a business-like principle of independent financing.

Municipalities will also levy development charges, which are collected from developers that build new properties or reconstruct old ones. The idea behind development charges is that a new development will induce strain on existing infrastructure systems, such as nearby roads or water networks, so a charge is collected from the developer to cover some of the cost of the public infrastructure impacted by the development. These charges are placed aside in provincially-mandated reserve funds under the Development Charges Act, which stipulates that separate funds must be prepared for each good or service a development charge supports (Government of Ontario, 1997, s. 33-36). The revenue put into these reserve funds must then be spent only on capital costs, corresponding to the principle that the charges cover only growth-related expenses. For example, if a municipality believes roads, transit systems, and parks could be fiscally impacted by a new development, the

municipality would introduce three separate development charges, each with a separate reserve fund, from which it would later withdraw funds for use in capital expenditures.

Reserve funds holding development charge revenue are not the only type of reserve or reserve fund held by a municipality. The City of Toronto alone has over 150 reserves and reserve funds (City of Toronto, 2016), which are used for a variety of purposes. Reserves and reserve funds can be categorized into different restrictive levels, based on the purpose and legislation guiding them. Reserves are the least restrictive type, which have no restrictions on their output, and simply consist of revenue meant to be spent for an intended purpose at a later date. *Discretionary* reserve funds are more restrictive, as city councils will form these to hold funds earmarked for a council-driven purpose. The most restrictive reserves are *obligatory* reserve funds, which are required typically by provincial law for a specific purpose with strict rules on how revenue is treated. The reserve funds for development charges are obligatory in nature, so development charges are generally a highly regulated revenue source.

Municipalities receive revenue from outside sources as well, which is not locally-administered in nature, through intergovernmental transfers. Other municipalities will sometimes provide transfers to a municipality to manage a joint project, like roads traversing municipal boundaries, but the bulk of these transfers come from higher tier governments. Sometimes the sources of these transfers are known, like the provincial and federal gas tax funds, which use each government's respective gas tax as the source of revenue, but in many cases it is not clear to the municipality how the revenue is paid. This forms one of the transparency gaps in municipal funding, where a taxpayer or even a municipality is uncertain what revenue is used to pay for their infrastructure. A similar problem arises from reserves and reserve funds. It can often be assumed that property taxes are the source for most reserves and reserve funds, but this may not actually be true if there are no clear guidelines on how a reserve or reserve fund is funded.

4.2 Government Funding Framework

The first step in understanding financial flows is constructing a framework to represent the flows related to governments. This framework used as the basis for this thesis is rooted in the economics concept of the circular flow diagram (Begg, Fischer, & Dornbusch, 1987), which depicts the direction of all financial flows in an economy. In their most simple form, circular flow diagrams depict a financial relationship between residents, businesses, and a monolithic government. Businesses provide wages to residents in return for labour,

residents provide sales to businesses in return for goods and services, and both provide a variety of revenue to governments in return for public goods and services. This forms the basis of understanding the nature of government revenue and expenditures, where revenue is the money received from residents and businesses, and expenditures are the goods and services provided by the government.

This relationship was used to develop a simplified framework of a single government's funding model, given by Figure 4.1. Revenue from residents and businesses is highlighted in white, revenue from governments is highlighted in light grey, reserves and funds are highlighted in grey with a dashed border, crown agencies and corporations are highlighted in dark grey with a dashed border, and expenditures are highlighted in black. Elements were chosen by examining the funding structure of the City of Waterloo, the Region of Waterloo, Ontario, and Canada; representing local, regional, provincial, and federal governments, respectively. Elements with an asterisk only apply to some of the levels of government. Residents and businesses pay taxes and user fees, which are applied to a budget. Businesses also pay development charges, which are added to reserve funds for later use. Higher tiers of government provide transfers to lower tiers, which are applied to a budget or to a reserve or reserve fund. Crown entities at the higher tiers of government can either provide or receive funds from a budget, depending on their financial status. From a budget, governments will spend money on various expenses and programs, transfers to lower tiers of government, and credits back to residents and businesses. Reserves and reserve funds can also be directly applied to expenses and programs. Governments borrow money from residents and businesses in the form of debentures, and pay them back through a budget at a later date.

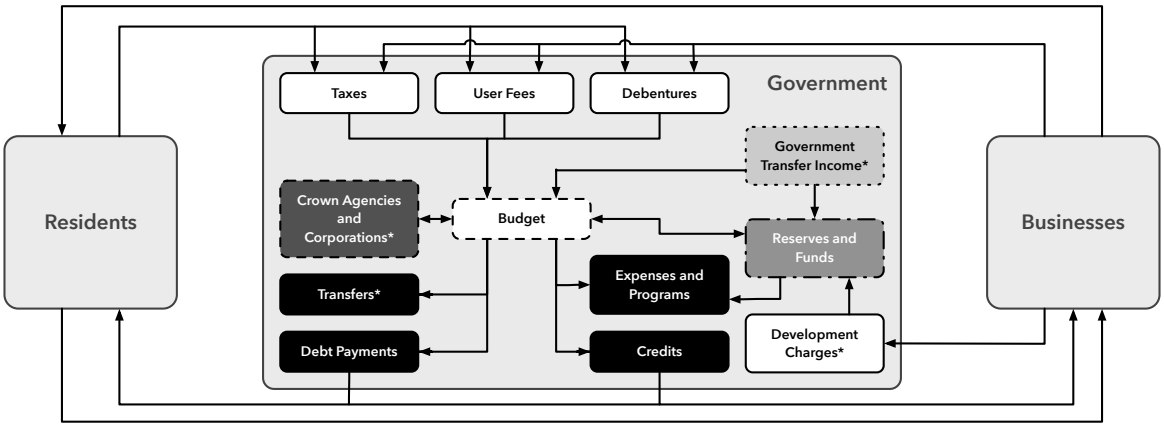

Figure 4.1: Single government funding framework for governments with jurisdiction in Ontario.

A further extension of this concept is depicted in Figure 4.2, which represents a funding model for a series of interconnected governments. The previously isolated government transfer income and transfers expenses are now connected between each government, as represented by groupings of elements that are tailored to each government's revenue and expenditures. When compared with the earlier circular flow diagrams, the monolithic black box of government has been expanded into a series of multiple independent bodies that interact in the greater economy. The multiple government framework brings greater clarity to the funding mechanisms of governments, by providing a rough visual representation of how funds are distributed between government bodies.

In the following sections, this framework is used as a baseline for understanding the relationship between governments, businesses and residents in the sample areas of Waterloo and Toronto. The priorities of each government will be revealed by their general spending habits over five years, along with the revenues used to pay for those expenditures. The multiple government funding framework depicted in Figure 4.2 also provides context to the reader about how revenues make their way through governments to be ultimately spent, and the financial flows in each section will flesh out the structure of the framework by revealing the volumes of revenues and expenditures across each tier of government.

4.3 Federal Funding

A general overview of federal revenue sources and primary categories of expenditure from 2011-2015 is given in Figure 4.3. Data for these tables were collected from the PA-C (Receiver General of Canada, 2017), following the methodology outlined in Appendices C and D, and is reported in nominal dollars. The most significant revenue source at the federal level is the personal income tax, which contributes 51% of the government's annual revenue, when averaged over the five years (Figure 4.3a). Other major taxes include corporate income taxes (14%) and sales taxes (11%). As a whole, taxes contribute 81% of the government's revenue. The remaining revenue consists of revenue from crown corporations, like Via Rail, and miscellaneous other revenues like user fees, investment returns, and gains on foreign exchange accounts.

Canadian expenditures are more varied (Figure 4.3b), with a fairly even spread between major provincial transfers (22% average over five years), Old Age Security (OAS) (15%), other transfers (24%), and departments (26%). Major provincial transfers include equalization payments, the Canada Health Transfer, and the Canada Social Transfer, among others. The Canada Health Transfer and Canada Social Transfer are

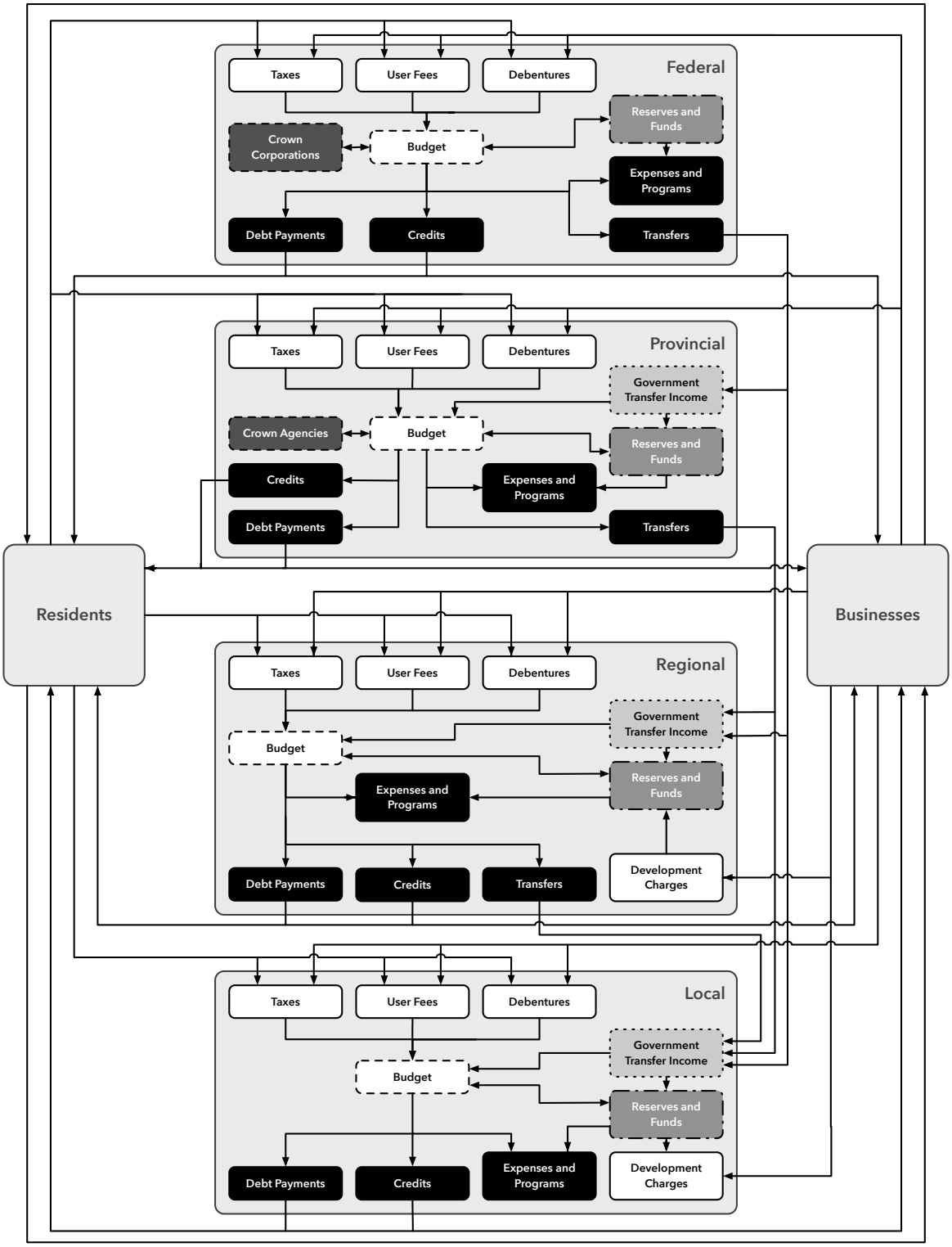

Figure 4.2: Multiple government funding framework for governments with jurisdiction in Ontario.

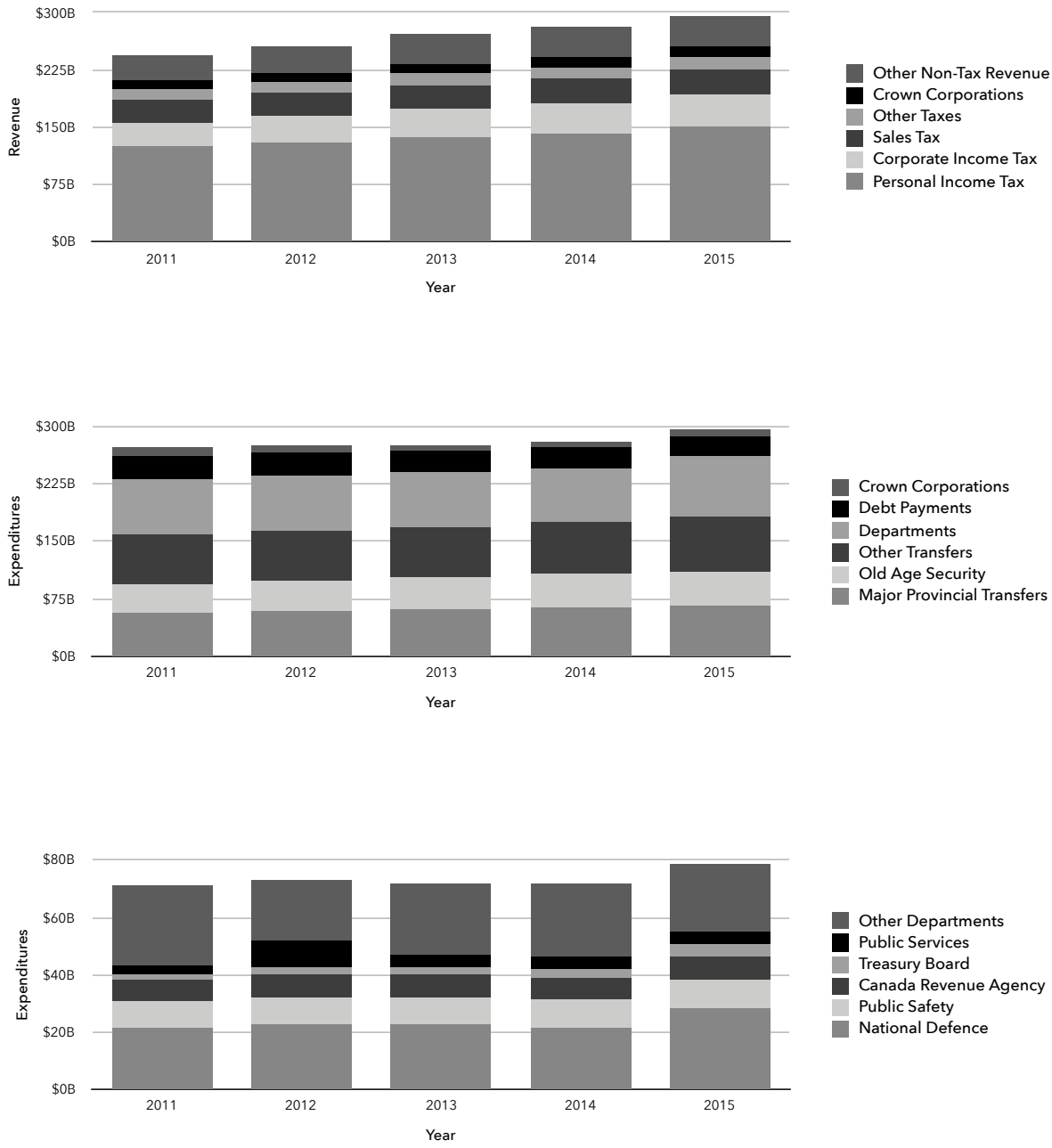

Figure 4.3: a) Revenue, b) Expenditures, and c) Departmental expenditures for Canada, 2011 to 2015.

large block payments made to provinces to support provincial health programs and provincial social, child and post-secondary programs, respectively (Finance Canada, 2014). Equalization payments are unconditional transfers made to provinces that have a lower 'fiscal capacity', or ability to raise revenues, so that residents of poorer provinces can enjoy similar services at similar levels to wealthier provinces. In 2017, provinces receiving equalization transfers are Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia and Prince Edward Island (Finance Canada, 2017). Larger provinces such as Ontario and Quebec can be added to the equalization list since the equalization formula is done on a per-capita fiscal capacity basis. OAS is the largest transfer to residents, and is paid out to eligible residents over the age of 65. Departments conduct the work of the government and organize its major programs. In Figure 4.3b, departments also includes agencies like the CRA. Payments on government debt and crown corporation subsidies make up the remaining 13%.

Within departments (Figure 4.3c), some units receive much higher allocations for spending. This figure expands the 'departments' section from Figure 4.3b. The largest ministry by spending in 2015 was defence (32% average over five years), followed by public safety (13%), the CRA (11%), the Treasury Board (4%), and public services (6%). These data provide some insight into the fiscal priorities at the federal level: transfers are the main priority at the federal level, whether they go to provinces or individuals. The remaining money is prioritized toward issues of national security, finances, and administration. These transfers reflect the general nature of the federal government. Like many national governments in federations, the bulk of domestic issues are treated at the provincial or state tier, leaving foreign affairs, national security, and other issues that would concern the country as a whole for the federal government.

4.4 Provincial Funding

A general overview of provincial revenue sources and primary categories of expenditure from 2011-2015 is given in Figure 4.4. Data for these tables were collected from the PA-O (Ontario Treasury Board Secretariat, 2017) following the methodology outlined in Appendices C and D, and similar to the federal funding charts, is reported in nominal dollars. There is a more diverse set of revenue sources in Ontario (Figure 4.4a), with the more notable contributions being the personal income tax (26% average over five years), sales tax (18%), other taxes (28%), and transfers from the Government of Canada (19%). Notable taxes included as 'other' taxes include corporate taxes, health taxes and the

education property tax. The remaining revenue consists of enterprise revenue from utilities, gambling, and liquor, and from various non-tax revenues like user fees and expenditure reimbursements. The largest fees are for vehicle registration and driver's licences, which account for 1% of the government's total revenue on average.

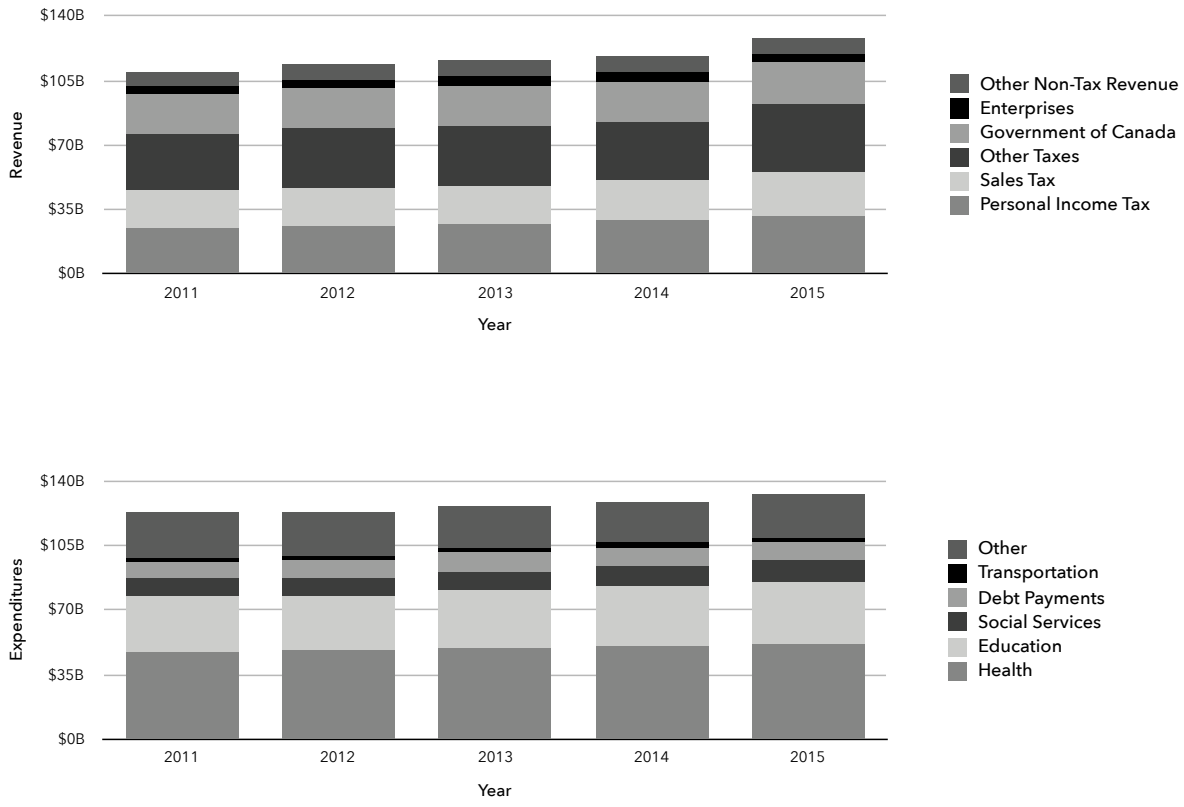

Figure 4.4: a) Revenue and b) Expenditures for Ontario, 2011 to 2015.

Ontario's expenditures (Figure 4.4b) are dominated by two major categories: health (39% average over five years) and education (25%). Expenditures on education include public and Catholic elementary and secondary schools, universities, colleges, and adult training. Other major expenditures include social services (8%) and payments on debt (8%), with the remainder going towards other ministries. Social services include the Ontario Works income support program and disability support. Transportation is isolated from the 'other' category to provide perspective of the impact of transportation in the provincial budget, which averages approximately 2%. As with Canada, this share somewhat reflects the priorities of the provincial government: health and education delivery stand out very clearly as the main outputs of the province.

4.5 Regional Funding

At this point, the structures for Waterloo and Toronto diverge. Waterloo falls under a two-tier municipal structure, while Toronto forms a single-tier municipality. This section outlines the funding model of Waterloo's upper-tier counterpart, the Region of Waterloo. A general overview of the Region's revenue sources and primary categories of expenditure from 2011-2015 is given in Figure 4.5. Revenue data are retrieved from annual financial reports, and expenditures data from the Region's FIR reports (Deloitte LLP, 2012; Deloitte LLP, 2013; Deloitte LLP, 2014; Deloitte LLP, 2015; Deloitte LLP, 2016; Ontario Ministry of Municipal Affairs, 2017), both reported in nominal dollars. The total value of expenditures was used from the annual financial report, since this document has precedence, but the FIR was needed to isolate individual programs from within the major expenditure categories. This procedure is outlined in more detail in Appendices C and D.

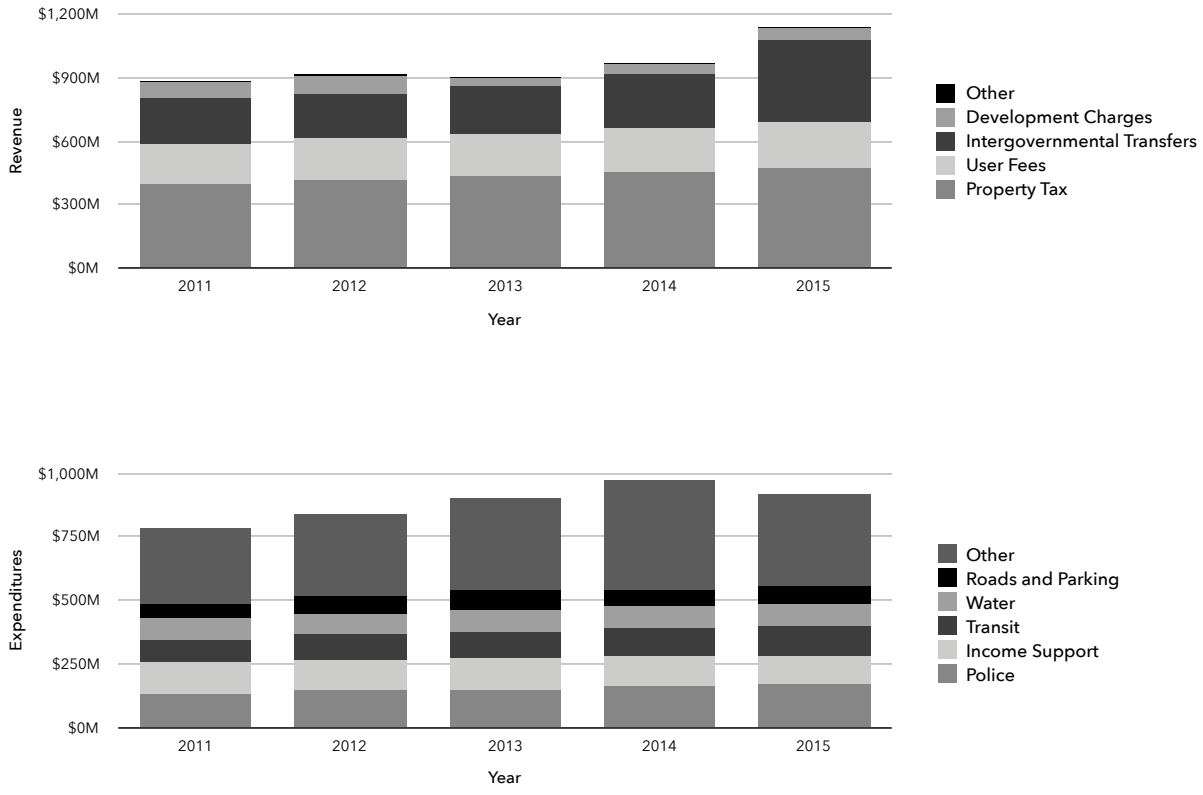

Figure 4.5: a) Revenue and b) Expenditures for the Region of Waterloo, 2011 to 2015.

As a municipality, the Region of Waterloo does not make use of many forms of income. The main sources of revenue are property taxes (45% average over five years, Figure 4.5a), user fees (21%), and transfers from Ontario and Canada (27%), of which

Ontario generally provides the bulk of funding. Development charges and other revenues make up the remaining amount of revenue, with the contribution of other revenues being insignificant to the point that they are hard to see in the figure.

The relatively few revenues received by the Region are used for a very diverse set of expenditures (Figure 4.5b). Of these regional outputs, the largest have tended to be regional police (17% average over five years), income support (14%), public transit (12%), the water system (10%), and the road and parking system (7%). Income support specifically refers to programs like Ontario Works, and the water system includes water supply, wastewater treatment, and delivery for more rural townships. Transit and road networks are separated because of the focus of interest in each of them in this thesis, but combined would potentially be the Region's largest expense. Roads is also a catch-all category for roadways, road bridges, parking lots, street lighting, and sidewalks, since sidewalk maintenance is challenging to isolate from the rest of the roads budget. It is evident from the primary expenditures of the regional government that the priorities of the regional government lie in services that are provided for all the constituent municipalities, and it defers management of other services to lower-tier municipalities. Policing, income support, and transit are all wholly regional services in the Region of Waterloo, leaving some capacity for the lower-tier municipalities to provide their own services.

4.6 Local Funding

The final aspect of government funding is the local government, which can refer to single-tier municipalities or lower-tier municipalities in two-tier municipal structures. The first government reviewed is Waterloo, a lower-tier municipality, and the second is Toronto, a single-tier municipality with special taxation privileges. Waterloo's revenue sources and primary categories of expenditure from 2011-2015 are given in Figure 4.6. Waterloo's revenue data were collected from the city's annual financial reports, and expenditure data from their FIR filings (KPMG LLP, 2012; KPMG LLP, 2013; KPMG LLP, 2014; KPMG LLP, 2015; KPMG LLP, 2016; Ontario Ministry of Municipal Affairs, 2017), both reported in nominal dollars. Similar to the Region of Waterloo, the total value of expenditures was used from the annual financial report, and the general procedure of determining revenue and expenditures is outlined in more detail in Appendices C and D.

Waterloo's annual revenue consists of a near-even share of property tax and user fees, with a lesser share coming from other revenue sources such as grants, development charges

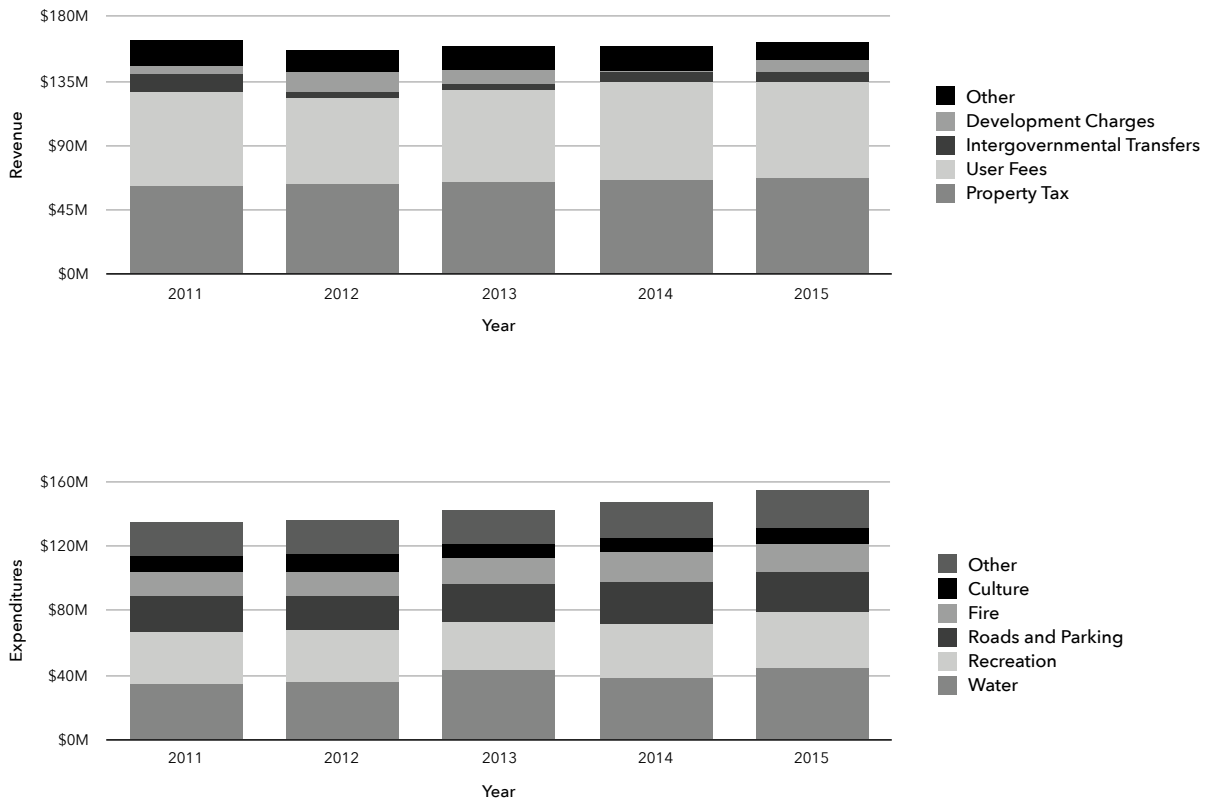

Figure 4.6: a) Revenue and b) Expenditures for Waterloo, 2011 to 2015.

or investment income (Figure 4.6a). Waterloo has an interesting funding mix, as their most significant revenue source is user fees (41% average over five years), closely followed by property tax (40%). The bulk of these user fees are collected and used for the water system, which alludes to the significance of the water system in the city's structure. Other main sources of revenue include transfers from the other three tiers of government (4%), development charges (5%). The remainder is received from a few different sources, most significantly from general investment income and returns on equity from Waterloo North Hydro, a power utility owned jointly by the Waterloo, the Township of Woolwich, and the Township of Wellesley.

The city spends the majority of its revenue on a small number of programs (Figure 4.6b). Water is the largest expenditure (27% average over five years), which receives no property tax support. Recreation (35%), the roads and parking system (17%), the fire department (12%), and culture (7%) also receive significant funds. Recreation includes parks and sports facilities, and culture includes libraries and museums. The separation of responsibilities between Waterloo and the Region of Waterloo is made clear from their expenditure data. The Region supplies and disposes of water, and Waterloo takes

responsibility for the distribution network. The Region operates major arterial roads and transit networks, since the roads and transit network cross lower-tier boundaries, and Waterloo operates smaller internal roads. The separation of police and fire is interesting, since police, health, and ambulances are operated through the regional government, but the fire department is operated locally. This separation of responsibility and funding is a common arrangement in many urbanized two-tier municipal structures in Canada.

In contrast, Toronto's revenue is quite unique among Ontario municipalities, as it does not fall under the guidelines of the Municipal Act (Government of Ontario, 2001, s. 7.1), but instead under the City of Toronto Act. One aspect of the City of Toronto Act that causes differences in Toronto's funding mix is its ability to raise some revenues other than through the property taxes, providing the city abides by a set of predefined conditions (Government of Ontario, 2006, s. 267). Toronto's revenue sources and primary categories of expenditure from 2011-2015 are given in Figure 4.7. Toronto's data collection procedure was identical to that of Waterloo: revenue was collected from annual financial reports[1], and expenditure data from FIR filings (Ontario Ministry of Municipal Affairs, 2017), with the caveat that the total expenditures value was used from the annual financial report, and with all data reported in nominal dollars.

Revenue primarily consists of property tax (33% average over five years), user fees (27%), and transfers from other governments (26%), with the majority of transfers coming from Ontario (Figure 4.7a). Other revenue includes the land transfer tax (6%) and development charges (1%), with the remainder coming from various sources like returns on investments. The land transfer tax is an example of one of the unique revenues available to Toronto, as permitted under the City of Toronto Act, which is applied to all home purchases on top of the provincial land transfer tax (City of Toronto, 2017).

Toronto's expenditures are quite varied (Figure 4.7b). The transit system (20% average over five years), income support (16%) and police (10%) are the city's biggest expenditures. Others of note include the roads and parking system (8%) and water system (6%). These five programs only account for 60% of the city's expenditures, which is much lower than in Waterloo. Also, the difference between priorities in Toronto versus Waterloo is noticeable: Toronto has to spread revenue across a wide range of priorities, and water in particular accounts for a smuch smaller contribution than it does in Waterloo's systems.

[1]Toronto financial reports used for this study can be found in the references.

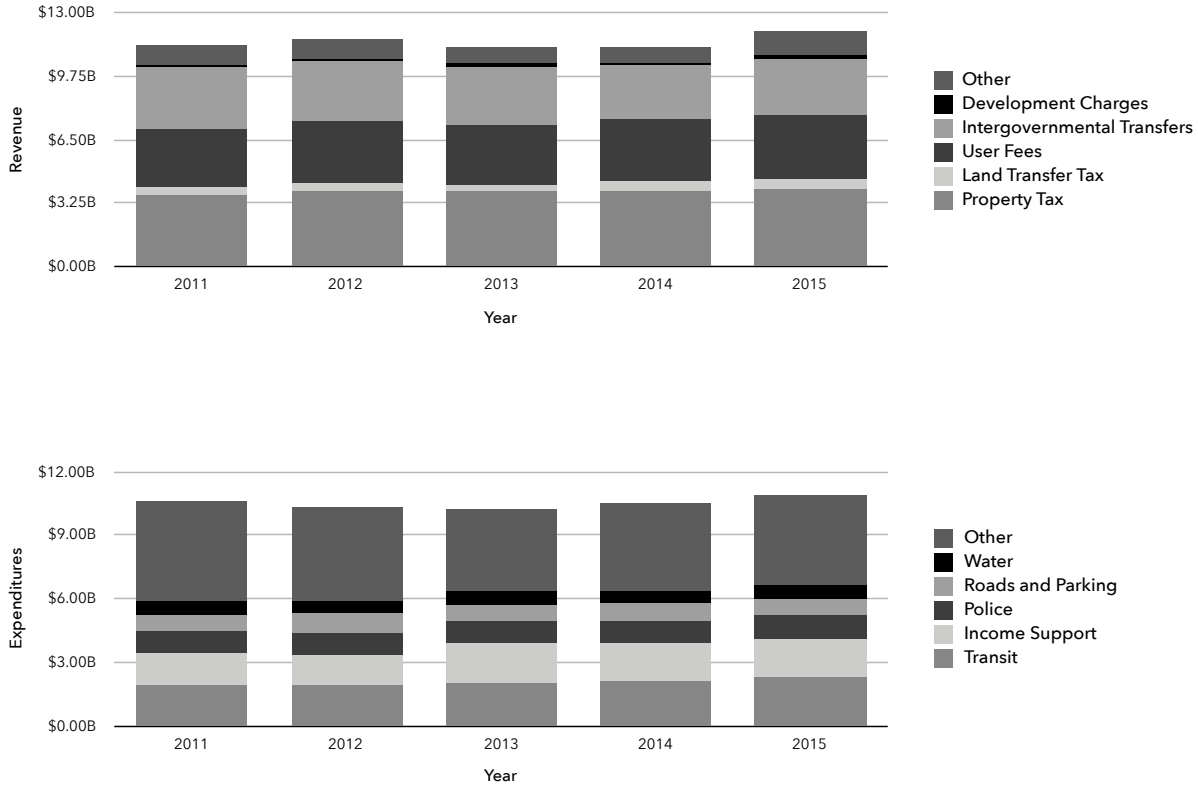

Figure 4.7: a) Revenue and b) Expenditures for Toronto, 2011 to 2015.

4.7 Concluding Remarks

A review of the primary revenue sources and categories of expenditure for each government tier is given in Table 4.1. Items marked with an asterisk (*) apply only to Waterloo, and items marked with a dagger (†) apply only to Toronto. The list of revenue sources and categories of expenditure is not exhaustive, but illustrates items that comprise the larger share of the financial flows of each tier.

Table 4.1: Summary of primary revenues and expenditures for all tiers of government.

	Federal	Provincial	Regional	Local
Revenues	Pers. Income Tax Corp. Income Tax Sales Tax Crown Corps.	Pers. Income Tax Sales Tax Other Taxes Transfers	Property Tax User Fees Transfers	Property Tax User Fees Transfers†
Expenditures	Transfers to Prov. Old Age Security Other Transfers National Defence	Health Education Social Services Debt Payments	Police Income Support Transit Water	Water* Transit† Recreation* Income Support† Police† Roads and Parking Fire*

The analysis provided in this chapter uses a simplified representation of operating revenues and expenditures to provide the reader with an understanding of the responsibilities of each tier of government and a high-level understanding of the general sources of revenue. The real-world flow of money within and between government tiers is more complicated. Transfers from higher levels of government do not come from a void of money; the higher levels of government must find revenue to pay for these transfers. Recalling the benefit model concept, the money used to pay for transfers may not be collected in a way that is efficient for their output goods and services. Likewise, expenditures have a trend of growing annually, and at face value one could assume this makes sense, as population increases and inflation rates could be the cause of increases. However, verifying that this is true through a sustainability analysis, using a proper indicator, is a good way to assess whether funding levels are appropriate. These concepts form the basis for the rest of this thesis: is current infrastructure paid for efficiently, what revenue sources are used to pay for municipal infrastructure from the point they first enter the government cycle, and is municipal infrastructure being paid for in a sustainable manner?

Chapter 5

Static Origin Revenue Sources Analysis

The first primary output of this research is a static analysis of water and transportation funding across four tiers of government: local, regional, provincial, and federal; conducted in Waterloo. This analysis identifies revenue sources used at each level of government to pay for municipal infrastructure projects, with the intent of interpreting the economic effectiveness of their revenue sources used.

5.1 Origin and Intermediary Revenue Sources

Recall that municipalities are limited to five main sources of revenue: user fees, property taxes, development charges, debentures, and intergovernmental transfers. These five revenue sources are referred to in this research as either origin or intermediary revenue sources. Taxes and user fees have inputs from a non-government source – their origins are transparent and easily recorded. Taxes and user fees are therefore categorized as origin revenue sources. Intermediary revenue sources receive income from an origin revenue source or another intermediary revenue source. Examples of intermediary revenue include reserves and intergovernmental transfers, where the non-government income source is not immediately identifiable. Reserves and reserve funds, while not traditionally considered a source of revenue for a municipality, work in the same way as other intermediary revenue sources, in the sense that they act as conduits for origin revenue sources to be applied to an expenditure. Previous literature does not seem to distinguish revenue sources this way, so the terms origin and intermediary revenue sources are introduced specifically for

this research. There are a few reasons why this distinction is necessary. First, a resident or business is likely to care more about what their specific contribution is to a government program. For example, it is more meaningful for a taxpayer to know that 50% of their parks system is paid by their federal income taxes, than it is to know that 50% is paid through federal transfers of various origins. Second, the revenue-linking principle of the benefit model can be more effectively applied if the revenue that went into each intermediary revenue source is identified. In Figure 4.1, shown in Chapter 4, origin revenue sources are indicated in white with a solid border, while intermediary revenue sources are identified in light grey with a dotted border (intergovernmental transfers) and medium grey with a dashed border (reserves and funds). Crown entities, which are also listed, may generate revenue, in which case they are considered here as origin revenue sources.

5.2 Infrastructure Systems

In this section, the circular flow diagram model is expanded to represent the detailed intricacies of the water and transportation systems, following the principles introduced in Chapter 4.

5.2.1 Water

In Waterloo, water infrastructure is provided as a partnership between the lower-tier municipalities and the Region. This relationship, along with connections to other levels of government, are depicted in Figure 5.1. The model shows only the economic flows relevant to the municipal and regional water system. Waterloo's water infrastructure includes water distribution, wastewater collection and the storm water system. The Region of Waterloo's water infrastructure includes water supply and wastewater treatment (The City of Waterloo, 2016b). The Region also operates water distribution and wastewater collection systems, but these services and their corresponding revenue streams are limited to the Townships of Woolwich and North Dumfries (Braan, 2016), where the lower-tier municipalities do not provide their own distribution and collection systems.

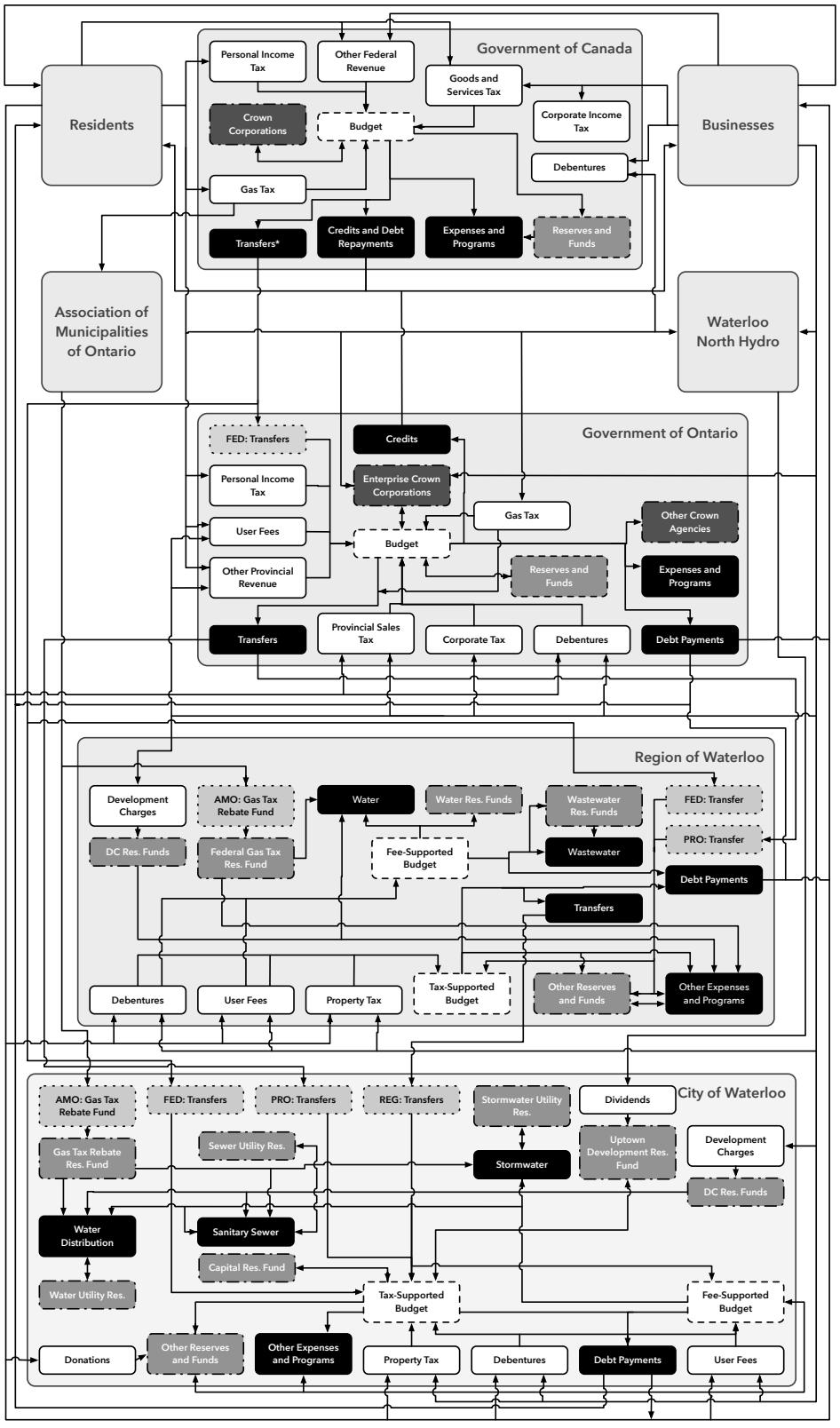

Figure 5.1: Circular flow diagram for water infrastructure funding in Waterloo, Ontario.

5.2.2 Transportation

As with water infrastructure, systems in the transportation network are funded and maintained by the lower-tier or upper-tier municipality. This relationship is depicted in Figure 5.2. Both municipalities maintain separate networks of roads, pedestrian infrastructure and cycling infrastructure. Waterloo also operates a parking network. The Region of Waterloo operates the bus-based GRT, and is currently building the ION rapid transit project.

5.3 Method

In this analysis, water infrastructure revenue sources are compared with transportation infrastructure revenue sources, both of which contain lower-tier and upper-tier components. The analysis was performed by collecting revenue sources and expenditures from a set of public government documents, separating intermediary revenue sources into origin revenue sources, and aggregating revenue sources by category. The procedure for determining origin revenue is done using Waterloo, but is generally replicable for other jurisdictions that employ the use of reserve funds and government transfers.

5.3.1 Revenue and Expenditure Collection

In Chapter 3, Figure 3.3 listed financial documents in order of priority. Annual financial reports took top priority, followed in order by FIRs, PA-C and PA-O records, government press releases, operating budgets, then capital budgets. This study, conducted earlier in the research process, was done without use of annual financial reports or FIRs, as the budget documents were believed to be the most reasonably accurate representations of the finances of municipal governments, and the higher-priority documents do not provide sufficient granularity to see individual reserve contributions to a unit. Where possible, data from other sources were swapped out to use annual financial reports or FIRs instead.

Data on revenues and expenditures were derived from the 2014-2016 operating and capital budgets for both municipalities. Multiple years of budgets were selected to establish representative trends and dampen any year over year spending fluctuations, particularly due to capital projects. The infrastructure systems of analysis are presented in Table 5.1.

Within each capital budget, allocated costs for the current year were provided per item, typically linked to the revenue streams – origin or intermediary – that were

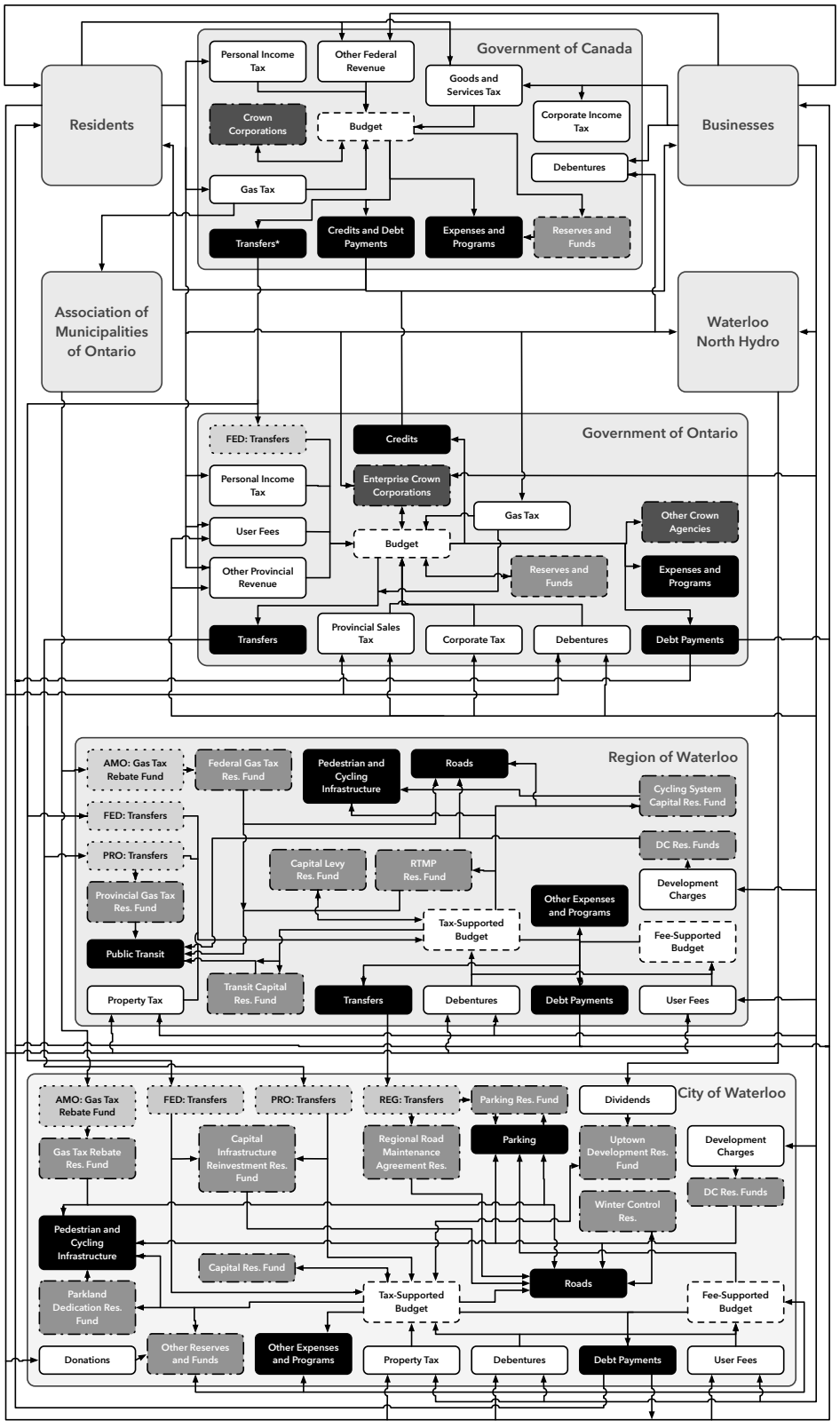

Figure 5.2: Circular flow diagram for transportation infrastructure funding in Waterloo, Ontario.

Table 5.1: Water and transportation infrastructure systems and subsystems in Waterloo, Ontario

System	Municipality	Subsystem
Water	Region of Waterloo	Water supply Wastewater treatment
	Waterloo	Water distribution Sanitary sewer Stormsewer
Auto	Region of Waterloo	Roads
	Waterloo	Roads Parking
Transit	Region of Waterloo	GRT and rapid transit
Active	Region of Waterloo	Sidewalks and cycling infrastructure
	Waterloo	Sidewalks and trails

supporting them. For origin revenue sources, data are recorded directly. The way in which intermediary revenue sources are treated is presented in the following section.

In the event that a revenue source was not directly tied to an expenditure, the revenue source could be inferred based on knowledge of the fund's usage guidelines or by matching expenditure values to revenue values in the budget. For example, if the road budget's expenditure list in a given year indicates an unexplained $600,000 in revenue, and there are two unallocated expenditures of $200,000 and $400,000, then these flows are linked.

In some instances, municipal and regional revenue or expenditure values could be verified using other data sources. For example, the federal (Infrastructure Canada, 2016) and provincial (Ontario Ministry of Transportation, 2014) contributions to the ION rapid transit project were verified using sources from their respective websites, and were used as the upper limit for grants and subsidies. Additionally, the 2014 and 2015 provincial gas tax allocations were available from the FIR submissions from the Region (Ontario Ministry of Municipal Affairs, 2017). For 2016, the provincial gas tax revenue was extrapolated using the rate of increase from the previous year.

For completeness, the analysis also requires that the origin revenue sources of governments that provide transfers to municipalities be articulated. For Waterloo, this consists of provincial and federal funds. For the federal government, revenue sources were taken from the PA-C, Volume 2 for 2014 and 2015 (Receiver General of Canada, 2017), which outlines actual expenditures and revenues for those years. For the provincial government, revenue sources were taken from the PA-O, Volume 1 for 2013-2014 and 2014-2015 (Ontario Treasury Board Secretariat, 2017), which serves the same function as the PA-C, but for provincial finances.

5.3.2 Intermediary Revenue Disaggregation

Intermediary revenue sources were processed separately, depending on whether they consisted of one or multiple sources of revenue. If an intermediary revenue source consisted of one source of revenue, then that source of revenue 'replaced' the intermediary revenue source in the analysis. In Waterloo's case, many intermediary revenue sources consisted entirely of one source of origin revenue. All municipal and regional reserve funds designated for the water system are supported directly through user fees, as this is implicit in the operating budgets for the Region of Waterloo (Braan, 2014; Braan, 2015; Braan, 2016), and explicit through the City of Waterloo's reserve fund policy (Koppeser, 2015). Municipal reserve funds used for transportation system funding also have guidelines designating the allowed sources of income for each reserve. Regional reserve funds for transportation are entirely from property taxes (Gray, personal communication, 2016, July 21). Intermediary revenue sources with multiple sources of revenue were scaled proportionally from the total eligible contributions from those sources to the fund.

Often, reserve funds received contributions from both federal and provincial governments, which required calculations of relative contributions. It was assumed that contributions were proportional to the overall revenue in the government, except for any revenue sources that were clearly targeted towards other projects. The ratio of funds was calculated based on values derived from the CRA and the Ontario Ministry of Finance as they were the primary revenue-generators for their levels of government. The ratios were then applied to the Department of Finance Canada, Infrastructure Canada, and the Ontario Ministry of Infrastructure, as they were the primary source of general transfers to lower levels of government (Receiver General of Canada, 2017; Ontario Treasury Board Secretariat, 2017).

For ION, the actual capital expenditures for 2014 and 2015 were estimated to improve accuracy. First, estimated total transfers in a given year (T_y) were calculated as the difference between the remaining transfers in the given year's budget and the following year's budget. Second, total transfers were converted to federal and provincial transfers, assuming same share as their total contribution (46.9% federally, 53.1% provincially). The estimated transfers for each year were divided by the total transfers (T_T, or \$565 million), then multiplied by the total federal contribution (F_T, or \$265 million) to find federal transfers in a given year (F_y), or by the total provincial contribution (P_T, or \$300 million) to find provincial transfers in a given year (P_y), using the expressions

$$F_y = T_y/T_T \times F_T \tag{5.1}$$

$$P_y = T_y/T_T \times P_T \tag{5.2}$$

The ION's yearly estimated capital expenditures were averaged over the 2014-2016 study period, and disaggregated into origin federal and provincial revenue sources, before being combined back into the transit analysis.

5.3.3 Origin Revenue Source Aggregation

Each subsystem's analysis was broken down into municipal, provincial and federal origin revenue sources. The revenue sources were converted from averages into per capita values, using population estimates for the city and the region in 2015 from the same data source (V. Martin & Parkin, 2016). The reason for this is twofold. First, the Region of Waterloo has a much larger budget than the City of Waterloo, by nature of serving a larger population. Second, per capita values make it easier to combine subsystems into larger systems. The per capita values within each system were compared to other values and divided over the total spending in each system, to provide a share of each revenue source in funding. The per capita values also provide a theoretical value of the charge applicable to each user of the system were the system to be solely funded through user fees, assuming all users of each system were from the City of Waterloo, and that there were no economic impacts from converting funding models.

5.4 Results

Sources of revenue used to pay for water and transportation infrastructure in the City of Waterloo were analyzed and compared. Figure 5.3 shows a visual representation of how each type of infrastructure was funded, on average, between 2014 and 2016. For the sake of visual comparison, the figure shows property tax, user fees, development charges and debentures. The fifth source is the provincial and federal gas tax, as the extent to which these taxes cover road infrastructure has been explored in previous research. While gas taxes are viewed in some jurisdictions as user fees, their use in Canada for infrastructure systems outside of roads results in the provincial and federal gas taxes acting more like a traditional tax. A sixth category, 'other,' reflects atypical sources including income and sales taxes.

Table 5.2 itemizes the funding share and average spending per capita for each of the four infrastructure systems by origin revenue source. For revenue sources with no funding

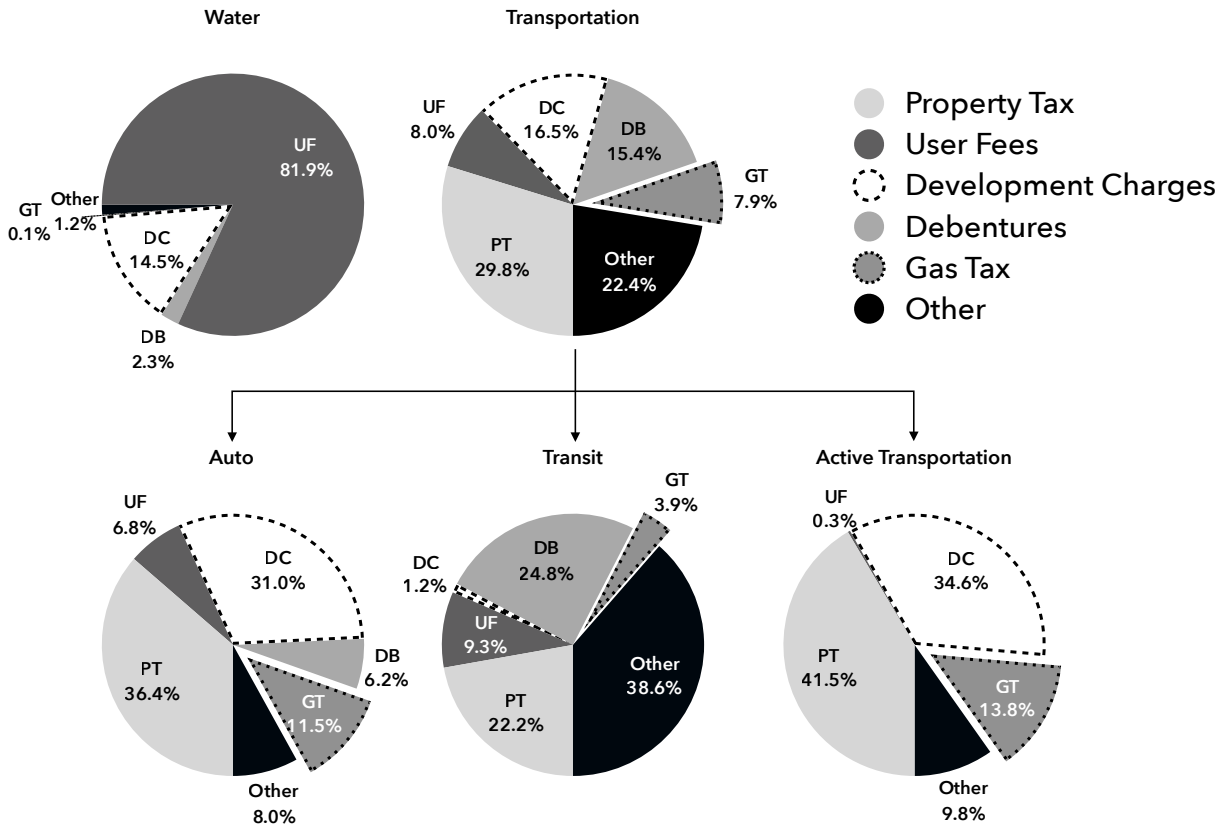

Figure 5.3: Funding share for water and transportation infrastructure for 2014-2016 in Waterloo, Ontario.

contribution, the cell was left blank; items marked with asterisks are effectively $0.00 per capita due to rounding. The gas tax in Table 5.2 and Figure 5.3 includes both provincial and federal gas taxes.

Municipal and regional sources of revenue (user fees, development charges and debentures) accounted for 99% of the water system's funding, all of which was based on revenue collected from consumers or direct beneficiaries of the water system. The remaining sources of revenue were the federal gas tax and a transfer from the Region to the municipal stormwater subsystem, which had no clear income source, but the transfer size was a negligible contribution to the system (0.09%).

Municipal and regional sources of revenue accounted for roughly 87% of the auto system's funding, of which half came from the property tax. User fees consist of funding from the water system and the municipal parking subsystem. Water system fees were allocated toward water system projects connected to roads, and therefore counted as consumer-funded revenue. Parking user fees were for the municipal parking subsystem, which has transitioned to an enterprise model much like the water system (Koppeser, 2015), but still relies on some portion of property tax. Parking, as part of the auto system in Table 5.2, had a funding share of 61.5% user fees, 26.5% development charges, 9% property tax and 3% debentures.

Transit infrastructure includes both the current bus-only GRT service and the ION. Municipal and regional sources of revenue accounted for 59% of transit funding. Capital construction costs for ION peaked in this time period, representing 60% of transit funding. The federal and provincial funding for both components with no assumed source of revenue were split into their origin revenue sources, which result in some of the additional funding sources in the table. The large contribution of non-regional funding for ION construction was the major source of other revenue sources for transit infrastructure in this time period, which explains their large share in transit (38.6%) compared to other transportation systems (8-9%). After ION is built, the share of other revenue sources may be closer to the auto and active transportation systems.

Municipal and regional sources of revenue accounted for 86% of active transportation funding, of which over half was sourced from consumers and direct beneficiaries. The only major intergovernmental transfer was the federal gas tax. The Region of Waterloo had no operating costs for sidewalks or trails, which are instead maintained by the lower-tier municipalities (Gray, personal communication, 2016, July 28). Operating costs for regional bicycle lanes are hidden under the regional road costs, so their operating costs are included in the auto infrastructure analysis. At the municipal level, there was a dedicated active

Table 5.2: Water and transportation infrastructure funding shares and average spending per capita per year for 2014-2016 in Waterloo, Ontario

Revenue Source	Funding Share and Average Spending per Capita per Year							
	Water		Auto		Transit		Active	
Property Tax			36.37%	$225.91	22.21%	$139.30	41.50%	$10.77
User Fees	81.86%	$567.19	6.83%	$42.45	9.34%	$58.61	0.29%	$0.07
Development Charges	14.46%	$100.18	31.04%	$192.78	1.16%	$7.26	34.59%	$8.98
Debentures	2.31%	$15.99	6.18%	$38.37	24.85%	$155.84		
Gas Tax	0.15%	$1.03	11.53%	$71.64	3.87%	$24.30	13.82%	$3.59
Other	1.23%	$8.51	8.04%	$49.96	38.56%	$241.96	9.79%	$2.53
Businesses	1.14%	$7.90	4.03%	$25.05	1.72%	$10.82	7.91%	$2.05
Corporate Tax			0.06%	$0.40	6.49%	$40.74		
Industrial Land Account			1.39%	$8.66				
Other Federal Revenue			0.00%*	$0.00*	0.64%	$4.02		
Other Provincial Revenue			0.05%	$0.29	2.10%	$13.15		
Other Waterloo Region Municipalities			0.13%	$0.78			0.79%	$0.20
Personal Income Tax			0.18%	$1.09	20.20%	$126.73		
Provincial Enterprise Revenue			0.02%	$0.13	0.92%	$5.79		
Region of Waterloo	0.09%	$0.61	1.15%	$7.15				
Sales Tax			0.12%	$0.78	6.49%	$40.71		
Third Parties			0.91%	$5.63				
Universities							1.09%	$0.28
Average Spending Per Capita		$692.90		$621.11		$627.26		$25.96
Hypothetical User Fees, Under Water Funding Model (81.86% Share)		$567.19		$508.44		$513.48		$21.25
Hypothetical Increase Over Existing Funding Model		0%		1097%		776%		30257%

transportation operating budget, which is included here. Both the municipal and regional capital budgets isolated sidewalks, trails and cycling facilities, all of which were included in the analysis.

For all transportation systems, an additional calculation was done to estimate the hypothetical increase in user fees assuming a funding model like the water system (last row of Table 5.2), where user fees consist of 82% of the total funding. This was done to determine the hypothetical user fee impact per user if transportation was funded under a fee-based system.

5.5 Discussion

The funding shares suggest that the water system maintains simplicity, even when broken down to origin revenue sources, while finding origin revenue sources for the transportation systems was challenging. By nature of receiving intergovernmental transfers with no clear revenue source, the assumption that they are funded equally through a share of federal and provincial revenues meant that transit was separated into thirteen origin revenue sources, some of which were clusters of small individual sources of revenue at the higher levels that were insignificant on their own, but showed some importance when aggregated.

A valuable aspect of public finance is the importance of connecting revenue and expenditures. User fees are considered an effective revenue source for private goods, since the beneficiary of the fee can be identified. For a public good, the beneficiary can not necessarily be identified, so a property or sales tax can be levied on all potential users of that good, acting somewhat like an "entry fee" for all residents or business customers in a given area to make use of that service. For a spillover good, residents of other municipalities may experience positive or negative externalities from that service, so transfers from higher levels of government may be used to cover the cost of users crossing municipal boundaries. The fourth type, redistributive goods, typically cover equity-oriented services like social housing or public health, and may use income tax to redistribute wealth.

Waterloo's water systems are considered private goods, and the revenue sources therefore connect effectively with system expenditures, as 80% of the water system funding came from user fees. The other major sources of revenue, development charges and debentures, would also be considered effective, as they are intended for growth-related or long-lasting projects.

The transportation systems consist of many different types of goods. Parking is considered a private good, while sidewalks, trails and road infrastructure could be considered public or spillover goods, depending on their usage from out-of-town users. Transit could be considered a private good, because it is excludable, and a spillover good, because it provides positive externalities for drivers by being a more compact travel mode. In some ways, transit also removes negative externalities of driving by lowering environmental impacts and occurrences of accidents. Parking linked revenues and expenditures effectively, since user fees, development charges and debentures accounted for 91% of total funding. Transit and road revenue-expenditure linkage are not as effectively linked. While transit and roads do collect some spillover fees through federal and provincial transfers, the origin revenue sources used to pay for these transfers may not be the most equitable sources. Income taxes are estimated to be a significant portion of any intergovernmental transfer, and while income taxes are ideal for dealing with equity, it may be more appropriate for sales taxes or other non-distributive sources of income to take a larger share of transfers for transit and road funding. Local sales taxes target users who shop in a given area, which would be an effective method for gaining revenue from spillover road and transit users. A drawback of this approach may be that the sales taxes would be higher in the transit-dense cities versus the rural townships, encouraging stores to move into the townships near the city borders to take advantage of providing lower sales taxes. Additionally, a much higher percentage of transit revenue is estimated to come from property tax rather than user fees. If transit is a primarily private and spillover good, then shifting this income share to be more funded by user-fees could be more effective.

For roads, which can be assumed public and spillover goods, the higher share of property tax funding may make sense, but if there is a mechanism for allocating users to road segments or charging by usage, then it could be more effective to shift to a user fee model. The idea of shifting to a mileage-based fee has been explored in previous research. For both the auto and transit modes, the low contribution of user fees to their current funding suggests that a shift to a water-style funding model could greatly increase the out-of-pocket cost of using either of these modes (last row of Table 5.2). Hypothetically, using the 2016 adult fare price of $3.25 for transit service (Grand River Transit, 2017), a user fee share similar to water could result in a fare of $28.47. The 2016 hourly rate for the parking facility in Waterloo's city centre was $3.25 (The City of Waterloo, 2016a), and as part of the auto system, would result in a rate of $38.91/h. This hypothetical scenario could also result in lower taxes, since transit and parking would not be subsidized. The impact of road fees on a transit network is excluded from this estimate, since depending on the

implementation of the fee there could be minimal to no impact on the transit system. These fees would likely be higher once economic impacts are included, since less people would be able to ride the system if they were not provided additional income or tax relief.

Although federal and provincial gas taxes are collected primarily from auto users and transit vehicles, the federal gas tax is also allocated toward other municipal initiatives like energy projects and brownfield development, which fall outside the scope of this analysis. Similarly, the provincial gas tax is directly allocated toward public transit projects, but is collected from both auto and transit vehicles. A possible explanation for this is that auto users fund public transit due to the spillover effect of reduced road congestion, and to encourage higher density travel.

5.6 Limitations

The methods used for analysis made assumptions in order to find the final funding shares, introducing limitations. Reserve funds with multiple potential sources of income were typically assumed to be composed of the most stable revenue source, although it is possible that one of the less steady revenue sources was a significant contributor. For example, the municipal Capital Infrastructure Reinvestment Reserve Fund (CIRRF), which received steady property tax revenue in addition to intergovernmental transfers allocated for road rehabilitation, was assumed to consist of property tax, but the transfers from higher levels of government could have been a significant fraction of the CIRRF's reserves. Similarly, the assumption that federal and provincial transfers with uncertain sources would follow the general budget for a set of select departments may have introduced error into the funding share of origin revenue sources derived through transfers. The necessity of these assumptions illustrates the opacity of infrastructure financing, even when examined under scrutiny.

The results of this section are somewhat sensitive to the assumptions made about how finances were separated in this process. Assuming the contents of reserves and reserve funds places a higher value on the property tax contribution to each system (or user fees, for water). The assumption that federal and provincial transfers are funded using a slightly modified version of a government's general revenue share reflects the way revenue is treated at these government levels, for the most part. The assumptions about which revenue the government would not apply uniformly, specifically the gas taxes and the Canada Health and Social Transfers at the provincial tier, may impact the way transfers are broken down into their origin revenue sources. Of each system, water would be less sensitive to the

assumptions made and transit would be more sensitive, because the origins of each system are very clear and not as clear, respectively.

To compare between the municipal and regional levels, per capita values were determined by dividing each municipality's total population estimate. This method was convenient, and was a good method for finding municipal values, but at the regional level may have skewed the proportion allocated to City of Waterloo residents, because property tax is not collected at the same rate between municipalities for all systems.

Finally, the ION's capital budget used a set of more realistic estimates, while the other capital budgets used forecasted values. This may result in the ION budget being disproportionally low compared to other capital budgets, but realistic values were preferred over using estimates of varying accuracy.

Chapter 6

Temporal Fiscal Sustainability Analysis

The second primary output of this research is a temporal analysis of transportation funding at the local and regional government tiers. A Key Performance Indicator (KPI) is introduced to measure fiscal sustainability, which is applied to road and transit infrastructure in Waterloo and Toronto. This indicator is compared against a series of existing KPIs, to validate the performance of the new KPI, and to evaluate the sustainability of the infrastructure in both cities.

6.1 Proposed Indicator

A review of existing literature outlined in Chapter 2 introduced the desire for KPIs in public-sector financing that can correct for a variety of factors, to better track fiscal sustainability. This chapter introduces an indicator consisting of a combination of two constituent indicators: total expenditures per capita (TEpc) and infrastructure supply per capita (ISpc). Infrastructure supply is represented by lane kilometres for roadways, while revenue vehicle kilometres are used for transit. These values are indexed to a base year, and the rate of change in TEpc is compared to the rate of change in ISpc, following the expression:

$$i = \frac{TEpc_{current} - TEpc_{index}}{TEpc_{index}} - \frac{ISpc_{current} - ISpc_{index}}{ISpc_{index}} \tag{6.1}$$

Where,

- i is the value of the proposed indicator [unitless];
- *current* represents the study year; and
- *index* represents the index year.

If i is negative, then compared to the index year, the relative increase in total expenditures per capita is less than the relative increase in infrastructure supply per capita, suggesting that the per unit cost of maintaining infrastructure at the given population levels is lower. Conversely, a positive i suggests the per unit cost is higher.

The goal of the proposed indicator is to capture changes that would not be identified by previous indicators. More specifically, the proposed indicator will reflect changes to any combination of infrastructure supply, total expenditures or population. Some examples of cases that may not be captured typically are shown in Table 6.1. For instance, a population boom that coincides with unchanged infrastructure supply and spending would theoretically mean the infrastructure is cheaper to maintain per unit in the sense that less money is spent per person. Similarly, dramatic increases in spending that outpace inflation, but result in the same level of infrastructure at relatively even population levels, would reflect higher costs per unit of infrastructure or per person. Neither of these changes would be captured by traditional indicators. And, as a result, insufficient information is available to determine the fiscal sustainability of an infrastructure system over time.

Table 6.1: Infrastructure growth edge-case scenarios

	IS/capita	TE/capita	TE/IS
Isolated population boom	Decrease	Decrease	No change
Isolated higher-than-inflation spending increases	No change	Increase	Increase
Isolated supply increases	Increase	No change	Decrease

6.2 Method

This analysis builds on the ideas behind the static analysis by analyzing expenditures over a 25-year period for transit and an 11-year period for roads. Active transportation is included in the road analysis, since the operating costs for this mode in most years were part of the roads budget. In the previous chapter, the active transportation values reported were primarily limited to capital costs, hence it was possible to separate active transportation from roads. Like the previous chapter, this analysis focuses on per capita costs from the perspective of a resident in the City of Waterloo, Ontario.

The methods used for calculating government expenditures have progressed from the static analysis in the previous chapter, where operating and capital budgets for the City of Waterloo and Region of Waterloo were used to estimate the average revenue share of funding for transportation and water infrastructure from 2014 to 2016. In the prior chapter, the realized values of operating budgets were taken from the following year's budget (except for 2016 where the projected value was used). On the other hand, the capital budgets were taken from the current budget year's forecast, acknowledging that these estimates would likely overestimate the value of capital expenditures compared to the realized operating expenditures, since forecasts represent the upper spending limit for each project.

In this chapter, the primary sources of data used were the FIR (Ontario Ministry of Municipal Affairs, 2017) for the City of Waterloo, the Region of Waterloo, the City of Kitchener, and the City of Toronto. These documents are submitted annually to the Ontario Ministry of Municipal Affairs, using a standardized series of schedules that report on various aspects of a municipalitys financial health. The standardization of the data format enables easier comparison between jurisdictions, since the differences in organizational structures between municipalities cause challenges in interpreting inclusions and exclusions from each municipality. Of importance to this study are the operating expenditures schedules, which report on how much a municipality spends per program (e.g., roadways) in the operating budget. These data are more general than what is included in most budgets, but served the purpose of distinguishing between road expenditures and transit expenditures. Similarly, the capital expenditures data reports expenditures by program in the capital budget. In 2009, where acceptable capital costs were not provided, and no clear alternative was given, all values were omitted.

Due to the change in ownership of the municipal transit system in 2000, the Region of Waterloo FIRs were used for the year 2000 and afterwards for transit data, and the City of Kitchener FIRs were used prior to 2000. Operation of transit services in the City of Waterloo were provided by Kitchener before shifting to the Region, so Kitchener's financial data were assumed to be the most accurate representation of transit expenditures before 2000. The Region's finances were used for regional roads, while the City of Waterloo's finances were used for local roads. Between the two jurisdictions, accurate estimates of expenditures in the City of Waterloo were developed.

After costs were calculated for roads and transit, other data were required to calculate the proposed and existing indicators, previously identified in Chapter 3, including FIRs, annual financial reports, population data, and CPI values. To represent infrastructure supply in the sustainability analysis, road lengths were measured in lane kilometres and

transit supply was measured as revenue vehicle kilometres. Road lengths in lane kilometres were collected from the City of Waterloo FIRs for the years 2005-2015 for city roads, the Region of Waterloo directly for the same period for regional roads, and the City of Toronto (Berkovitz, personal communication, 2017, April 28) for Toronto roads. Revenue vehicle kilometres were collected from GRT (Allen, personal communication, 2017, February 24), which serves as the Regions transit agency, and from the TTC (Chu, personal communication, 2017 April 26) for Toronto's transit.

Once all the supporting data were gathered, each indicator could be calculated for transit infrastructure and road infrastructure, then converted into indices, as shown in Table 6.2. For ease of comparison, each indicator is compared as a percent change to the 2005 value to provide an index, where an index of 0 represents the 2005 value. The indices are therefore intended to be read from 2005 toward 1991, and from 2005 toward 2015, where values below 0 represent increased per unit cost compared to 2005, and values above 0 represent decreased per unit cost compared to 2005. Indexing from 2005 instead of 1991 was done to provide an easier comparison of the road growth indicators, where the available infrastructure supply data only go back to 2005. The intent is that values that trend extremely positively over time would represent decreased fiscal sustainability, due to increasing costs per unit. Conversely, values that trend negatively over time would represent increased fiscal sustainability, to a degree, due to decreasing costs per unit. The ideal scenario would have values stay constant over time, which would indicate that a sustainable financing system has been developed (i.e., achieved steady-state). The value of this indexed analysis is in understanding the long-term trends versus year-over-year changes. Therefore, the selection of the base year and whether the index is above or below 0 in the short term is less important than whether the index continues to move above or below 0 over time. A steady-state financing system would also need to paired with system performance, which is not assessed in this study.

6.3 Results

A comparison of transit growth indicators is presented in Figures 6.1 and 6.2. The proposed indicator (circles) is compared against total expenditures (TE) per capita (squares), TE per trip (downward-pointing triangles), operating expenditures (OE) per trip (upward-pointing triangles) and TE per revenue vehicle kilometre (diamonds). TE and OE per trip were included to provide some comparison to the methods used in Ontario's FIRs, but are only shown from 2005-2015 in Waterloo due to the availability of ridership data. TE per

Table 6.2: Infrastructure growth index calculation methods.

Index	Calculation method	System
Proposed indicator (TE per capita vs. lane km per capita)	Percent change in (total expenditures / population) since 2005 minus percent change in (lane kilometres / population) since 2005	Roads
Proposed indicator (TE per capita vs. rev. veh. km per capita)	Percent change in (total expenditures / population) since 2005 minus percent change in (revenue vehicle kilometres since 2005 / population) since 2005	Transit
TE per capita	Percent change in (total expenditures / population) since 2005	Roads, transit
OE per lane km	Percent change in (operating expenditures / population) since 2005	Roads
TE per lane km	Percent change in (total expenditures / population) since 2005	Roads
TE per rev. veh. km	Percent change in (revenue vehicle kilometres / population) since 2005	Transit
TE per trip	Percent change in (total expenditures / passenger trip) since 2005	Transit

revenue vehicle kilometre was included to represent a more accurate infrastructure supply indicator comparable to the use of lane kilometres in roads.

In Waterloo, in all indicators using TE, the highest indices are in 2014 and 2015, which is likely due to the construction of Waterloo's light rail transit system, with much lower values in prior years. The TE per capita indicator tends to suggest less sustainable funding compared to 2005 than the other indicators, while the TE per trip indicator tends to suggest more sustainable funding from 2005-2013. The proposed indicator and TE per revenue vehicle kilometre indicator suggest nearly equal results until 2012, when the proposed indicator begins to suggest a higher trend toward unsustainable funding than the TE per revenue vehicle kilometre indicator. In Toronto, transit growth again correlated quite strongly with the TE per revenue vehicle kilometre indicator. All indicators showed the same trends of relatively increasing costs per unit, suggesting that sustainable funding levels have not been achieved, although the funding appears to stabilize in the 2010s.

A comparison of road growth indicators is presented in Figures 6.3 and 6.4. The proposed indicator (circles) is compared against TE per capita (squares), TE per lane kilometre (diamonds), and OE per lane kilometre (triangles). OE per lane kilometre is included to provide direct comparison to the reporting methods used for Ontario's FIRs up to 2014, since capital costs are often not included in the FIR's key performance indicators. The OE per lane kilometre values are adjusted for inflation and use the same cost calculation method as the other indicators instead of the actual values found in the

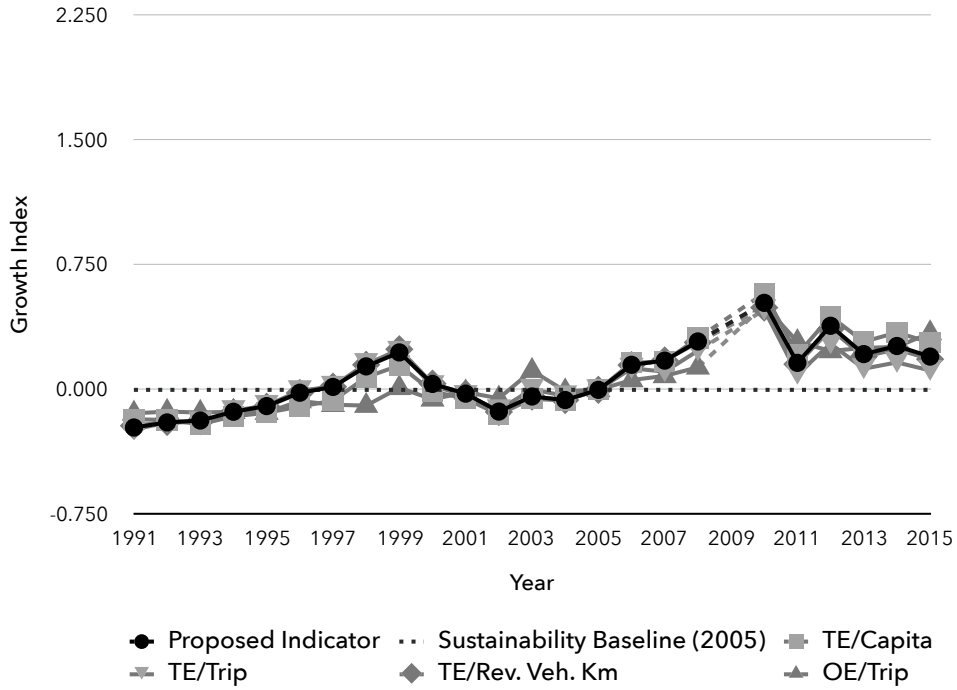

Figure 6.1: Transit growth indices for Toronto from 1991-2015 (2016$, indexed to 2005)

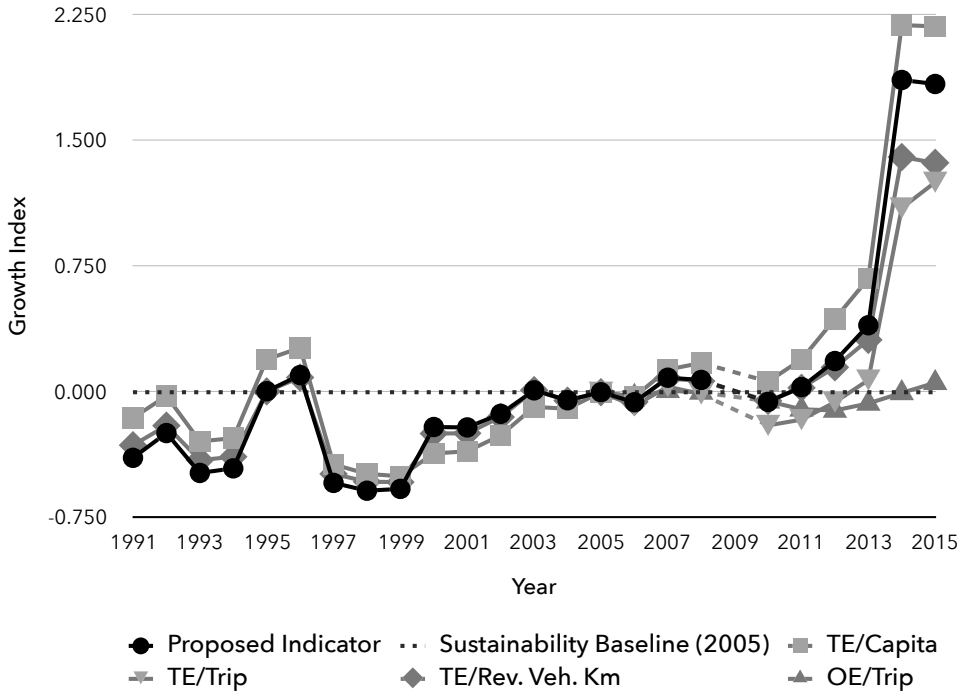

Figure 6.2: Transit growth indices for Waterloo from 1991-2015 (2016$, indexed to 2005)

FIRs to provide a better comparison.

In Waterloo, the proposed indicator is visually most like the TE per capita indicator, but every indicator makes different suggestions about the sustainability of road infrastructure in subsequent years compared to 2005, although they all suggest that sustainability has decreased since then to varying degrees. The TE per capita indicator suggests the closest return to 2005 per unit cost levels, the TE per lane kilometre indicator initially suggests a higher level of unsustainable spending between 2005 and 2008 before aligning with the other indicators, and the TE per lane kilometre indicator suggests a slow and stable trend toward unsustainability across the 11-year analysis. The proposed indicator tends to suggest a higher level of unsustainable spending between 2009 and 2015 compared to 2005 than the other TE indicators. In Toronto, the proposed indicator is most similar to the TE per lane km indicator and the TE per capita indicator, indicating a somewhat stable funding pattern with an upward trend. OE per lane kilometre begins showing a similar trend, then increases rapidly after 2008.

6.4 Discussion

Across all indicators that include capital costs, Waterloo's transit service was found to have a lower per unit cost than 2005 levels in the years 1991-1994, 1997-2004, 2006, and 2010. Additional years were also found to meet this criterion depending on the indicator used, but these transient years did not strongly correlate with a lower per unit cost. Over the long term, the fiscal sustainability of transit funding was turbulent in the years where Kitchener Transit served Waterloo, but once it fell under the regional jurisdiction of GRT, the key performance indicators indicate a more stable and sustainable trend in the years 2003-2011. This continued until the beginnings of the construction of the Region of Waterloos LRT system in 2011, where costs greatly outpaced infrastructure supply. The OE per trip analysis shows that, while there has been a slight increase in the per unit cost, the sustainability trend has been quite stable, likely a sign that the upward shock is just a side-effect of building the light rail transit system. If this is true, then the shock should be eliminated in the next couple years once the bulk of the construction is finished.

For Waterloo's road service, every indicator including those with or without capital costs showed that roads were on a general upward trend in per unit cost, suggesting potential problems for long term sustainability. This was particularly true when only looking at the OE per lane kilometre indicator, which showed a stronger correlation of unsustainability. Of the included years, 2005 had the lowest per unit cost, so all growth indices were higher

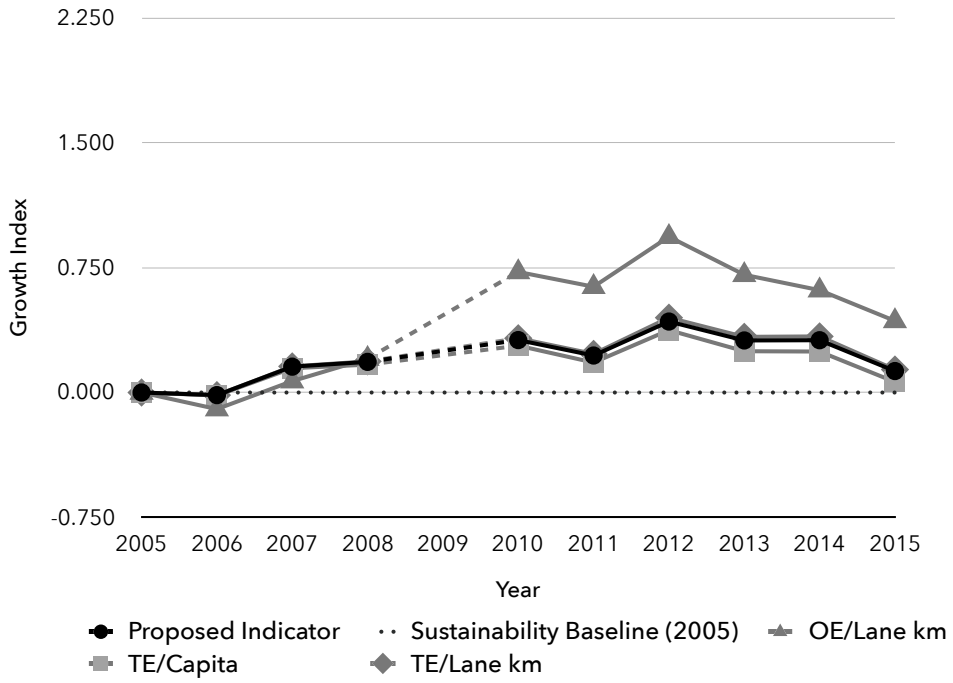

Figure 6.3: Road growth indices for Toronto from 2005-2015 (2016$, indexed to 2005)

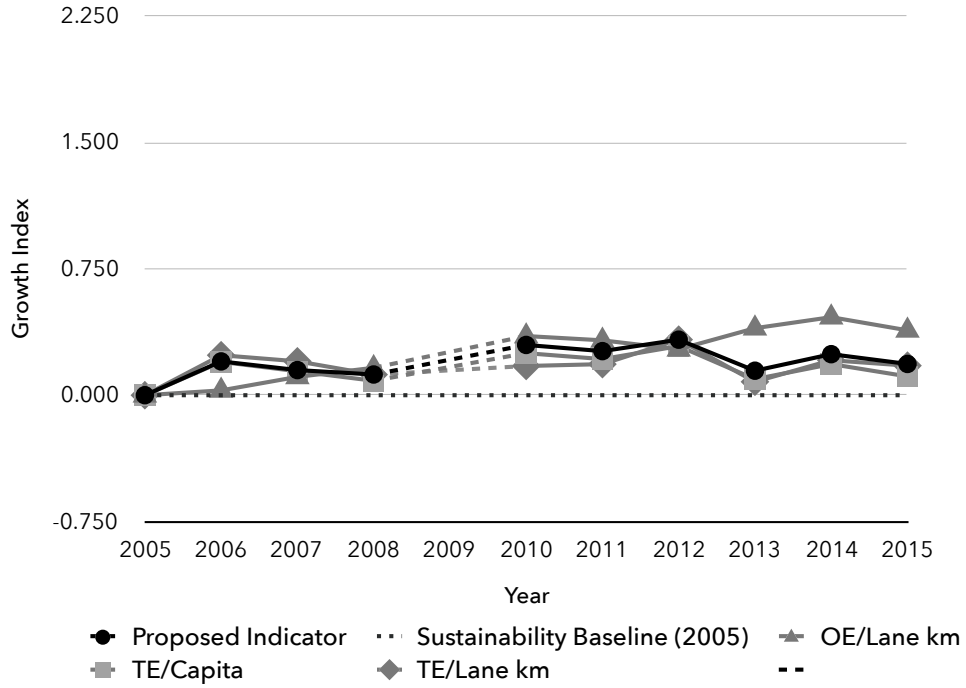

Figure 6.4: Road growth indices for Waterloo from 2005-2015 (2016$, indexed to 2005)

than 0.

In Toronto, transit service was found to have a lower per unit cost than 2005 levels before 1996 and between 2001-2004. The long term trend suggests the system experiences spikes in unit cost, but that the system is also generally trending upwards in unit cost. Both OE and TE trends suggest this, with minimal differences between indicators. It is possible that the TTC is finding a new equilibrium price, or in other words, that the current prices are unsustainably low.

For road service, indicators showed similar results to Waterloo, including the proposed indicator. OE per capita showed stronger turbulence than in Waterloo. Outside of 2006, all growth indices were higher than 0, suggesting increased unsustainability over time.

Regarding the proposed indicator, there appears to be some utility when the analysis period covers a longer term, or when the spikes in costs per unit are much higher. This was noticeable in the more recent years in the transit analysis, and to a lesser degree, in the road analysis. However, all indicators in this analysis that used TE tended to give a similar result, suggesting that either the cost on its own is more of a contributing factor to the variances over time in the indices, or that the population and infrastructure supply and demand factors correlate well enough in practice that indicators making use of only one of the factors work most of the time.

6.5 Limitations and Future Work

A limitation in this analysis that could also be part of a future phase of this study is to identify transit revenues and expenditures that take place only in the GRTs urban service area. This would narrow down the scope of what City of Waterloo residents pay for, but may be challenging as the capital budgets for the GRT often mix urban and rural expenditures. Another limitation to the interpretations of this study is a comparison against the level of service for the road and transit systems. This would provide insight into whether the increases in spending are necessitated by changes in system performance.

The use of the general CPI to represent inflation, while often used in governments as a baseline for wage increases or other regular annual increases, may not accurately reflect the increased price of goods and services that make up a transit or road service. A component of this project in the future will be to determine whether other inflation indices should be used to represent the increases in cost instead. The use of 2005 as a baseline for the analysis was also not ideal, but was made necessary by a lack of lane kilometre data available for

roads at the local and regional levels in Waterloo. In the future, there would ideally be enough road supply data to conduct an analysis of roads from 1991 as well, allowing for 1991 to be the baseline in both evaluations. This would make it simpler to compare both systems, and make it easier to understand visually if transportation infrastructure is funded sustainably.

While the proposed indicator was able to show similar results to existing ones that compare fundamentally different things, the utility was not demonstrated as strongly due to the relatively stable nature of Waterloo and Toronto's population, infrastructure supply and spending levels. A good point for future study would be finding a region where there has been a demonstrated shock in one of these criteria, and stable levels in the other two, to truly test the resilience of the proposed indicator.

There is the possibility that some capital costs have been counted twice in this analysis. Money that went into reserves or reserve funds may have been included in operating costs, depending on the reporting structure of each municipality's FIR, which would then be included again in the capital costs when the money is withdrawn from the reserve or reserve funds for capital expenditures. This enforces the desire to incorporate reserves and reserve funds into the analysis, to conduct a more transparent sustainability analysis of the citys infrastructure over time, since reserves and reserve funds would provide details of which funds are new to a government and which funds are coming from reserves and reserve funds.

Chapter 7

Conclusions

This research was conducted with the goal of improving the transparency and sustainability of public-sector infrastructure funding. In this respect, the research has produced successful results. The static analysis of Waterloo was able to provide some clarity concerning the true origin revenue sources of infrastructure funding. Subsequently, an analysis of those funding sources with the benefit model principles showed that water, with its user fee model, has excellent linkages between the revenues it collects and its expenditures, while transportation networks varied. Roads require a mechanism for identifying individual vehicles (i.e., users) in an urban environment, which does not raise concerns from the public that ultimately results in a political impasse. Transit showed lower effectiveness, partly due to the large amount of transfers, which consisted substantially of income taxes.

The temporal analysis was able to demonstrate that there could be methods for improving sustainability measurement at a level that is understandable to the everyday taxpayer. A proposed indicator was suggested that gave similar results to existing indicators, once adjusted for inflation and indexed, that could also prove more resilient against edge-case scenarios. The indicator was not able to be tested against possible edge-case scenarios, like population booms or dramatic spending changes, due to the stability of each of the cities in the study. Transit expenditures were found to be generally sustainable in Waterloo, particularly since GRT took ownership of the transit system, and somewhat sustainable in Toronto, where the per unit cost has continuously risen even after adjusting for inflation. Road expenditures in Waterloo and Toronto were found to be somewhat sustainable, with less aggressive peaks and dips than in the transit system.

7.1 Future Work

The static analysis in Chapter 5 was conducted earlier in the research process, therefore, there are some lessons learned from subsequent work that could improve the results of that chapter. Specifically, the reliance on operating and capital budgets was a necessity of the time when this study was conducted, and may still be necessary if no sufficient data are provided from higher-priority data sources. Further study should be done into finding ways to incorporate annual financial report and FIR data into the methodology. Much of the work that could be extended from Chapter 5 is based in the temporal analysis of Chapter 6. Adding Toronto to the analysis in Chapter 5 would be of benefit to the transparency study as well. This would require an improved methodology first, because Toronto's budgets were not as simple to decipher.

The analysis performed in Chapter 6 is the basis of a larger sustainability analysis of the Waterloo and Toronto's infrastructure. There are two immediate goals for the future analyses: analyzing reserves and reserve funds, and analyzing revenue sources over time. By analyzing the cash flows in and out of reserves and reserve funds, the intent is to conduct an 'age of money' analysis could also be conducted, where it could be determined over time how long a 1991 taxpayer's dollar lasts versus a 2015 taxpayer's dollar. This could lead to a better understanding of which revenue sources go into these reserves, and is explored in Appendix A: 'Proposed Method: Age of Money'.

Following up on the previous analysis that examined sources of intergovernmental transfers and reserves, transfers from the provincial and federal governments could also be broken down into their origin revenue sources, such as sales tax or income tax, enabling a determination of how the composition of these origin revenue sources has changed over time. Incorporating other municipal revenues could also enable long-term tracking of whether municipalities are relying more on higher levels of government to fund their transportation infrastructure. This could capture the financial contribution commuters and other visitors have to a transportation system. Once property taxes are included in the revenue analysis, there is sufficient regional data in the Region of Waterloo to separate the origin of regional property taxes by lower-tier municipality, such as Waterloo or Kitchener. These will lead to a better understanding of a larger question, which is whether or not current residents pay for infrastructure intended for new residents versus that intended for their own needs.

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Appendix A

Proposed Method: Age of Money Analysis

One method proposed for future temporal studies is an age of money analysis. This analysis would be able to determine how old revenues in reserves are, so over time one could see if a municipality is relying more on older revenues or if it is gathering enough new revenue to keep healthy reserves of funds. The analysis was designed as a proposal for future implementation due to a large gaps in existing data concerning which reserves and reserve funds contribute to each infrastructure system. While reasonable estimations were able to be made for the three-year analysis presented in Chapter 5, reserve data over 25 years were not able to be gathered with high levels of accuracy. A sample age of money analysis is carried out using hypothetical revenue and expenditures, provided in Table A.1

A.1 Method

The method would work on a first-in first-out (FIFO) principle, visualized in Figure A.1. This diagram demonstrates a three-year example of how the analysis would work. In the first year, existing reserve balances are set as the oldest revenue (Pre-Y1 Revenue), with a value of $\$R_0$. Revenues from the first year are added to the balance of the reserve, still separated by origin revenue source (Y1 Revenues A-D), adding to a sum of $\$R_1$. Expenditures from the reserve in the first year (Y1 Expenditures, worth $\$E_1$) are then subtracted, from the earliest revenue. In the first year, this is the Pre-Y1 Revenue, which in this example is less than Y1 Expenditures ($R_0 < E_1$), so the entirety of the Pre-Y1 Revenue is removed from the reserve. The remaining value of Y1 Expenditures are paid off using the next earliest revenues, which are from the first year. The remaining value of the Y1 Revenues is greater than the remaining Y1 Expenditures, so each Y1 Revenue is proportionally applied to the difference based on their original value. As an example, if Y1 Revenue A were worth \$100 000, and Y1 Revenue B were worth \$50 000, then for every \$1 Y1 Revenue B contributes to paying off the remaining expenditures, Y1 Revenue A would contribute \$2, since it has contributed twice as much to the balance. In this way, all Y1 Revenues deplete at the same time, since they all entered the reserve at the same time.

Table A.1: Sample revenues and expenditures for age of money proposal.

Year	User Fees	Property Tax	Ontario Grant	Canada Grant	Existing Balance	Expenditures
1990	$0.00	$0.00	$0.00	$0.00	$1,000,000.00	—
1991	$100,000.00	$500,000.00	$200,000.00	$20,000.00	$0.00	$500,000.00
1992	$125,000.00	$550,000.00	$10,000.00	$400,000.00	$0.00	$300,000.00
1993	$130,000.00	$450,000.00	$100,000.00	$10,000.00	$0.00	$400,000.00
1994	$115,000.00	$600,000.00	$20,000.00	$1,000.00	$0.00	$550,000.00
1995	$140,000.00	$500,000.00	$40,000.00	$40,000.00	$0.00	$600,000.00
1996	$145,000.00	$530,000.00	$0.00	$600,000.00	$0.00	$550,000.00
1997	$150,000.00	$570,000.00	$200,000.00	$50,000.00	$0.00	$650,000.00
1998	$135,000.00	$650,000.00	$200,000.00	$70,000.00	$0.00	$700,000.00
1999	$160,000.00	$400,000.00	$10,000.00	$90,000.00	$0.00	$750,000.00
2000	$150,000.00	$500,000.00	$100,000.00	$20,000.00	$0.00	$700,000.00
2001	$140,000.00	$550,000.00	$20,000.00	$400,000.00	$0.00	$650,000.00
2002	$145,000.00	$450,000.00	$40,000.00	$10,000.00	$0.00	$500,000.00
2003	$160,000.00	$600,000.00	$0.00	$1,000.00	$0.00	$650,000.00
2004	$155,000.00	$500,000.00	$200,000.00	$40,000.00	$0.00	$0.00
2005	$130,000.00	$530,000.00	$200,000.00	$600,000.00	$0.00	$550,000.00
2006	$115,000.00	$570,000.00	$10,000.00	$50,000.00	$0.00	$600,000.00
2007	$140,000.00	$650,000.00	$100,000.00	$70,000.00	$0.00	$550,000.00
2008	$145,000.00	$400,000.00	$20,000.00	$90,000.00	$0.00	$650,000.00
2009	$150,000.00	$500,000.00	$40,000.00	$20,000.00	$0.00	$700,000.00
2010	$135,000.00	$550,000.00	$0.00	$400,000.00	$0.00	$750,000.00
2011	$160,000.00	$450,000.00	$200,000.00	$10,000.00	$0.00	$700,000.00
2012	$150,000.00	$600,000.00	$200,000.00	$1,000.00	$0.00	$650,000.00
2013	$140,000.00	$500,000.00	$10,000.00	$40,000.00	$0.00	$2,500,000.00
2014	$145,000.00	$550,000.00	$100,000.00	$20,000.00	$0.00	$1,000,000.00
2015	$160,000.00	$450,000.00	$20,000.00	$400,000.00	$0.00	$400,000.00
2016	$155,000.00	$600,000.00	$40,000.00	$10,000.00	$0.00	$550,000.00

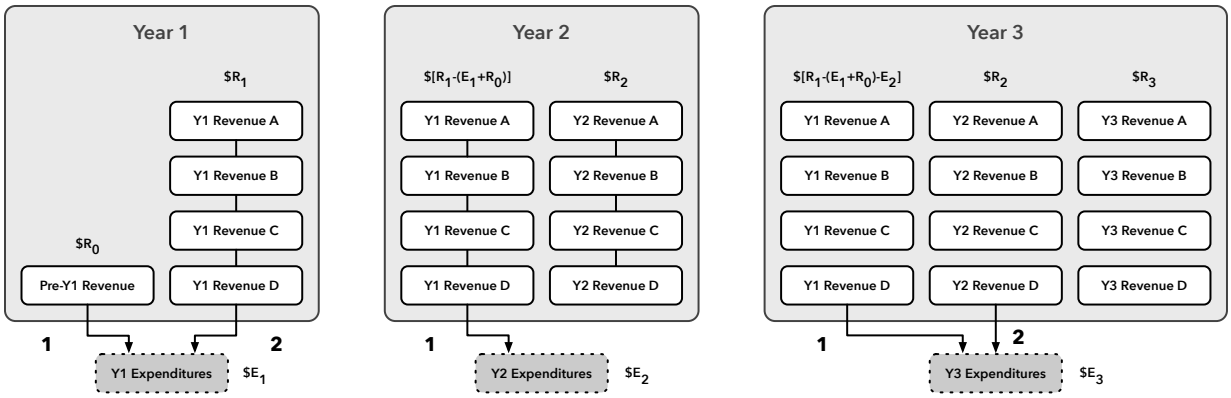

Figure A.1: First-in first-out principle for age of money analysis

This process continues in the second year, where Y1 Revenue is now the earliest, and Y2 Revenues A-D are added to the reserve. This time, expenditures in the second year (Y2 Expenditures, worth E_2) are lower than the remainder of Y1 Revenue ($E_2 < (R_1 - (E_1 + R_0))$), so the Y1 Revenues are again applied proportionally to the expenditures until the expenditures have been paid for. Revenue in the second year (Y2 Revenue) is added but none is then removed, since the Y1 Revenue was not depleted. In the third year, expenditures in the third year (Y3 Expenditures, worth E_3) are higher than the remaining Y1 Revenue, but not higher than the sum of remaining Y1 Revenue and the Y2 Revenue. As a result, the remaining Y1 Revenue is applied to Y3 Expenditures, and Y2 Revenues are applied proportionally. Revenue in the third year (Y3 Revenues) is added but none is then removed, since Y2 Revenue was not depleted. For examples of any length, this would continue until the study period is over.

A.2 Sample Results

A hypothetical example of how this analysis would work in practice is conducted with the revenue and expenditure data previously shown in Table A.1. Code used to generate implement the method and generate results is given in Appendix E. An overview of age of money results using the hypothetical data given by Figure A.2. Weighted average age of money and oldest dollar measurements were calculated for all years, presented starting from 1994 – the first year where pre-existing revenue (revenue before 1991) was not a part of the expenditures contribution. This sample shows the model is capable of reflecting negative and positive changes in the reserve balance, the age of money in the reserves, and the oldest dollars in the reserves.

More granular results can also be presented. Mixtures of revenue remaining in the balance at the end of the year are given per year, such as the 2016 sample results in Table A.2. The table shows proportionally-scaled results for the 2009 share of revenue, as it was used to pay off part of the 2016 expenditures. These individual charts can be combined to generate long-term revenue share graphs, like the one shown in Figure A.3, which depict the share of revenues coming from the years given in the legend (on the right) at the end of

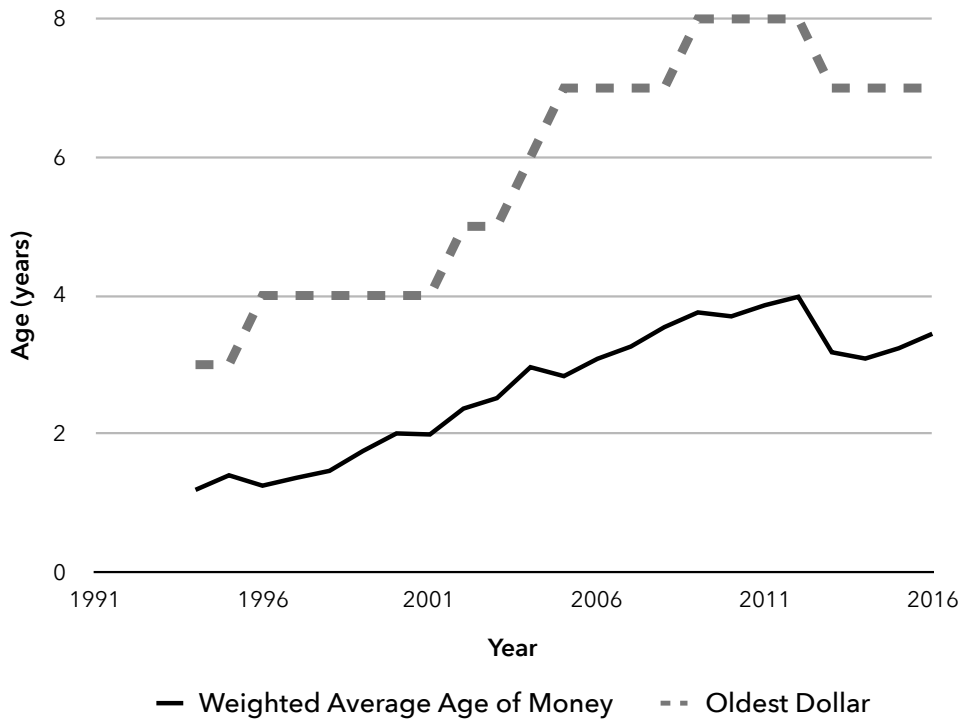

Figure A.2: Sample age of money analysis results.

any given year. In this graph, revenue sources within years are aggregated so the graph is easier to see, but a similar graph could also be created showing the share of revenues coming from specific sources like property taxes, instead of by the year they were added to the balance. These analyses could enable richer measures of sustainability and transparency, by allowing residents and governments to estimate their long-term changes in revenue.

Table A.2: Sample 2016 revenue mixture in reserve for age of money proposal.

Year	Existing Balance	Property Tax	Canada Grant	Ontario Grant	User Fees
2009	$0.00	$438,028.17	$17,521.13	$35,042.25	$131,408.45
2010	$0.00	$550,000.00	$400,000.00	$0	$135,000.00
2011	$0.00	$450,000.00	$10,000.00	$200,000.00	$160,000.00
2012	$0.00	$600,000.00	$1,000.00	$200,000.00	$150,000.00
2013	$0.00	$500,000.00	$40,000.00	$10,000.00	$140,000.00
2014	$0.00	$550,000.00	$20,000.00	$100,000.00	$145,000.00
2015	$0.00	$450,000.00	$400,000.00	$20,000.00	$160,000.00
2016	$0.00	$600,000.00	$10,000.00	$40,000.00	$155,000.00

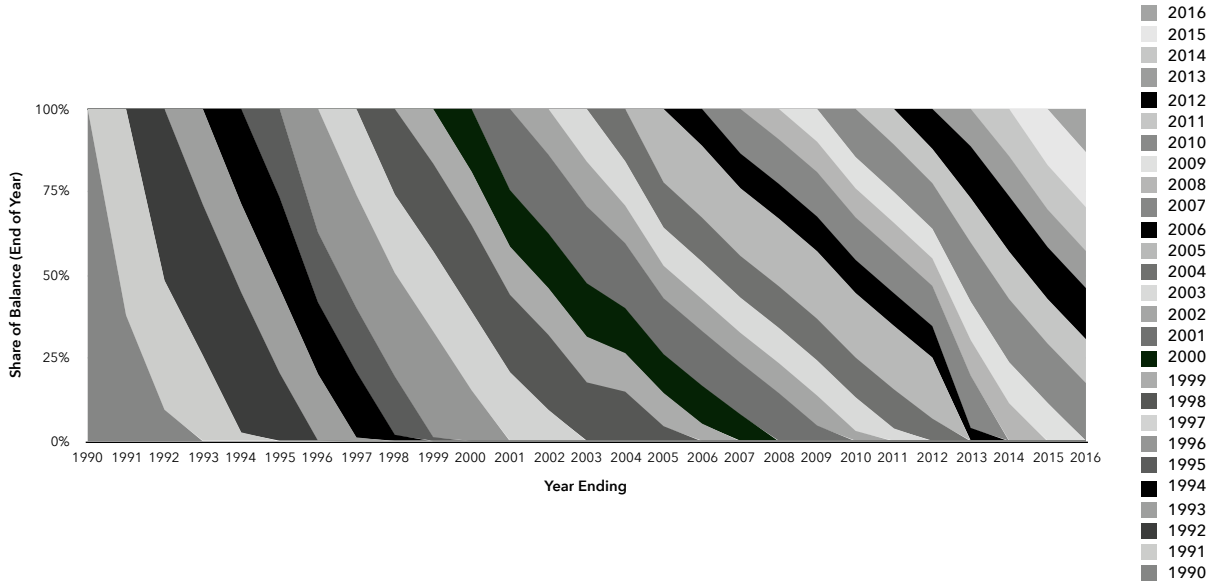

Figure A.3: Sample age of money analysis results.

Appendix B

Financial Information Return Structure

Each FIR is comprised of a series of schedules, or financial tables, which changed over time. Table B.1 forms clusters of schedule categories, which simplified the process of determining how to calculate a specific revenue. Table B.2 expands each cluster into the constituent schedules by year.

Table B.1: Clusters of schedules over time in Ontario's Financial Information Returns from 1991-2015.

Cluster	Description
A	Operating revenue, overview
B	Taxes
C	Operating revenue, non-tax sources
D	Operating expenses
E	Capital revenue and expenses, overview
F	Capital revenue and expenses
G	Debentures
H	Continuity analysis of taxes and levies
I	Reserves and reserve funds
J	Year-end balances
K	Statistics
L	Audited grant information
M	Capital loan repayments, Ontario financing
N	User fee analysis
O	Property tax reform
P	Development charges
Q	Cash flow analysis
R	Water
S	Government business enterprises
T	Other entities
U	Community improvement plans
V	Annual debt repayment limit

Table B.2: Structure of Ontario's Financial Information Returns from 1991-2015.

Cluster	Schedule	Schedule Title	Years Active
A	1	Analysis of Revenue Fund Revenues	1990-1999
A	10	Consolidated Statement of Operations: Revenue	2000-2015
B	2LT	Analysis of Taxation	1990-1999
B	2MA	Analysis of Taxation in Merged Areas	1990-1997
B	2UT	Analysis of Upper Tier Requisitions and Direct Charges	1990-1999
B	20	Taxation Information	2000-2015
B	22	Municipal and School Board Taxation	2000-2015
B	24	Payments-in-Lieu of Taxation	2000-2015
B	26	Taxation and Payments-in-Lieu Summary	2000-2015
B	28	Upper-Tier Entitlements	2000-2015
C	3	Analysis of Current Revenue for Specific Functions	1990-1999
C	12	Current Revenue for Specific Functions	2000-2008
C	12	Grants, User Fees and Service Charges	2009-2015
D	4	Analysis of Revenue Fund Expenditures	1990-1999
D	40	Consolidated Statement of Operations: Expenses	2000-2015
D	42	Additional Information	2000-2015
E	5	Analysis of Capital Operations	1990-1999
E	50	Capital Fund Operations	2000-2008
E	53	Consolidated Statement of Change in Net Debt and Tangible Capital Asset Acquisition Financing / Donations	2009-2015
F	6	Analysis of Capital Grants and Own Expenditures	1990-1999
F	52	Sources of Capital Fund Financing and Expenditures	2000-2008
F	12	Grants, User Fees and Service Charges	2009-2015
F	51	Schedule of Tangible Capital Assets	2009-2015
G	7	Analysis of Net Long Term Liabilities By Function	1990-1999
G	8	Analysis of Long Term Liabilities and Commitments	1990-1999
G	74	Long Term Liabilities and Commitments	2000-2015
H	9LT	Continuity of Upper Tier and School Board Levies	1990-1999
H	72	Continuity of Taxes Receivable	2000-2015
I	10	Continuity of Reserves and Reserve Funds	1990-1999
I	60	Continuity of Reserves and Reserve Funds	2000-2015
J	11	Analysis of Consolidated Year End Balances	1990-1999
J	70	Consolidated Statement of Financial Position	2000-2015
K	12	Statistical Data	1990-1999
K	80	Statistical Information	2000-2015
K	PM90-95	Performance Measures	2000-2013
L	13	Grant Information	1990-1994
L	14	Grant Information	1990-1994
M	15	Ontario Financing of Capital Loan Repayments	1994-1995
N	16	Analysis of User Fees	1998-1999
N	82	Municipal User Charges	2000-2004
O	17	Property Tax Reform Tools	1998-1998
P	61	Development Charges Reserve Funds	2010-2015
P	62	Development Charges Rates (Including Special Areas)	2012-2015
Q	54	Consolidated Statement of Cash Flow	2009-2015
R	75	Water and Wastewater	2009-2012
S	76	Government Business Enterprises	2009-2015
T	77	Other Entities	2009-2015
U	79	Community Improvement Plans	2009-2015
V	81	Annual Debt Repayment Limit	2009-2015

Appendix C

Detailed Revenue Methodology

C.1 Federal

Revenues listed here were gathered from the Public Accounts of Canada. Public Accounts documents cover the fiscal year (April to March), and report the fiscal year by the second calendar year it covers (e.g., 2016 Public Accounts are for the fiscal year 2015-2016). For the purposes of this study, it was assumed that most fiscal flows were in the year covering the majority of the calendar, so for simplicity in calculation, flows were assumed to happen in the year prior to that which is reported on the Public Accounts document. In other words, the 2016 Public Accounts would be used for 2015.

The reporting method also slightly changed between 2001 and 2002. "Net revenues" were used for values from 2001 and earlier. Each subsection introduces how revenues was categorized and aggregated, for later use.

C.1.1 Tax Revenue

- Corporate Income Tax
- Excise Taxes and Duties
  - Air Travellers Security Charges (2002 and later)
  - Aviation Gas and Diesel Fuel Tax
  - Customs Import Duties
  - Excise Duties
  - Miscellaneous Excise Taxes and Duties
- Gas Tax
  - Excise Tax – Gasoline
  - Petroleum and Gas Revenue Tax (1993 and earlier)

- Personal Income Tax:
  - Non-Resident Income Tax (1993 and earlier, 2008 and later)
  - Other Income Tax Revenues (from 1994 to 2007)
  - Personal Income Tax
- Sales Tax (Goods and Services Tax)
- Miscellaneous Taxes (Other Tax Revenue (1993 and earlier))

C.1.2 Non-Tax Revenue

- Crown Corporations
  - Consolidated Crown Corporations (2002 and later)
  - Enterprise Crown Corporations and Other Government Business Enterprises Share of Annual Profits (2002 and later)
  - Enterprise Crown Corporations and Other Government Business Enterprises Interest and Other Revenues (2002 and later)
- Employment Insurance Premiums
  - Employment Insurance Premiums (1996 and later)
  - Unemployment Insurance Premiums (1995 and earlier)
- Net Foreign Exchange:
  - Exchange Fund Account (2002 and later)
  - International Monetary Fund (2002 and later)
  - Other Net Foreign Exchange Revenues (2002 and later)
  - Net Gain on Exchange (from 1996 to 1999)
  - Premium and Discount on Exchange (1994 and earlier)
- Return on Investments
- User Fees
  - Sales of Goods and Services (2002 and later)
  - Rights and Privileges (from 2000 to 2001)
  - Leases and Use of Public Properties (from 2000 to 2001)
  - Services of a Regulatory Nature (from 2000 to 2001)
  - Services of a Non-Regulatory Nature (from 2000 to 2001)
  - Sales of Goods and Information Products (from 2000 to 2001)

  - Other Fees and Charges (from 2000 to 2001)
  - Privileges, Licences and Permits (1999 and earlier)
  - Services and Service Fees (1999 and earlier)
  - Proceeds from Sales (1999 and earlier)
- Miscellaneous Non-Tax
  - Miscellaneous Revenues (2002 and later)
  - Refunds of Previous Years' Expenditures (2001 and earlier)
  - Proceeds from the Disposal of Surplus Crown Assets (from 1994 to 2001)
  - Miscellaneous Non-Tax Revenues (2001 and earlier)
  - Domestic Coinage (2000 and earlier)

C.2 Provincial

Revenues listed here were gathered from the Public Accounts of Ontario. Public Accounts documents cover the fiscal year (April to March), and report the fiscal year by the second calendar year it covers (e.g., 2016 Public Accounts are for the fiscal year 2015-2016). For the purposes of this study, it was assumed that most fiscal flows were in the year covering the majority of the calendar, so for simplicity in calculation, flows were assumed to happen in the year prior to that which is reported on the Public Accounts document. In other words, the 2016 Public Accounts would be used for 2015.

The reporting method also slightly changed between 1997 and 1998, and between 2008 and 2009. Each subsection introduces categories of revenues used to aggregate funding sources. Individual funding sources are not given as the there was a large number of sources for many categories, and an exact breakdown of every change in revenue across years for all categories was not conducted for this research, since such specificity was not required for the majority of categories.

C.2.1 Tax Revenue

- Athletics Commission
- Corporate Taxes
- Education Property Tax
- Electrical Utilities Tax
- Estate Taxes
- Excise Taxes

- Gas Tax
- Health Taxes
- Land Transfer Tax
- Mining Taxes
- Miscellaneous Tax
- Northern Property Taxes
- Personal Income Tax
- Sales Tax

C.2.2 Government of Canada Transfers

- Canada – Advanced Education
- Canada – Agriculture
- Canada – Bilingualism
- Canada – Finance
- Canada – Health and Social
- Canada – Health Explicit
- Canada – Health Implicit
- Canada – Housing
- Canada – Indigenous
- Canada – Infrastructure
- Canada – Labour
- Canada – Legal
- Canada – Relief
- Canada – Safety
- Canada – Social
- Canada – Transportation
- Canada – Youth Justice
- Canada – Miscellaneous

C.2.3 Crown Corporations

- Crown Corporations – Gambling
- Crown Corporations – Liquor
- Crown Corporations – Utilities
- Crown Corporations – Miscellaneous

C.2.4 Other Non-Tax Revenue

- Electricity Non-Tax Revenue
- Recovery of Prior Years' Expenditures
- Reimbursement of Expenditures
- Royalties – Resources
- Royalties – Services
- Royalties – Miscellaneous
- User Fees – Business
- User Fees – Environment
- User Fees – Finance
- User Fees – Gambling
- User Fees – Legal
- User Fees – Liquor
- User Fees – Property
- User Fees – Transportation
- User Fees – Miscellaneous

C.3 Regional and Local

Regional and local revenues were grouped differently depending on the source from which they were aggregated and for each study. Chapter 4 used the following section's methodology to gather revenues.

C.4 Disaggregating Government Flows

This section outlines the methodology used for Chapter 4's funding overviews, related to revenues. In all cases, a maximum of six categories were chosen to ensure each category is visually identifiable.

Federal revenues were separated first on a tax revenue and non-tax revenue basis, following the groupings in Section B.1. The 2016 Public Accounts of Canada were used to find the highest tax or non-tax revenue sources, to isolate them from the others. The source of authority for revenue was Volume 2, Table 1, which summarizes the consolidated revenues and expenses for the government. Crown corporations were isolated from non-tax revenue since they operate with some level of independence. The highest sources were found to be personal income tax, corporate income tax, and sales tax. Remaining revenues were placed in the other taxes and other non-tax revenue categories.

Provincial revenues were separated first on a tax revenue and non-tax revenue basis, following the groupings in Section B.2. The 2016 Public Accounts of Ontario were used to find the highest tax or non-tax revenue sources, to isolate them from the others. The source of authority for revenue was Volume 1, Section 1, which details the main revenues and expenses for the government, and separates the four revenue categories into tax revenue, transfers from Canada, enterprises and other non-tax revenues. Transfers and enterprises were removed from the non-tax revenue to align with the Public Accounts documents. These highest sources were found to be personal income tax and sales tax. Remaining revenues were placed in the other taxes and other non-tax revenue categories.

Regional revenues were gathered from annual financial reports. The source of authority was the Consolidated Statement of Operations and Accumulated Surplus, listed near the beginning of each report. All revenue comes from this table, and are categorized into property taxes, user fees, intergovernmental transfers, development charges, and other, for consistency with municipal literature and the rest of the thesis.

Local revenues were gathered from annual financial reports. For Waterloo, the source of authority was the Consolidated Statement of Operations listed near the beginning of the city's annual financial reports. All revenue was categorized similarly to the Region of Waterloo. For Toronto, the source of authority was the Consolidated Statement of Operations and Accumulated Surplus, near the beginning of the financial statements section of the annual reports. Revenue was again similarly categorized to the Region of Waterloo, with the extra category of land transfer taxes, to identify a key difference in Toronto's funding mix.

Appendix D

Detailed Expenditure Methodology

D.1 Federal

Expenditures were gathered from the Public Accounts of Canada. Public Accounts documents cover the fiscal year (April to March), and report the fiscal year by the second calendar year it covers (e.g., 2016 Public Accounts are for the fiscal year 2015-2016). For the purposes of this study, it was assumed that most fiscal flows were in the year covering the majority of the calendar, so for simplicity in calculation, flows were assumed to happen in the year prior to that which is reported on the Public Accounts document. In other words, the 2016 Public Accounts would be used for 2015.

The reporting method also slightly changed between 2001 and 2002. "Net expenditures" were used for values from 2001 and earlier. Most values were collected as is from Volume 2, Table 1. The exception to this rule is the Federal Gas Tax Fund, which was found from the Transport Canada or Office of Infrastructure sections of Volume 2, under 'Transfer Payments'.

D.2 Provincial

Expenditures were gathered from the Public Accounts of Ontario. Public Accounts documents cover the fiscal year (April to March), and report the fiscal year by the second calendar year it covers (e.g., 2016 Public Accounts are for the fiscal year 2015-2016). For the purposes of this study, it was assumed that most fiscal flows were in the year covering the majority of the calendar, so for simplicity in calculation, flows were assumed to happen in the year prior to that which is reported on the Public Accounts document. In other words, the 2016 Public Accounts would be used for 2015.

D.3 Regional and Local

Regional and local expenditures were grouped differently depending on the source from which they were aggregated and for each study. Chapter 4 used the following section's methodology to gather expenditures.

D.4 Disaggregating Government Flows

This section outlines the methodology used for Chapter 4's funding overviews, related to expenditures. In all cases, a maximum of six categories were chosen to ensure each category is visually identifiable.

Federal expenditures were gathered from the Public Accounts of Canada. The source of authority for expenditures was Volume 2, Table 1, which summarizes the consolidated revenues and expenditures for the government. The 2016 edition was used to identify the largest expenditures in each year, to isolate them from the others. Provincial transfers were grouped together, as were departments, crown corporations, and debt payments. Old Age Security was then isolated, since it was the single largest expenditure. Departments were then further separated to provide insight into the biggest responsibilities of the federal government outside of transfers. The largest departments were again chosen using the 2016 edition, and the others were grouped together.

Provincial expenditures were gathered from the Public Accounts of Ontario. The source of authority for expenditures was the Summary of Expenses by Standard Accounts Classification and Ministry. Debt payments were isolated from the Details of Expenses and Assets by Items and Accounts Classification for the Treasury Program in the Ministry of Finance, and subtracted from the final value for Finance. The three largest ministries by expenditure were isolated using the 2016 edition, along with the transportation department for the sake of comparison. Other revenues were aggregated and reported in a single value.

Regional expenditures were gathered from the FIR. The source of authority was Cluster D (Schedule 40). Expenditures were chosen by taking the largest categories from the 2015 return. Individual expenditures were grouped together based on which items were able to be isolated without sounding too similar to another category. For example, paved roads and traffic signalling would logically be placed together under a road network. The total value was taken from the annual financial report for accuracy.

Local expenditures were also gathered from FIRs. For both Waterloo and Toronto, the source of authority was Cluster D (Schedule 40). The procedure followed the same process used for regional expenditures.

Appendix E

Python Scripts

Code listed here was used for the proposed age of money analysis at the end of Chapter 6.

```
#!usr/bin/python

# To execute, open Terminal (macOS) and enter "python <filepath>"
# DESCRIPTION: This script receives reserve line items and
# calculates age of money

import os
import csv
from datetime import datetime
from decimal import *
from copy import deepcopy

## DEFINITIONS
TWOPLACES = Decimal(10) ** -2
# Decimal multiplier for only two decimal places
def mul(x, y, fp=TWOPLACES):
    return (x * y).quantize(fp)

## VARIABLES
revenue = {}                # Stores revenue of each year
years = []                  # Ordered list of years
revenue_sources = []        # Revenue sources to get from first set of entries
expenses = {}               # Stores expenses of each year
revenue_totals = {}         # Stores revenue totals for each row, year as key
revenue_shares = {}         # Stores percentage shares of each revenue
balances = {}               # Stores balance of each year
active_years = {}           # Stores which years need to be checked each year
ages_of_money = []          # Stores the age of money CSV values
```

```
total_str = 'Remaining Year 1 Total'
# Must match CSV file's definition of year
year_str = 'Year'
# Must match CSV file's definition of expenses
expenses_str = 'Expenses'
avg_age_of_money_str = 'Weighted Average Age of Money'
old_age_of_money_str = 'Oldest Dollar'

csv_revenue = 'revenue.csv'
csv_expenses = 'expenses.csv'
csv_age_of_money = 'age_of_money.csv'
separator = '/'                 # Need to change this if you use Windows

## REVENUE IMPORT: Input revenue file, must be a CSV file
current_directory = os.getcwd()
revenue_file = open(current_directory + separator + csv_revenue)
with revenue_file:
    print('Importing revenue file.')
    # First row of revenue file has the keys,
    # values are in each row following
    revenue_reader = csv.DictReader(revenue_file)
    rows = list(revenue_reader)
    # Reduce total years by 1, to account for the pre-analysis period
    # existing balance
    total_years_rev = len(rows) - 1
    for i, row in enumerate(rows):
        year = int(row[year_str])
        years.append(year)
        sources = deepcopy(row)
        del sources[year_str]
        if i == 0:
            # Gather revenue sources from the first set of entries
            revenue_sources = list(sources.keys())
        revenue_this_year = {}
        for source, value in sources.items():
            revenue_this_year[source] = Decimal(value)
        revenue[year] = revenue_this_year

## EXPENSES IMPORT: Import expenses file, must be a CSV file
expense_file = open(current_directory + separator + csv_expenses)
with expense_file as sample_expenses:
    print('Importing expense file.')
    # First row of expense file has the keys,
    # values are in each row following
    expense_reader = csv.DictReader(sample_expenses)
```

```
    rows = list(expense_reader)
    for i, row in enumerate(rows):
        year = int(row[year_str])
        expense = Decimal(row[expenses_str])
        expenses[year] = expense

## BALANCES: Calculate balances each year
for i, year in enumerate(years):
    print('Calculating balances for ' + str(year) + '.')
    last_year = year - 1
    sources = deepcopy(revenue[year])
    # Calculate total spent each year
    totals = Decimal(0.00)
    totals += sum(sources.values())
    revenue_totals[year] = totals
    # Calculate revenue shares each year
    share_dictionary = {}
    share_check = Decimal(0.00)
    for source, value in sources.items():
        share = value / totals
        share_dictionary[source] = share
    revenue_shares[year] = share_dictionary
    if i == 0:
        init_balance = deepcopy(sources)
        balances[year] = {year: init_balance, total_str: totals}
        active_years[year] = [year]
    else:
        new_balance = deepcopy(balances[last_year])
        # Grab last year's balance
        new_active_years = deepcopy(active_years[last_year])
        # Grab last year's active years
        early_active_year = new_active_years[0]
        # Return the earliest active year
        early_total = new_balance[total_str]    # Find earliest total
        remaining_expenses = expenses[year]    # Grab current expenses
        # Check how much of the existing balances will be used,
        # and in which years
        while True:
            if (early_total < remaining_expenses):
                # Remove the data for early active year from current data
                new_balance.pop(early_active_year)
                new_active_years.remove(early_active_year)
                early_active_year = new_active_years[0]
                # Increase early active year
                # Remove the values from the old early active year
```

```
            # from remaining expenses
            remaining_expenses = remaining_expenses - early_total
            early_total = Decimal(0.00)
            early_sources = new_balance[early_active_year]
            for value in early_sources.values():
                early_total += value
            new_balance[total_str] = early_total
        else:
            break
    # Now, only one calculation needs to be done
    # to remove exp. from EA year
    test_value = Decimal(0.00)
    subtract_value = Decimal(0.00)
    for source in revenue_sources:
        new_balance[early_active_year][source] =
         new_balance[early_active_year][source] -
         mul(remaining_expenses,revenue_shares[early_active_year][source])
        test_value += new_balance[early_active_year][source]
        subtract_value +=
         mul(remaining_expenses,revenue_shares[early_active_year][source])
    new_balance[year] = deepcopy(sources)
    early_total = early_total - remaining_expenses
    # Find new remaining balance
    new_balance[total_str] = early_total
    balances[year] = new_balance
    # Check for failure in calculations
    if (abs(early_total - test_value) > Decimal(0.05)):
        print('Difference in estimated value and real
         value more than $0.05! Calculation ended.')
        break
    # Wrap up year and move to the next one
    new_active_years.append(year)
    active_years[year] = new_active_years
    # Find ages of money at the end of the year
    temp_avg_age_of_money = Decimal(0.00)
    denominator = Decimal(0.00)
    temp_old_age_of_money = Decimal(0.00)
    for i, active_year in enumerate(active_years[year]):
        difference = year - active_year
        if i == 0:
            temp_avg_age_of_money += early_total * difference
            denominator += early_total
            temp_old_age_of_money = difference
        else:
            temp_avg_age_of_money += revenue_totals[active_year] * difference
```

```
                denominator += revenue_totals[active_year]
        temp_avg_age_of_money = temp_avg_age_of_money / denominator
        ages_of_money.append({
            year_str: year,
            avg_age_of_money_str: temp_avg_age_of_money,
            old_age_of_money_str: temp_old_age_of_money,
        })

## SAVE: Send balances into CSV files
# Just in case the directory has changed
current_directory = os.getcwd()
directory_extension = ''
save_directory = current_directory
while True:
    directory_extension = str(datetime.now())
    if os.path.exists(current_directory + separator + directory_extension):
        print('Trying new directory.')
    else:
        save_directory = current_directory + separator + directory_extension
        print('Created new directory at ' + save_directory + '.')
        break
os.mkdir(save_directory)
# Write each year's CSV file
fieldnames = deepcopy(revenue_sources)
fieldnames.insert(0, year_str)
for i, year in enumerate(years):
    year_file = open(save_directory + separator + str(year) + '.csv', 'w')
    print('Prepare file for ' + str(year) + '.')
    with year_file as year_output:
        year_writer = csv.DictWriter(year_output, fieldnames=fieldnames)
        year_sets = deepcopy(balances[year])
        year_sets.pop(total_str)
        year_writer.writeheader()
        for active_year in active_years[year]:
            year_row = year_sets[active_year]
            year_row[year_str] = active_year
            year_writer.writerow(year_row)
# Write age of money CSV file
fieldnames = [year_str, avg_age_of_money_str, old_age_of_money_str]
age_file = open(save_directory + separator + csv_age_of_money, 'w')
print('Prepare age of money file.')
with age_file as age_output:
    age_writer = csv.DictWriter(age_output, fieldnames=fieldnames)
    age_writer.writeheader()
    age_writer.writerows(ages_of_money)
```

Appendix F

Data Charts

This appendix contains raw data tables used in Chapter 3.

Table F.1: Road supply values in lane kilometres from 2000-2015.

Year	Toronto	Waterloo	Region of Waterloo
2000	−−	710	1643
2001	−−	728	1646
2002	−−	742	1646
2003	−−	755	1641
2004	−−	762	1661
2005	14,767	779	1673
2006	14,767	781	1684
2007	14,786	785	1679
2008	14,808	788	1680
2009	14,808	792	1685
2010	14,808	792	1696
2011	14,801	813	1697
2012	14,787	813	1709
2013	14,712	811	1709
2014	14,788	809	1725
2015	14,957	824	1725

Table F.2: Transit supply values in revenue vehicle kilometres from 1991-2015.

Year	Toronto Transit Commission	Kitchener Transit	Grand River Transit
1991	187,971,000	5,772,926	−−
1992	183,465,000	5,799,505	−−
1993	178,500,000	5,737,802	−−
1994	179,100,000	5,758,784	−−
1995	178,500,000	5,854,180	−−
1996	172,100,000	5,791,907	−−
1997	173,500,000	5,635,217	−−
1998	178,300,000	5,673,507	−−
1999	177,100,000	5,673,216	−−
2000	184,900,000	−−	7,116,922
2001	189,300,000	−−	7,408,480
2002	192,200,000	−−	7,680,148
2003	193,200,000	−−	8,120,371
2004	195,700,000	−−	8,778,075
2005	196,600,000	−−	9,434,936
2006	199,300,000	−−	9,931,626
2007	197,600,000	−−	10,193,784
2008	204,500,000	−−	10,885,687
2009	214,800,000	−−	11,271,570
2010	215,700,000	−−	11,332,020
2011	216,100,000	−−	11,933,119
2012	219,300,000	−−	12,931,434
2013	224,900,000	−−	13,349,614
2014	228,400,000	−−	14,006,366
2015	231,100,000	−−	14,351,749

Table F.3: Population for selected study areas from 1991-2015.

Year	Toronto	Waterloo	Kitchener	Region of Waterloo	Ontario	Canada
1991	2,275,771	82,750	168,282	399,400	10,431,316	28,037,420
1992	2,297,701	84,910	170,638	406,600	10,572,205	28,371,264
1993	2,319,631	86,210	173,700	411,900	10,690,038	28,684,764
1994	2,341,561	87,910	174,756	418,000	10,819,146	29,000,663
1995	2,363,491	88,900	175,911	421,100	10,950,119	29,302,311
1996	2,385,421	89,710	178,420	424,000	11,082,903	29,610,218
1997	2,404,636	91,560	181,703	430,200	11,227,651	29,905,948
1998	2,423,850	93,370	184,100	437,600	11,365,901	30,155,173
1999	2,443,065	95,770	188,300	446,200	11,504,759	30,401,286
2000	2,462,279	99,060	190,100	454,800	11,683,290	30,685,730
2001	2,481,494	104,630	193,880	465,100	11,897,370	31,020,596
2002	2,485,851	108,150	197,660	474,500	12,093,299	31,358,418
2003	2,490,209	112,520	201,440	485,200	12,243,758	31,641,630
2004	2,494,566	116,610	205,220	497,600	12,390,068	31,938,004
2005	2,498,924	119,210	209,000	507,900	12,527,990	32,242,364
2006	2,503,281	121,140	210,900	517,400	12,661,566	32,570,505
2007	2,525,637	121,540	213,900	523,200	12,764,195	32,887,928
2008	2,547,993	122,380	220,600	532,100	12,882,625	33,245,773
2009	2,570,348	124,270	224,120	535,300	12,997,687	33,628,571
2010	2,592,704	125,340	229,400	544,000	13,135,063	34,005,274
2011	2,615,060	126,150	234,300	551,500	13,263,544	34,342,780
2012	2,638,362	127,700	234,100	556,200	13,413,702	34,750,545
2013	2,661,664	130,210	234,000	561,800	13,556,229	35,155,451
2014	2,684,967	131,760	236,500	567,900	13,685,171	35,544,564
2015	2,708,269	133,660	239,900	575,000	13,797,038	35,848,610

Table F.4: Generic CPI for Canada from 1991-2015 (2002=100).

Year	CPI
1991	82.8
1992	84
1993	85.6
1994	85.7
1995	87.6
1996	88.9
1997	90.4
1998	91.3
1999	92.9
2000	95.4
2001	97.8
2002	100
2003	102.8
2004	104.7
2005	107
2006	109.1
2007	111.5
2008	114.1
2009	114.4
2010	116.5
2011	119.9
2012	121.7
2013	122.8
2014	125.2
2015	126.6
2016	128.4

Glossary

annual financial report audited report generated by municipalities that provides high accuracy financial data with low levels of detail.

Financial Information Return a financial reporting form submitted to the Ontario Ministry of Municipal Affairs annually by municipalities.

intergovernmental transfer an intermediary revenue source for municipalities that consists of revenue from higher tiers of government.

lower-tier municipality a municipality which forms part of a larger municipality.

single-tier municipality a municipality not consisting of or forming part of another municipality.

two-tier municipal structure a structure of government with an upper-tier municipality consisting of multiple lower-tier municipalities.

upper-tier municipality a municipality which consists of two or more lower-tier municipalities.