Economic Sustainability in Transit

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Executive summary

This paper aims to provide an overview of the concept of economic sustainability and address how economic sustainability goals may be pursued within Edmonton's public transit system. Following a discussion of economic sustainability and what it can mean for the public transit system, we discuss some of the major economic factors through which public transit can contribute to economic sustainability in Edmonton.

First, we find strong support for the impact of public transit investment and expenditures on economic development within cities. This information provides a basis for a strong case to pursue economic sustainability goals through public transit planning. Subsequently, we study several economic factors, including economic competitiveness, business agglomeration patterns, employment including the role of industry types and urban form, property values, land-use planning, affordability, and transit ridership that can be considered to better align public transit planning with economic sustainability goals. In brief, the primary findings can be summarized as the following 5 items:

- Public transit availability and public transit investments are positively associated with economic competitiveness of regions. An underdeveloped transportation system can act as a bottleneck and hinder a city's competitiveness when other contributing factors to competitiveness are present.
- Property values are affected by sizeable transit investments and capturing these added values can improve cost recovery for transit investments.
- Understanding business agglomeration patterns is an important step in improving the efficiency and effectiveness of transit service delivery, as transit planning affects agglomeration patterns and is also affected by them.
- Public transit may have a positive impact on employment levels, especially for segments of the population with lower incomes.
- Public transit planning affects land use and is also affected by it. This strategic relationship creates an important area where economic sustainability goals can be

pursued in transit. Particularly, adoption of transit oriented development policies can lead to increased land use density that has a positive impact on the economic sustainability of transit by promoting transit ridership.

Moreover, we address how sustainability goals can be pursued in the economic assessment of transit investments by converting future costs and benefits into present day values. This is done in a way that is supportive of transit projects with longer-term impact, while also paying particular attention to negative externalities that may threaten the economic sustainability of transit projects over time. In our conclusion, a number of action alternatives derived from the report are proposed for consideration in transit planning.

Introduction

In this paper, we first discuss the concept of economic sustainability and its relationship with sustainable development. We then move on to defining economic sustainability for a transit system and discuss some indicators that can be used to assess economic sustainability in this context.

In subsequent sections, we focus on the role that public transit plays in economic sustainability of the community. Public transit has two direct pathways of influence on economic sustainability, 1) through transit investments and expenditures, and 2) through its impact on creating a better living and business environment. To study these pathways, we start with a discussion of the role of transit investments on economic growth and provide examples and benchmarks of the impact of transit on national and local economies. We then delve deeper into the relationship between public transit and a number of important economic factors including those that are conducive to the creation of a better living and business environment. These factors include competitiveness, business agglomeration patterns, employment, property values, land-use, affordability, and transit ridership. Discussion of these

factors suggests a number of ways that transit can contribute to economic sustainability and identify action opportunities that can enhance these contributions.

We then summarize economic and public-finance issues that are typically also considered when assessing large public projects and investments in infrastructure. Such considerations are relevant to further transit development in Edmonton.

We conclude with a list of possible action alternatives that could enhance the positive impact of public transit on economic sustainability. These alternatives build on the considerations from the earlier topics. We will now start this report with an overview of sustainability and particularly economic sustainability.

Background on sustainability

Economic sustainability, social sustainability, and environmental sustainability comprise the so-called triple bottom line and are considered to be the three pillars of sustainable development as depicted in Figure 1. The success of sustainable development relies on the success of sustainability in each of these three dimensions.

Figure 1. The three pillars of sustainability

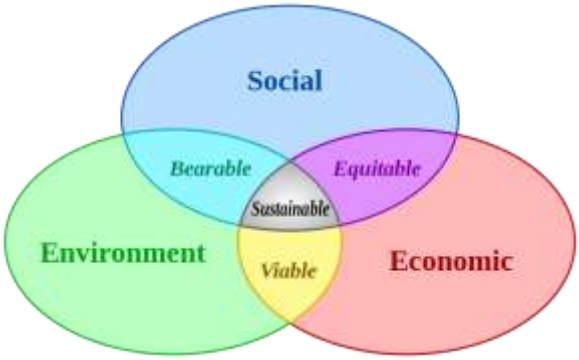


Image Source: Wikimedia Commons

The idea of sustainability dates back to a few decades ago starting from sustainability in forestry. In 1987, the Brundtland Commission report by the United Nation's World Commission on Environment and Development reframed the issue of sustainability as 'sustainable

development', and defined sustainable development as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (Rogers et al. 2012). The reframing of the sustainability issue to sustainable development and the vagueness of this definition have been criticized (Daly 1996) and described (Strong 2010) as a tactic to allow for a broad consensus among nations. However, this reframing also makes the element of economic activity a more explicit part of the sustainability equation (Portney 2003).

In 1992, the UN's Conference on Environment and Development in Rio de Janeiro, known as the 'Earth Summit' framed sustainable development as the overarching policy of the 21st century through five pacts that were signed by representatives from over 120 nations, in what was the largest gathering of world leaders in human history. A common theme in several of the 27 principles of the Rio Declaration is the integration of economic growth with environmental protection, and the Agenda 21 declaration lays out "a blueprint on how to make development socially, economically, and environmentally sustainable" (Basiago 1999).

The three areas of sustainability that form the pillars of sustainable development are interdependent; social and economic sustainability depend on one another and both of them depend on environmental sustainability. This dependence structure is partly depicted in the so-called "egg of sustainability" where economy is shown to lie within society, and society lies within environment in a nested hierarchy, which implies the reliance of economic and social sustainability on the sustainability of the environment. Despite the higher priority of environment in this hierarchy, sustainability is mainly seen as a peaceful coexistence of economic development and the environment in a way that economic growth is promoted, but not at the expense of the environment and without undermining future generations (Portney 2003).

Economic sustainability

The overarching purpose of sustainable development is to guide economic activities in a direction that ensures sustainability of resources for existing and future generations. In general

terms, economics deals with the production, distribution and consumption of goods, services, and wealth through the allocation and use of scarce resources. Economics revolves around the three primary factors of production that are used to produce economic output: capital, labor, and land (or more generally ecosystem).

According to Basiago (1999), economic sustainability implies a system of production that addresses current consumption levels without compromising the needs of the future, and the term sustainability in 'economic sustainability' in a way refers to the sustainability of the economic system itself. A sustainable economic system by definition restrains the use of resources to ensure the sustainability of natural resources for future generations (Basiago 1999). According to Portney (2015), the focus in sustainability is the use of natural resources in order to maintain a steady state in which the earth can support both human population and economic growth. The pursuit of economic sustainability in transit requires the development of transit policies, programs, and practices that are in line with the above goals.

According to the economic component of a widely accepted definition, a sustainable transportation system is "affordable, operates efficiently, offers choice of transport mode, and supports a competitive economy" (AASHTO 2009). Different measures and indicators have been suggested for assessing economic sustainability in transit that address the components enumerated in this definition. For example, a set of measures has been proposed by the Canadian Urban Transit Association (CUTA/ACTU) that corresponds closely with the above definition and classifies indicators into four categories, namely economic vitality, affordability, sustainable procurement, and funding that influences travel choices (CUTA/ACTU 2013). Economic vitality includes measures such as employee numbers, skill levels, employment status, capturing property value to generate transit funds, transit planning to support neighborhood regeneration, proportion of local suppliers, and proportion of spending on local suppliers. Affordability measures include affordable transit fares for lower income groups such as the elderly, youth, and students, and discounted transit passes for those in need. Sustainable procurement measures include staff training, purchasing preference for environmentally

certified, recyclable, recycled, or renewable content products, and use of life-cycle costing in purchase decisions. Measures for funding that influence travel choices include working with government to achieve funding security, and advocacy for municipal powers to generate transit funds through road user tolls and parking taxes. The only indicator for this last set of measures is the proportion of transit operating funding from sources other than fares and property taxes.

Litman and Burwell (2006) also provide a list of measures and indicators for assessing sustainability in transit systems. Their measures for economic sustainability include accessibility (indicators: average commute travel time, number of job opportunities and commercial services within 30-minute travel distance of residents, implementation of policy and planning practices that lead to more accessible, clustered, mixed, multi-modal development), transport diversity (indicator: mode split or portion of travel made by walking, cycling, rideshare, public transit and telework), affordability (indicator: portion of household expenditures devoted to transport by 20% lowest income households) , facility costs (indicator: per capita expenditures on roads, traffic services and parking facilities, freight efficiency (indicator: speed and affordability of freight and commercial transport), and planning (indicator: degree to which transport institutions reflect least-cost planning and investment practices). The choice of indicators requires a balance between convenience and comprehensiveness that keeps data collection costs down while avoiding the oversight of important impacts.

Transit policy and economic development

There is a two-way relationship between economic growth and public transit. Economic growth can increase demand for transportation of goods and people, while improvements in transportation systems (including transit) can make businesses more competitive by reducing their costs, and hence play a positive role in economic growth. Transportation is generally viewed as a necessary condition for economic development, as the absence of effective transportation system can act as a constraining factor on development (Hickman & Banister

2003). Public transit systems are an integral part of a city's transportation system that attract substantial investments and influence the economic activities of businesses and travel patterns. Public transit can contribute to economic development through several mechanisms:

- *Generating jobs and wealth*: According to a 2012 US estimate, investing in infrastructure creates immediate jobs in construction (68%), professional and business services (6%), manufacturing equipment (10%), retail trade (6%), operations, maintenance, and other jobs (10%) (NEC 2014). Rise of demand for goods and services as a result of investments in infrastructure is the main reason for the creation of these new jobs. Information on the percentage of net added jobs to the economy after the flow of investment ends is scarce.
- *Increasing the productivity and economic efficiencies of cities:* This is achieved by enhancing labor mobility and improving the matching of jobs with skilled workers. A more efficient transit system is also better at operating cost recovery in addition to its economic benefits for businesses and citizens.
- *Reducing the negative economic impact of congestion, pollution (e.g. through reduction in health care costs), and car collisions:* Currently, traffic gridlock is costing the Toronto Region $6 billion in lost productivity each year which will rise to an estimated $15 billion by 2031 if not solved (TRBT 2013). Higher rates of collisions and health risks resulting from congestion produce economic inefficiencies that can be reduced with a strong public transit system.
- *Reducing personal and commercial transportation monetary costs:* e.g. commuting on public transit is one-third to one-half as expensive as commuting by car (CUTA/ACTU 2010a), and the resulting economic efficiencies can reduce commercial transportation costs. As a result, more disposable income will be available to citizens; that is, both public transit users and people who use private vehicles benefit from cost savings that result from a more efficient transportation and transit system , lower congestion levels, fewer collisions, and lower pollution and health costs (BTMM 2004).

- *Re-injecting expenditures into local economies:* According to one study conducted for Montreal, public transit generated twice the economic benefits of transport by car. Also, in terms of money that "leaves" Quebec, the leakage rate for public transit expenditures is approximately 10% in comparison with a value of 50% for private transport by car. This difference in impact is due to the sourcing of labour, equipment, and supplies that tends to be more local for public transit. Hence, increasing public transit's share of trips will increase the resources that are re-injected through transit expenditures into local economies. A 10% increase in public transit trips in Montreal is estimated to translate into 19 million fewer trips by car in the Montreal region and a total economic impact of $156.1 million in cost savings which re-invigorates the local economy (BTMM 2004). Toronto Transit Commission (TTC) has developed a Green Procurement Policy that supports the purchase of environmentally preferred products (CUTA/ACTU 2011). A comprehensive procurement policy should not only entail green procurement, but also encourage local procurement to the extent allowed by regional agreements that might hinder local procurement.
- *Guiding improvements in land use:* by encouraging transit-oriented development that has economic, social, and environmental benefits. Public transit can influence land use density and composition of businesses to create walkable, dynamic urban environments.

The overall impact of public transit on economic development has been classified in three categories, 1) generative, 2) redistributive, and 3) financial transfer impacts. Generative impacts increase net economic growth by utilizing underused resources or using existing resources more efficiently. Examples of generative impacts include travel time savings, user safety benefits, creation of new jobs, and easier access to employment. Redistributive impacts shift economic activities within a region. Examples of redistributive impacts include changes in land development such as the clustering of development around transit stations and the shift of existing economic activities to areas within the transit corridor. Financial transfer impacts refer

to the transfer of monies between entities, that is, from one accounting ledger to another. Examples of these impacts include property tax payments and joint development income such as income from air-rights developments that may involve financial transfers from land developers to transit agencies (TRB-NRC 1998). Although the redistributive and financial transfer impacts do not directly increase economic growth, their resulting economic and monetary shifts may indirectly spur growth by creating strategic advantages for some industries. The combined effect of these three impacts may be realized in the form of increased business efficiency, investment and innovation, agglomeration economies, higher efficiency of labor markets, competitiveness, and trade (See Eddington (2006) for a more detailed discussion of these effects). Despite these potential outcomes, empirical evidence is scarce about what percentage of impacts of public transit on economic development may be generative, redistribute or in the form of financial transfer. (It is noteworthy that another paper in this series titled 'Exploring the relationship between transit and land use' also addresses some aspects of generative vs. redistributive growth impacts and views financial transfer impacts as redistributive, which is not uncommon).

For practical purposes related to economic impact analysis, economic impacts resulting from operations and capital spending can also be categorized into direct, indirect, and induced effects. Direct effects are the impact of such spending on workers and businesses involved in the manufacturing of vehicles/equipment, construction, and operation jobs. Indirect effects influence supporting industries that supply goods and services that enable the direct effects and induced effects come from the re-spending of worker income on consumer goods and services.

It is noteworthy that a given transit project may not necessarily produce all types of intended economic benefits. If achievement of specific economic benefits is being pursued for a given project, planners need to make sure that those benefits are achievable within the context of that project. For example, in the case of Atlanta's MARTA rail transit system, researchers were not able to find a discernible effect of the new rail transit on overall population or employment

levels despite finding changes in the composition of jobs that favored the public sector in affected areas (Bollinger and Ihlanfeldt 1997). However, a study of Washington DC's rapid transit system (METRO) shows that zones with stations contained 2.5 times more jobs than zones without stations (Green and James 1993). The economic return on transit investments may need to be carefully modelled and analyzed to ensure that desired economic return or at least the main intended economic outcomes are achievable given the context of an investment.

Economic impact of transit investments and expenditures

In general, infrastructure investments affect a city's economic sustainability by helping to maintain or improve its long-term competitiveness, productivity, innovation, lower prices, and higher incomes (NEC 2014). Public transit infrastructure receives a substantial portion of such investments. Overall assessments of public transit investments in the US provide estimates for both their short-term and potential long-term economic impacts. A report by the American Public Transportation Association (APTA) estimates a potential long-term added value of $3.5 billion to GDP per $1 billion dollar of continuous annual investment in public transit. This figure represents the annual effect on the 20th year of which $1.8 billion comes from public transportation spending and $1.7 billion comes from net annual additional GDP due to cost savings. It is to be noted that these figures do not take into account the potential social and environmental impacts such as personal time savings and emissions impacts. The authors also estimate the following annual economic impacts for each billion dollars of investment in public transit (APTA 2009).

Table 1: The Annual Economic Impact per Billion Dollars of National Investment in Public Transportation

(Includes indirect and induced effects)

Economic Impact	Per $1 billion of Capital Spending	Per $1 billion of Operations Spending	Per $1 billion of Average Spending*
Jobs	23,790	41,140	36,110
Labor Income ($ billions)	$ 1.1	$ 1.8	$ 1.6
Output (Business Sales, $ billions)	$ 3.0	$ 3.8	$ 3.6
GDP (Value Added, $ billions)	$ 1.5	$ 2.0	$ 1.8
Tax Revenue ($ millions, rounded)	$ 350	$ 530	$ 490

** The US average impact reflects a mix of 29% capital and 71% operations spending.*

Source: APTA report 2009, titled "Economic Impact of Public Transportation Investment".

According to the above estimates, per each billion of average capital spending, operations spending, and average spending, respectively, about 24,000, 41,000, and 36,000 jobs are supported for a year (The rest of the figures in the table reflect the economic impact of these jobs and should not be added or combined with one another). These 36,000 jobs created from a billion dollar average spending earn $1.6 billion in salaries, and create $3.6 billion of added business revenue, which contributes $1.8 billion to the GDP, and creates $490 million dollar in tax revenues. From the 23,790 jobs created from $1 billion in capital spending, 31% were in construction, 13% in manufacturing, 8% in professional services, 7% in retail trade, 6% in administrative services, 5% in health and social services, 5% for hotels and restaurants, and 25% in other categories.

The economic impact of public transit in Canada has also received some attention. A study by CUTA finds that in 2007, a $2 billion investment in transit projects in Canada, produced a $3.7 billion increase in Canada's GDP, $160 million in taxes, and 22,570 full-time equivalent jobs as direct economic benefits. For comparison, of the 23,790 jobs created from capital spending in the US in 2009 (as shown in Table 1), direct economic effects, i.e. disregarding indirect and induced effects, account for only 8,200 of the total 23,790 jobs. This study found that in Canada, 11,285 direct jobs (3,085 more than in the US) were created per billion dollar of

investment in transit projects.[1] (For a more detailed review of the overall economic impact of transit investment in Canada, See the CUTA 2010 report titled "The economic impact of transit investment: A national survey.") Based on both U.S. and Canadian figures, roughly speaking, on average close to 10,000 direct jobs may be created for each $1 billion of capital investment in public transit.

In 2003, public transit in Montreal was assessed to generate an annual $937 million in economic benefits for transit authorities, $570 million in savings for Montreal households, $159 million in benefits from the reduction in road accidents and air pollution, $300 million in annual revenues for the provincial and federal governments, and supported 12,845 FTE jobs with transit authorities and their suppliers. Closer to home, one analysis based on the City of Edmonton's Regional Transportation Demand Model - conducted as part of the comprehensive review of the transit system - estimated the short-term annual benefits of public transit in Edmonton at about $700 million (Anderson & Datla 2013). This shows ETS service provides approximately $2.5 in benefit for each $1 spent providing the service. These numbers show the substantial impact of transit expenditures and investments on local economies and highlight how transit expenditures can create economic multiplier effects. These effects support the notion that investment in public transit projects, benefits the local economy in the short term through direct economic benefits. Additional benefits accrue over time mainly due to the economic efficiencies resulting from these investments.

Public transit and its relationship with major economic factors

In the following sections, we will review the relationship between public transit and several important factors in the economy. This review can help to guide the development of public transit policies that are more consistent with economic sustainability goals. Some of these relationships have been briefly mentioned in the previous sections, but in this section we

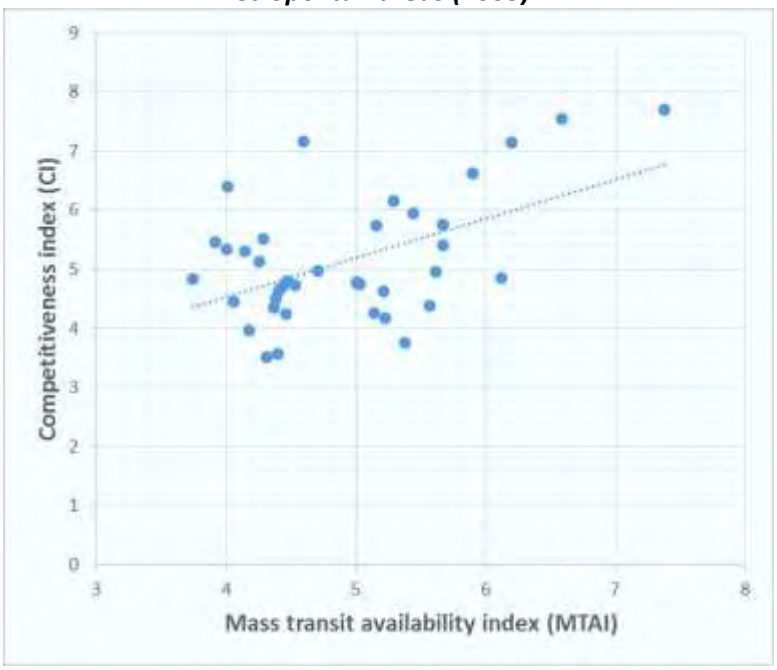
[1] The figures in Table 1 provide a fair approximation of the economic impact of transit spending for Canada as well.

discuss them in more detail and highlight opportunities for public transit to contribute to the economic sustainability of the city by careful consideration of these relationships.

Public transit and economic competitiveness

In addition to specific economic benefits such as lower cost of trips, higher household purchasing power, reduced congestion costs and lower pollution (BTMM 2004), public transit affects the economic vitality and competitiveness of a region. One study shows a significant positive relationship between the mass transit availability index and the overall competitiveness index of 39 major U.S. metropolitan areas as seen in Figure 2 (correlation coefficient r= 0.51). The five regions that rank highest in their competitive index are Seattle, San Francisco, Boston, Denver and Minneapolis. Studying these cities in more detail in the future can provide us with a better understanding of the role of public transit in the economic competitiveness a region.

Figure 2. The relationship between mass transit availability and the overall competitiveness of U.S. metropolitan areas (2003)



Data source: Metro Area and State Competitiveness Report 2003

U.S. regions that rank high on the competitiveness index, also tend to have higher investments in public transit; i.e., cities that are more competitive have either invested in public transit in the past and have an effective public transit system in place, or are currently making investments to improve existing systems. Although these relationships are not causal, they provide evidence in support of a positive association between transit service availability levels and economic competitiveness and the public transit's potential influence on it (BTMM 2004). This impact of public transit systems relies on the network's ability to efficiently and economically connect origins and destinations within a city in a way that leads to cost and time savings for the network users. As a result, the appropriate choice of transit modes such as LRT, BRT or regular bus service for specific segments of the transit network becomes important, due to the impact of these decisions on overall network efficiency. Transit modes each have advantages and disadvantages in terms of capacity, speed, and development & operation costs. Thus, the optimal mode would depend on these considerations and the specific characteristics of demand for public transit in a given network. Major demand pathways can be served better with more efficient and higher-capacity modes such as LRT and BRT which can complement one another rather than compete (Vuchic 2005) while different types of regular bus services can serve lower-demand pathways in the network.

A city's transportation system, including public transit and the city's network of roads and highways, is often viewed as one of several factors that affect the economic competitiveness of a city and mainly contributes to the creation of 'the right business environment' (Begg 1999). Hence, it is viewed as a necessary but not a sufficient component for the competitiveness of a city or region; a city without a strong transportation system in place can face major challenges on its path to economic growth.

Public transit and business agglomeration patterns

Transit system design can affect and be affected by the agglomeration patterns of businesses in a region. Agglomeration refers to businesses independently choosing to locate in proximity to one another to collectively enjoy what is termed "economies of agglomeration".

Concentrating in the same areas reduces transportation costs from suppliers and distribution costs to customers. In addition, agglomeration allows businesses and their employees to participate in labor market pooling and enjoy industry knowledge spillovers. The transfer of knowledge and skills within an industry increases with closer geographical proximity between firms. These effects collectively make agglomerated businesses more competitive by lowering their supply costs and improving workforce mobility and R&D collaborations.

Understanding existing agglomeration patterns in a city can help to identify industries that enjoy local advantages that can be further capitalized upon. Similarly, industries that may not be efficient due to their geographical dispersion may benefit from developing policies that incentivize their agglomeration in order to improve their competitiveness. For example, the city of Burnaby has conducted a cluster analysis of businesses which found higher concentration of some industries that benefit from regional advantages in Burnaby, and has used the resulting information to develop sector strategies (Holbrook 2004).

Policy makers at many local and regional levels are working to find ways to concentrate employment growth in higher density mixed-use districts and encourage voluntary agglomeration of businesses in these areas (CTOD 2011a). This is partly due to the higher cost of reaching dispersed and lower-density employment centres by public transit. In addition, job dispersion has negative implications for equity as lower-income residents have difficulty in accessing jobs that are dispersed in auto-oriented suburbs. The environmental impacts of job sprawl, such as increased land consumption and greater pollution are yet another reason for pursuing policies that encourage agglomeration of businesses. Public transit policies, strategies, or programs, such as transit-oriented development initiatives, can encourage agglomeration of businesses and may be devised in a way that positively affect existing industry clusters or promote the growth of emerging industry clusters.

In sum, transit service delivery can affect and is also affected by business agglomeration patterns and can use this opportunity to further contribute to economic sustainability by providing transit services in a way that supports the voluntary agglomeration of businesses.

Public transit and employment

Findings on the effect of public transit access on employment levels are generally mixed. While some researchers have found such effects to be negligible (Lawless 1999), others have reported a positive association. For example, Yi (2006) finds that job accessibility by public transit has a stronger effect in increasing the levels of employment than job accessibility by private vehicles. In another study, Sanchez (1999) finds that the number of average annual weeks that a person has worked declines by approximately 3 weeks for every 0.5 km they live away from the nearest transit stop. In a unique study that used a natural experiment resulting from the expansion of the San Francisco Bay Area's heavy rail transit system, the authors find a sizeable increase in the hiring of Latinos living near the new stations, but little evidence of such an effect on African American hiring rates (Holzer et al. 2003). These findings suggest that while overall employment levels may not always improve or may not improve for all segments of population who live near transit stations, higher transit accessibility may still increase access to jobs and overall employment levels. Understanding why these effects may or may not be observed requires more research.

In general, the effect of transit accessibility on employment levels may be stronger for the lower-income segments of the population. Stoll and Raphael (2010) report that the multi-decade trend in the decentralization of jobs towards suburbs has also driven the suburbanization of poverty in US cities. Vulnerable workers who fall into the lower income quantiles rely more heavily on public transit to access jobs. Consequently, when job sprawl reduces the effectiveness of public transit to serve areas that may not be economical to serve, the lower-income segments will have lower exposure to job opportunities in those areas. This mismatch between where low-income people live and their access to job opportunities is commonly referred to as the spatial mismatch hypothesis.

The reliance of lower-income segments on public transit is higher for workers in industries with a higher incidence of low-income jobs. For example, the Montreal Metropolitan Community has identified some industries such as the retail, accommodation, food services,

and recreation industries as “outreach clusters” in need of transit provisions due to their relatively young workforce that do not have motor vehicles for their commute (BTMM 2004). Providing public transit can directly improve employment of such vulnerable worker populations.

The role of industry types

In terms of employment sprawl patterns, industrial and manufacturing jobs are the most suburbanized, while skill-intensive or high-tech industries tend to have a preference for higher density locations that are served by transit. One way for public transit to support industrial and manufacturing jobs is to enter partnerships with related businesses and have them contribute to the costs of service delivery near these businesses. For example, in Montreal, several companies have entered partnerships with the Société de transport de Montréal (STM) for public transit services. Another alternative is for city policies to incentivize agglomeration of businesses in specific zones to help to create the type of ridership demand that supports economical service delivery (e.g., See New Jersey’s Urban Transit Hub Tax Credit and Illinois’ Business Location Efficiency Incentive Act. Also, Edmonton Transit has an informal “developer funded service” program intended for developing areas.)

Office jobs such as technical, financial, or insurance jobs, as well as hotels, some clothing stores, and potentially bio-tech and high-tech businesses are also well-suited for being located near public transit because of their propensity to locate in high-density areas that can create the level of ridership that justifies economical delivery of transit services. Industries such as warehousing, manufacturing, and “big box” retail cannot be easily built at the densities and concentrations that are conducive to high transit ridership, especially if they are not located in mixed-use districts with additional transit demand (RA-CTOD 2008). Understanding how different industries could benefit from public transit can help the development of appropriate transit policies. For example, policies may be developed to encourage more skill-based jobs to locate themselves close to transit-served locations (CTOD 2011a).

The role of urban form

When discussing the role of public transit on employment levels, attention needs to be paid to the role of urban form in this relationship. Historically, "Hub and spoke pattern" regional transit systems were developed to move residents from low-density residential areas to a single high-density employment center such as urban downtowns. As cities expanded, the inevitable development of new employment centers in areas other than downtowns has given rise to multifocal cities with several or many employment centers. This evolutionary urban outcome has implications for public transit as major commuter cross flows are created in multifocal cities, and the transit system needs to recognize and respond to these movement flows.

There is also evidence that concentrated employment areas are more highly associated with transit ridership (Barnes 2005). In addition to the connectedness between residential centres and employment centres, a transit system that connects multiple relatively dense employment centers to one another would provide easier access to job opportunities in any of these centers (Brown and Thompson 2008). When employment centers are efficiently connected, easy access to one of them ensures easy access to all of them, which increases the job opportunities available to individuals and leads to higher workforce mobility. The FasTracks project in Denver is one such example that connects several major employment centers. A report prepared by CTOD provides a sample analysis of the spatial distribution of job clusters in three US cities (CTOD 2011b).

Edmonton is considered to be a multifocal city. Figure 3 shows the concentration of jobs as determined by the number of commercial permits in 2015. Depending on the purpose of analysis and thresholds on cluster sizes, at least three to six clusters of employment can be observed in this figure. It is not clear how well-connected or well-served these employment clusters are by public transit. City Planning at the City of Edmonton (formerly, Urban Planning & Environment) is currently working on a more comprehensive project to map out the distribution of actual jobs in Edmonton, as the number of permits is more representative of the

number of businesses rather than the number of jobs. Insights from this project will be provide useful input for public transit service delivery management in Edmonton.

Figure 3: Edmonton commercial permit heat map 2015

Public transit and property values

Developing higher order transit systems such as light rail can also increase nearby property values. Capturing this additional value may be a feasible way to partially finance transit developments (CUTA/ACTU 2010b; Also see Smith and Gihring (2006) for a discussion of this topic). There are several example cases where cost of transit developments have at least partially been captured by the resulting increases in nearby property values (VTPI 2015).

Property value increases are not limited to areas near major transit investments such as new light rails. Less major improvements in the transportation system, such as construction of new roads and highways can also positively affect property values. According to one report, transportation improvements in Edmonton, comprised of the expansion of the Ring Road and

the LRT projects, will cause affected regions to experience an additional 10%-20% increase in real estate values if the market goes up and a similar level of higher resistance to price drops if overall real estate prices drop (REIN 2010). The Ring Road and the LRT expansions in Edmonton have been reported to differentially affect areas that fall into four tiers based on their proximity to the improvements. The first tier is comprised of areas that enjoy the twin economic impacts of access to both the Ring Road and the LRT expansion. These areas are mostly located on the 111th street corridor, and include Blue Quill, Ermineskin, Sky Rattler, Twin Brooks, Park Allen, McKernan and Belgravia, Lewis Estates, Belmead, Aldergrove, and Thorncliff. The areas in the second tier will also feel a strong positive impact due to proximity to one of the two mentioned improvements and include South Mill Woods, Pleasant View, Lendrum, Jamieson, Glastonbury, McCauley, east Queen Mary Park, McDougall, Spruce Avenue, and Prince Rupert. The third tier includes areas that will feel the impact in years to come after the Northern Section of the Ring Road is developed. These include (NW) Castledowns neighbourhoods, Lago Lindo; (NE) Miller, Casselman, Kirkness, Fraser, Rundle Heights, Abbotsfield. The fourth tier is comprised of regions outside the main impact areas that will feel a ripple effect, such as St. Albert, Ft. Saskatchewan, Devon, and Sherwood Park.

Understanding the effect of investments in transit infrastructure on property values may create opportunities to achieve higher economic return from transit investments and deserves consideration in transit planning. (For more discussion of this topic, see the report in this series titled ‘Exploring the relationship between transit and land use.’)

Public transit and land-use planning

In Transit-oriented development (TOD), the aim is to cluster high-density mixed use development in a pedestrian-oriented layout near major transit nodes, so that users of these districts will have high accessibility and mobility while reducing auto use (Deakin 2001). Hence TOD creates areas that are walkable and bikeable where people can live, work, play, and interact, and at the same time have good access to public transit. Achieving this objective, requires the coordination of land-use and transit plans and programs (Suzuki et al. 2013). TOD

is an important component in recent sustainability initiatives in North American cities and regions including the Maryland Smart Growth initiative, Portland OR 2040 plan, Sustainable San Francisco, Sustainable Toronto, Sustainable Seattle, and the Bay Area Alliance for Sustainable Development.

TOD has a close relationship with transit policies and practices as it entails public transit provisions by definition. But more importantly, it leads to increased land use density that has a positive impact on the economic sustainability of transit by promoting transit ridership. A separate report in these series will be entirely devoted to land use and public transit.

Public transit and affordability

Affordability of public transit and rider cost savings as a result of using an efficiently designed public transit system is one of the indicators of economic sustainability for public transit. This goal requires a careful examination and review of the transit network and organization to ensure that per capita cost of service delivery remains competitive and is minimized over time. Unfortunately, this goal is often at odds with other social initiatives and so a compromise is often needed.

Affordability also involves employing fare structures that reflect perceptions of public transit value for different segments in the market. For this to happen, segments of the market who receive higher value from public transit (e.g., through time-of-day pricing that recognizes the higher value of public transit during peak traffic hours) can be charged higher fares, while the usage of more vulnerable segments of the market who also derive relatively less value from public transit can be subsidized.

Despite the evident economic rationale for creating and serving high density areas that are amenable to service delivery by public transit, social sustainability and equity goals also justify service delivery to lower-density areas or more vulnerable segments of the market including lower income groups, such as seniors, students and youth. Although these groups may be more costly to serve, it is noteworthy that part of the additional costs may be retrieved by devising

strategies that can increase ridership of vulnerable segments to produce further economies of scale for public transit. There is also an economic rationale in seeking socially optimal outcomes by supporting the more vulnerable segments of the population, as increasing their ability to move can reduce demand on support programs and create further advantages in terms of employment and multiplier effects that have a positive impact on the economy.

Public transit and ridership

Public transit would not be economically sustainable if ridership were low, and many of its environmental benefits accrue when a higher number of people use transit. Hence, increasing ridership is a priority for many transit authorities. For example, Edmonton has a goal of increasing transit ridership to 105 rides per capita by 2018 (Dashboard 2015a). Understanding ridership patterns and modifying policies and services to support these patterns is a step towards a more economically efficient transit service design. Although Edmonton is actively working to understand rider preferences and adjust its transit services in response to them, this is an area where improvement can still be achieved.

A number of studies clearly indicate that transit ridership in North America comprises a small percentage of work trips and that there may be an opportunity for transit policies to shift this distribution in favor of public transit. These statistics also suggest that the existing public transit systems may be more aligned with commuting to work and school, and less aligned with personal and social/recreational trips. Perhaps this is due to the higher diversity of destinations and the higher overall trip times for these purposes. Nevertheless, understanding trip purposes and expanding the target market for transit can provide ways in which the transit system can adapt itself to encourage higher ridership. The Transit Performance Monitoring System (TPMS) surveys provide more detailed data on transit usage patterns that can be used as a benchmark for analyzing usage patterns in Edmonton.

Commute trips have a significant impact on communities and infrastructure costs by affecting the structure of a city's freeways and arterials, as these structures are designed to

handle peak-hour commuter flows. Given the current low mode split for commute trips, any shift of ridership from private cars to public transit for commute purposes would have a sizeable effect on congestion and peak-hour traffic levels, which would keep worsening if transit adoption were not improved.

It is also noteworthy that public transit's share of work trips highly depends on urban form, population and employment density especially on the transit corridor. For example, in the San Francisco Bay Area, about 51% of commute trips from Alameda County into downtown are made by transit compared to the US national average of 4.7% transit ridership by commuters. These numbers show that transit could aim to achieve a higher market share of commute trips by providing better time efficiency.

Statistics Canada's 2011 census indicates that 11.3% of Edmontonians use public transit for their commutes, This puts Edmonton behind the leading cities of Toronto, Montreal, Ottawa, and Vancouver where respectively 23.3%, 22.2%, 20.1%, and 19.7% of commuters use public transit (NHS 2011). Although these differences are partly rooted in urban factors such as city size and population density, public transit in Edmonton could still benefit from the opportunity to capture a larger share of trips.

Based on the 2014 municipal Journey to Work Mode survey results, only 24.3% of Edmontonians choose modes other than driving a car to work (Dashboard 2015b). The 2018 target for the above statistic is 25.9%. One of the major factors that can affect the choice of citizens to take public transit instead of driving to work is "difference in travel time"; consequently, public transit is more competitive with private cars over shorter distances (CUTA/ACTU 2010b). Designing transit service delivery in a way that leads to further savings in time may help to convince some private car commuters to switch to public transit. Time savings on public transit may be achieved by a more efficient transit route design or scheduling, or using tactics to reduce private vehicle traffic on busier routes, such as cordon pricing, or higher parking costs or lower parking space availability in congestion-prone areas.

Sustainability and economic assessment of large projects

Economic sustainability of a region is significantly affected by the economic sustainability of large projects and investments in infrastructure. The ultimate challenge in the economic assessment of such projects lies in the determination of the total costs and benefits of a project over time (Rogers et al. 2012). Two specific issues in this context are 1) how to account for time in the financial evaluation of future costs and benefits, and 2) the issue of externalities.

Accounting for time

In financial evaluations, future costs and benefits are incorporated in estimates after discounting. For this purpose, a discount rate is used to convert future benefits and costs into lower present-day values and hence account for the time value of money; for example, the present-day value of $1 earned in the next year is respectively $1, $0.97, or $0.93 with yearly discount rates of 0%, 3%, or 8%. The private sector uses discount rates that are determined by factors such as the cost of borrowing money and investment risks, and may range from 10% to 15%. Public organizations often use a social discount rate (SDR) in their cost-benefit analyses. This rate reflects the time value of future costs and benefits from the viewpoint of society rather than profit maximization (Rogers et al. 2012). SDR values are typically low which discounts future benefits less heavily and favors projects with long-run benefits over those projects that have higher payoffs in the short term. Determining the social discount rate is a controversial issue. In Canada, recent guidelines of the Treasury Board Secretariat (2007) recommend a discount rate of 8% to be used by federal cost-benefit analysts. Boardman et al. (2008) argue that this level of SDR is too high and that lower rates (3.5%) or a schedule of time-declining SDRs should be used depending on whether the project has impacts beyond 50 years or not and whether it crowds out private investments.

Using low social discount rates in cost benefit analyses for a project may not adequately capture the total benefits and costs of projects, especially for components that may be non-monetary or non-monetizable. To address this issue, multi-criteria or multiple account

evaluation techniques are used that include comparison of projects along other qualitative accounts in addition to the financial account (Schiller et al. 2010). These accounts may include customer service, environmental, social and economic development implications of a project. Within each account, relevant measures are included and a given project is assigned a rating or score on each measure. From these scores, higher level scores or an index score is calculated and projects are compared based on their overall scores. Nevertheless, thorough determination of costs and benefits for a project also requires attention to potential externalities that may arise.

The issue of externalities

Externalities are an important part of economic sustainability. An externality can be defined as an outcome that affects uninvolved parties, positively or negatively, without them having any control in the decision-making process that led to that outcome. For example, a new rail line may have both negative (noise pollution) and positive (cleaner air, less congestion) externalities. Positive externalities provide a benefit to the society whereas negative externalities impose a cost. Hence, negative externalities need to be either eliminated with appropriate provisions or be corrected. In the above example, if the neighboring communities allow the rail line to be built, given that appropriate sound barriers are also installed to minimize noise pollution or adjacent buildings receive funds to soundproof their buildings, these affected parties are compensated for the costs to them of the decision and the externality is internalized. An externality is internalized when the party who causes the negative externality also bears its costs to the affected parties. Hence, assigning a dollar value to the costs imposed by externalities is one way to correct them. These dollar values may be estimated by identifying affected parties and determining the costs of the externalities to them. As another example of internalizing externalities, cordon pricing is a congestion pricing technique that has been implemented in some large cities. Cordon pricing functions by assessing a fee to vehicles entering defined geographical areas during peak travel hours. In this example, vehicles that contribute to the congestion of a given geographical region and play a

role in creating the negative externality are required to pay the cost that their vehicle usage imposes on the society, and the negative externality is thereby internalized for them. Both determining and dealing with externalities can be a complicated process and the solutions are not limited to those discussed here. The interested reader is referred to *The Theory of Externalities, Public Goods, and Club Goods* by Cornes and Sandler for a more detailed account of externalities and ways to deal with them.

Eliminating or correcting negative externalities may be challenging. Nevertheless, decision makers and policy developers need to address them; they need to identify externalities, their costs, benefits, and those segments of the population that are affected by them so they can find solutions that can offset or eliminate them. Attention also should be paid to spatial versus temporal externalities. The latter includes issues that affect people over time, for example, climate change (Rogers et al. 2012). It is also known that the private sector may have a tendency to ignore the externalities that it imposes on the society in order to avoid additional costs. In such cases, clear legislation or judicial precedent could be used to require them to address any negative externalities created by their economic activities.

Potential action alternatives for consideration

The following list contains a number of action alternatives that follow from the discussions in previous sections:

- **Contribute to the city's economic growth by identifying and supporting competitive business clusters with better transit service delivery:** The transit system can contribute to the city's economic growth by identifying competitive clusters of businesses in the city and putting in place policies that ensure affordable transit service delivery to these clusters.
- **Analyze employment clusters to guide service delivery priorities:** Use employment cluster analysis for Edmonton to identify high-, medium-, and low-density employment centres and plan service delivery priorities (e.g. service frequency/quality) for different

tiers of job density (See CTOD 2011 report titled, “Transit-Oriented Development (TOD) and Employment” for some insights that can be drawn from such an analysis). One study by City Planning at the City of Edmonton (formerly, Urban Planning & Environment) is collecting job distribution data in Edmonton, which can be used for this purpose.

- **Consider extending cost sharing programs with local businesses:** Consider extending joint programs with local businesses to provide transit services to potentially underserved areas. Individual businesses or business groups might have an incentive to contribute to the cost of such improvements.
- **Identify vulnerable segments in the workforce to improve their transit usage:** Identify whether vulnerable segments in the workforce require specific transit provisions to facilitate their access to or their use of public transit. Vulnerable workers with low-paying service class occupations may face fewer job opportunities due to their lack of access to transit. These workers may be identified by the industries they work in. For example, the Montreal Metropolitan Community identifies the accommodation, retail, food services, and recreation industries as “outreach clusters” in need of transit provisions due to their relatively young workforce that do not have motor vehicles for their commute.
- **Study how the fare structure can be subsidized for lower income populations or lower density service areas in order to produce socially optimal outcomes:** This could be partly achieved through the economies of scale effect that result from higher demand for public transit when price is lowered for some segments of the market. In addition, using segmentation pricing techniques can allow transit usage by some segments of the market to be subsidized by other segments of the market based on the perceived/actual value of public transit to them. For example, time-of-day pricing, can be used to charge higher prices for times of the day where the value of public transit is highest to users.
- **To the extent allowed by regional agreements, consider local procurement of goods and services for transit:** conduct local procurement of goods and services required for building, operating and maintaining public transit infrastructure to re-inject

expenditures into the local economy and spur further economic activities from these expenditures.

- **Study the role of public transit in the economic competitiveness of U.S. cities that rank high on this metric.** The cities of Seattle, San Francisco, Boston, Denver and Minneapolis have the highest rank in competitiveness in the data provided in Figure 2. Studying these cities can provide insights on the specifics of how public transit may affect economic competitiveness.
- **Assess and improve the proximity of jobs to transit stations to guide service delivery goals:** Edmonton is monitoring this metric and its current target is to have transit service within 800 meters of employment locations. This action alternative aims to highlight the need for attention to the metric of proximity and its continued assessment in order to improve job accessibility via public transit in Edmonton.

Conclusion

There is general consensus about the economic benefits of public transit and its significant role in the economic sustainability and competitiveness of cities. Public transit can contribute to the economic sustainability of a city through two pathways, 1) through transit investments and expenditures, and 2) through its impact on creating a better living and business environment. Investments in public transit have immediate effects in local economies in the form of new economic activities resulting from these expenditures and long-term effects in the form of a better living and business environment when transit investments create an overall more efficient transportation network.

Public transit can also play an important role in the city's economic sustainability by guiding and supporting business agglomeration patterns with appropriate service delivery, higher proximity of transit stations to jobs, retrieving costs by capturing increases in property values, appropriate land-use planning and support of transit-oriented development, ensuring overall affordability of transit services by taking into account income levels, and pursuing strategies

aimed at increasing ridership. In addition, financial cost-benefit analyses for transit investments could support economic sustainability by appropriately accounting for time, non-monetary costs and benefits, and negative externalities of an investment project.

Although economic sustainability of a city or region depends on several factors other than an efficient public transit system, having such a system is necessary for economic growth and can have a substantial positive impact on the economy of a region; public transit is one of the largest economic players in any region including the city of Edmonton, and can also lead to the creation of a better business environment for smaller players through appropriate policies and practices.

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