

Road development, income, unemployment and crime: evidence from Arctic Canada*

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Abstract

Fourteen percent of the world's population lives more than 2 km from an all-season road. From 1974 to 2017, a winter ice road was the only ground transportation from Tuktoyaktuk, Northwest Territories, to Inuvik, the regional centre and subsequently the rest of Canada. On November 15, 2017, the Inuvik-Tuktoyaktuk Highway (ITH) opened, allowing people to travel to the community year-round (Government of the Northwest Territories, 2010). I use a synthetic control analysis to study the impact of the causal effect of the opening of the ITH on crime, income, employment and population. I find non-positive results for income and employment outcomes and mixed results for crime outcomes. This paper contributes to the current literature by applying a synthetic control methodology to new road development in a high-income country. Relevant indicators of socioeconomic well-being are identified through impact assessments and qualitative research on the Inuvik Tuktoyaktuk Highway, allowing the analysis to reflect community-specific hopes and concerns about the impact of the new highway.

Keywords: Infrastructure, road development, socio-economic outcomes, employment, infrastructure and income, economics of crime, demographic changes

JEL Codes: J15, J21, K14, O18, P25, R23

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1 Introduction

Globally, road development is often cited as a means for isolated and remote communities to facilitate economic development ([Foster, Gorgulu, Straub, & Vagliasindi, 2023](#)), with fourteen percent of the world's population living more than 2 km from an all-season ([Wenz, Weddige, Jakob, & Steckel, 2020](#)). In Canada, winter roads are the primary overland infrastructure for 52 remote Indigenous communities ([Salles, Mullan, Spagnolo, & Catney, 2025](#)), and there is a total of 8,000 km of official winter roads ([Government of Canada & National Research Council Canada, 2025](#)). Winter roads facilitate shipping of bulk and heavy items such as building materials and fuel, provide links for remote communities to access southern amenities, and aid in resource extraction activities ([Barrette, Hori, & Kim, 2022](#)). These roads exist on a combination of frozen ground and ice that forms on rivers and lakes. This natural construction is distinctly vulnerable to climate change, which has been happening at a faster pace in polar regions ([Barrette et al., 2022](#); [Zhang, Chenier, & Roghani, 2024](#)). The Indigenous population in Canada sees lower socio-economic outcomes than non-Indigenous Canadians ([Government of Canada & Indigenous Services Canada - Geomatics Services, 2023](#)). Given the combination of potential economic opportunities and the knowledge that current infrastructure is highly vulnerable to a changing climate, there is ongoing policy discussion about expanding year-round overland infrastructure in Canada ([Senate of Canada, 2017, 2016](#)).

The Inuvik-Tuktoyaktuk Highway (ITH) was born out of the desire for local economic opportunity ([Bennett, 2018](#)). It connects Tuktoyaktuk, a predominantly Inuit hamlet of 900 people on the Arctic Ocean, to Inuvik, the regional centre. Stretching 138 kilometres, the opening of the ITH in November 2017 was the first time Tuktoyaktuk had year-round overland access to a hospital, pool, and other amenities in the regional centre of Inuvik ([GNWT Finance, n.d.](#)). As the only public road to the Arctic Ocean in North America, the ITH created the first connection in Canada to its northernmost ocean, and gave those in the south a chance to dip their toes into the Arctic waters. A tourist rush ensued with reports of 30 to 50 tourists coming through Tuktoyaktuk a day in the first summer the road was open ([Scott, 2018](#)). Impact assessments and development reports promised economic development

opportunities through tourism and resource extraction. Fears of increased crime tempered the hope of these economic opportunities, and changes to access to traditional hunting, fishing, and wild plant harvesting activities ([Bennett, 2018](#)).

This paper seeks to understand the effects of the Inuvik-Tuktoyaktuk highway on those living in Tuktoyaktuk. I focus on population, income, labour force and crime outcomes using a synthetic control research design. I study these outcomes because of their relevance to those living in Tuktoyaktuk and their feasibility given the synthetic control design. The synthetic control method is an ideal method for understanding this question because it considers a single treated unit at an aggregate level, making explicit counterfactual weights, allowing for causal understanding of an important and immediate policy question – how effective is all season road development for community socio-economic improvement in Arctic Canada – in a context where there are limited numbers of possible controls, a single treatment and relatively infrequent data available at a local and control unit level.

There is a general assumption that new transportation infrastructure creates positive economic outcomes. There is evidence of a positive relationship between transportation infrastructure and national and regional GDP ([Banerjee, Duflo, & Qian, 2020](#); [Jaworski & Kitchens, 2019](#)), employment ([Fiorini, Sanfilippo, & UNU-WIDER, 2019](#); [Lei, Desai, & Vanneman, 2019](#); [Frye, 2024](#)), improved consumer choice ([Aggarwal, 2018](#); [Wiegand, Koomen, Pradhan, & Edmunds, 2023](#)) improved gender outcomes ([Lei et al., 2019](#); [Anti & Zhang, 2023](#)).

One cannot infer from the existing literature, however, that transportation is ubiquitously positive, particularly when looking at newly created rural roads. A 2023 meta-analysis of papers on the effects of road development found that though outcomes were firmly positive in sub-Saharan Africa, that was not the case when looking at studies in Asia and Latin America ([Foster et al., 2023](#)). Asher and Novosad ([2020](#)) find that impacts on local incomes, wages, and wealth are ambiguous four years after a major rural road development initiative in India. There is evidence of heterogeneous effects across income, skill and sector dimensions. Banerjee et al. ([2020](#)) find increased income inequality after new railroad development in China, results that are echoed in Chatterjee et al. ([2025](#)), who find skill premiums increasing in labour markets in India with increased road development, no association between road

development and increases in employment for high or low skilled labour and in Perra et al. (2024) who find heterogeneous outcomes between formal and informal labour markets in Ethiopia. There is also evidence of geographic heterogeneity. Faber (2014) found that urban connector communities realize economic benefits, but this may come at the cost of economic development in communities peripheral to the new transportation infrastructure. Jaworski and Kitchens (2019) find substantial leakages from the Appalachian region after major highway development through the region starting in 1965. Gachassin et al. (2015) find heterogeneous effects on poverty reduction from new road development in Cameroon depending on local characteristics and levels of isolation. They suggest that it is not the road itself that reduces poverty but the facilities and services that often follow road development. In Brazil, Bird and Straub (2020) find different effects of road development on GDP and local labour markets depending on where a connected community was on the road network and its relative market size.

Road development impacts aspects of life that are not directly economic outcomes, and studies that incorporate the effects on the environment and measures of subjective wellbeing indicate a new road may not be net-positive for a community, even if economic outcomes such as income and employment tend to improve. A pan-African study by Djemaï et al. (2024) finds differences in material and subjective wellbeing after new transportation infrastructure. They found higher material wellbeing, but no changes in subjective wellbeing, pointing to the nuance of the many aspects of life that transportation impacts. Reyes-García et al. (2020) find mixed opinions from Indigenous people in Bolivia about the effects of new road development, depending both on community location and the income level of the individual's family. In the tropical rainforest context of the Democratic Republic of Congo, new road development leads to deforestation in many areas (Damania & Wheeler, 2015; Damania, Russ, Wheeler, & Barra, 2018).

Arctic road development in Canada has its own small body of literature. Like the global literature, there are patterns of benefit in some areas, and ambiguous change in others. Stringer and Joanis (2022) find positive correlations between road connection, employment rates, and education in Nunatsiavut and Nunavik, though they do not find robust effects on income. Relating directly to the ITH Fellows et al. (2022) consider the decrease in

remoteness, as measured by the Canadian Remoteness Index, as a predictor of economic outcomes. They predict that the ITH would increase incomes and high school graduation rates without statistically significant changes to violent and property crime. Kenney et al. study the effects of ITH on food prices and find prices in Tuktoyaktuk rose compared to an adjacent ice road community after the opening of the ITH due to a loss of food subsidies to the community (Kenny et al., 2025).

Much of the previous literature has relied on large national or regional infrastructure programs. This paper contributes to the literature by applying synthetic control to a unique circumstance of new road development that would otherwise not be feasible to get causal evidence from. The synthetic control method provides the ability to study a context where there are limited numbers of possible controls, a single treatment and relatively infrequent data. The ITH presents a unique context to study road development because it is a remote region of a high-income country. This context includes substitutes for overland transportation, such as barges and planes. The community and region are primarily Indigenous, with a large proportion of the population participating in traditional land-based economic activities. Given the heterogeneous results found elsewhere in the world, this new context provides insight into when and where new road development might benefit a community and when the results might be neutral or negative. This paper also contributes to the broader literature by studying multiple outcomes that are of interest to the community. Particular to these outcomes is the impact of roads on crime, an area of anticipated increase, which, if economic outcomes appear positive, may mean the creation of a road is not net positive for a community in an overall sense.

The rest of the paper proceeds as follows. Section 2 provides the context of the ITH, Tuktoyaktuk and Inuvik, and the Inuvialuit Settlement Region. Section 3 motivates the outcomes of interest based on community hopes and concerns about the effects of the ITH. Section 4 outlines the methods used. Section 5 describes the data and its sources, and Section 6 discusses the results and concludes.

2 Context

Understanding the socio-economic effects of all-season road development in the context of the ITH adds a high-income context to the broad and heterogeneous literature on road development. The majority of the literature on new road infrastructure focuses on low- and middle-income countries. In the high-income context, most of the main overland roads have existed in some form for decades, so analysis of the impact of any new overland connection is either historical or considers changes in existing infrastructure. It also provides specific insight into new all-season road development in Northern Canada, where there is a high proportion of Indigenous peoples, many remote communities without all-season road access, and an extensive ice road network.

Canada is one of the largest countries by land area. However, most of its population is concentrated in the south, with two-thirds living within 100 km of the southern US-Canada border ([Government of Canada, 2017](#)). This leaves millions of kilometres for the other third of the population, where overland infrastructure is increasingly sparse as networks move North. The Canadian Territories have only four highways connecting them to southern Canada. Many communities do not connect year-round to these highways. Instead, people and goods move over ice roads, summer barges or by air. Inuvik connects to the southern highway network via Dempster Highway, a 740 km gravel highway. The closest Census Metropolitan Area (Statistics Canada’s designation of larger population centres of 100 000 people or more) is Prince George, BC, 2844 km away by road ([Google, 2024](#)), illustrated in Figure 1, which shows the roads between Tuktoyaktuk, the Yukon, British Columbia and Alaska. This distance means that even with a new all-season road, Tuktoyaktuk is relatively remote compared to southern Canadian communities.

There is an estimated 8000-9000 km ice road network in Canada, created anew each winter and thawing again each spring ([Barrette et al., 2022](#); [Salles et al., 2025](#)). These roads form over frozen land and bodies of water, including rivers, lakes, and the frozen Arctic Ocean. This network connects 59 Indigenous communities to the rest of Canada by land. They serve as a mode of transportation for supplies that are difficult to ship by air, and as a way to connect communities to the rest of Canada for health services, recreation and

consumption. Ice roads are mainly a product of nature, unlike all-season roads that are a product of engineering and, as such, are more vulnerable to climate change. Global shifts in temperature and weather have lead to shorter and less predictable transportation seasons, limiting supply lines, and the ability to access the rest of Canada ([Barrette et al., 2022](#)). Given the vulnerability of these roads to climate change and the seasonal limits of overland travel, there has been a move to create more all-season roads.

In the Northwest Territories, there is a proposed all-season road along the Mackenzie River ([Government of the Northwest Territories, 2009](#)), and proposals for increased trade corridors across Canada have been in policy discussion for decades ([Senate of Canada, 2017](#); [One Canadian Economy, 2025](#)). The ITH is the first public road in North America to the Arctic Ocean. It is also strategically important to Canada as global warming makes the Northwest Passage increasingly navigable, as it connects southern Canada to a location that offers the potential for a deep-water port in the western Arctic ([Bennett, 2018](#)).

The ITH was built entirely within the traditional territory of the Inuvialuit and the Inuvialuit settlement region. The Inuvialuit are the Indigenous Inuit group whose traditional territory extends throughout the Western Arctic in Canada. The Inuvialuit Settlement Agreement, signed and implemented in 1984, was the second comprehensive land claim agreement, or modern treaty, in Canada. The purpose of the agreement was to preserve Inuvialuit culture, establish Inuvialuit as equal partners in economic development alongside other Canadians, to encourage economic self-sufficiency and to preserve the Arctic environment ([Inuvialuit Regional Corporation, 2025](#)). These modern treaties have increased incomes for both Indigenous and non-Indigenous people who live and work in settlement areas ([Aragón, 2015](#)). Regardless of the benefits of the modern treaties, Inuit in Canada face overall worse socio-economic conditions than the rest of the population. In 2018, Canada ranked 12th overall in the Human Development Index rankings, whereas Inuit in Canada would have ranked 69th in the world ([Canada, 2022](#)) if it were a separate country. Increased economic opportunity for Inuit has the potential to close this gap, and the hope of the ITH was to provide such an opportunity.

Tuktoyaktuk is an Inuvialuit hamlet whose name means ‘resembling a caribou’ in Inuvialuktun (the Inuvialuit language). It was a fishing and caribou harvesting place for

Inuvialuit before being established as a permanent settlement in 1905. The shore's natural harbour near the mouth of the Mackenzie River made it a useful location for fur trading boats and an easy place to receive community supplies. The town boasts of a blend of traditional and modern lifestyles ([Hamlet of Tuktoyaktuk, 2024](#)). Land-based activities are important to a large proportion of the community, with most community members actively engaged in traditional land-based economic activity with 55.4% of people saying they fished in 2019, and 55.3% of people saying they gathered wild plants in 2019, and 38% of households obtained 75% or more of their meat and fish through wild harvest ([Northwest Territories Bureau of Statistics, 2019](#)). A sense of community is high in Tuktoyaktuk, with 84% of people saying they were "satisfied with their sense of belonging" and 74% of community members saying they were "overall satisfied with the community they call home" in 2019. This satisfaction did not extend to employment opportunities and cost of living, with only 17% and 24% of people being satisfied with these, respectively, in 2019. 31% of households were worried about making ends meet, and 44% of households were worried about having enough money for groceries, indicating high levels of food and financial insecurity ([Northwest Territories Bureau of Statistics, 2019](#)). In 2013, at the start of road construction, Tuktoyaktuk had a health centre with four nurses, six community police officers, two grocery stores and no banking institution or ATM. The majority of housing was public housing rented by community members (167 out of 284 dwellings) ([Northwest Territories Bureau of Statistics, 2013](#)).

The ITH was advocated for by community members who saw it as a way to alleviate some of the food and financial insecurity in the community, as well as provide a connection to the resources and community in Inuvik. The hope was that the hospital, a larger airport, a pool and many relatives and friends would be more accessible year-round once the road opened. There was optimism that the road would increase economic activity and opportunities.

3 Motivation

Understanding all the socio-economic effects of a new all-season road is inherently broad to the point of being unwieldy. To hone in on a feasible set of outcomes to study in this context,

I consider two main factors. First, how relevant are outcomes to those living in Tuktoyaktuk, to those making policy about all-season road building and the overall economic literature? Second, is it feasible to study these outcomes given the data available? To this end, I present causal synthetic control results on population changes, labour force, income, and crime. I also present suggestive results on traditional economic activity. The data on traditional economic activity do not meet the requirements for a valid causal synthetic control analysis; however, because this is an important area of socio-economic activity, suggestive results are still worth including in order to understand the local impact of the ITH fully.

In order to understand community members' hopes and fears about what a new all-season road might bring to Tuktoyaktuk and the Beaufort Delta region, I rely on discussions recorded in economic and environmental assessments and academic literature. Bennett (2018) interviewed community members about the creation of the road, and found mixed feelings about what the road might bring. Some interviewees were hopeful that prices would fall, access to medical, mental health and recreation services would increase, and incomes would rise. Bennet also recorded anxieties that a road would open up bootleggers for drugs and alcohol – Tuktoyaktuk is an alcohol-restricted community with only two litres of spirits allowed in the community at a time unless there are special circumstances (GNWT Finance, n.d.). These hopes and fears are also found in the review of the ITH development proposal done by the Inuvialuit and Government of Northwest Territories co-managed Environmental Impact Review Board, citing concerns about access to harvesting and increased access to drugs and alcohol (Environmental Impact Review Board, 2013).

Economic and environmental assessments anticipated that the opening of the ITH would increase economic activity. The increase would occur first during construction, with a boom in employment estimated at around 1000 full-time equivalent jobs, and then a lower level of increased economic activity after the completion of the road. The anticipated drivers of economic activity were more tourism, the potential for Tuktoyaktuk to become an Arctic port, and increased investment in the oil and gas sectors. There was a projected increase in GDP of \$27 million across the NWT in the first 45 years of its opening (Environmental Impact Review Board, 2013; GNWT Department of Transportation, 2010).

The Environmental Impact Review Board indicated strong community support for the

project because of the jobs and training that would come with it. The community cited the need for employment and income to increase participation in traditional harvesting activities, thereby increasing cultural activity. Community concerns were that increased openness would lead to increased disturbance of traditional areas by tourists and outsiders, which might impact harvesting and traditional land use. The report also noted the likely long-run effects on culture a road might bring, some of which would be hard to mitigate once detected ([Environmental Impact Review Board, 2013](#)).

In 2010, the Government of the Northwest Territories commissioned a report on the anticipated economic impacts of the Inuvik-Tuktoyaktuk Highway ([GNWT Department of Transportation, 2010](#)). Their focus was on the effects on jobs and GDP both in the Northwest Territories and in Canada. They also anticipated a net rise in both Canadian and Northwest Territories GDP, with an increase in one-time jobs for construction in the territory. The report anticipated a decline in jobs and income previously needed for winter road maintenance and freight flights, to be offset by decreased cost of living and jobs created by increased oil and gas development and tourism. The report projected tourism to increase by 500 tourists a year, spending \$2935 in the region each visit.

Fellows et al. ([2022](#)) study the anticipated effect on community outcomes in Tuktoyaktuk using the change in remoteness index – a Statistics Canada measurement of community connectedness ([Statistics Canada, 2023](#)) – to predict what would happen in Tuktoyaktuk once the Inuvik-Tuktoyaktuk Highway opened and Tuktoyaktuk’s remoteness level declined. They predicted positive results for incomes, with a weaker positive effect on labour force outcomes. They predict better housing results and higher high school education attainment, but lower levels of Indigenous people speaking Indigenous languages. They consider crime in the same five categories I will highlight, and only find a positive and significant predicted effect for ‘Other Criminal Code Violations’.

The above reports and studies consider many aspects of socio-economic well-being in both Tuktoyaktuk and Inuvik. Most of these aspects are measured in some way by the Northwest Territories Statistics Bureau or the Canadian Census. However, to run this analysis, data used in synthetic control must be available and aggregated at the community level across treated and control communities, have had a long enough time horizon post-treatment for

outcome changes to occur, and have enough pre-treatment periods for a reasonable estimation of community weights from pre-treatment data. This limits the analysis, as certain important outcomes, including education and speaking or understanding an Indigenous language, do not meet the post-treatment requirements. Other variables are not recorded with enough frequency to produce meaningful results.

4 Methods

The ITH provides a unique case study of what happens when a community goes from having seasonal overland access to year-round overland access. The uniqueness of the circumstance makes this context important to study, but it also poses issues for causal empirical analysis. The Inuvik-Tuktoyaktuk Highway is a single intervention, and the other possible counterfactual communities are heterogeneous in their similarities to the treated communities. Only using one community means we lose potential information that other communities could provide. Using all of the communities with equal weight may mean that we are adding irrelevant information and losing a tight pre-trend fit. In this circumstance, a weighted combination of communities will likely serve as a better control than any single community or an equal weighting of all possible communities. Northern data in Canada tends to be more limited than data in the south and data from more populated areas. Most data on relevant outcomes is available either annually or every two to three years. The Synthetic Control Method with placebo-based inference address the issues of this empirical situation well.

4.1 Syntehtic Control

As in Abadie, Diamond and Hainmueller (2010, 2015), I consider $J + 1$ communities, where $j = 1$ is the treated community - this is either Tuktoyaktuk or Inuvik. Other communities used to create the weighted counterfactual are indexed $j = 2$ to $j = J + 1$. The full time period spans $t = 1, \dots, T$, with T_0 pre-periods and T_1 post periods, with treatment occurring at time $T_0 + 1$, and $T_0 + T_1 = T$.

I estimate how outcomes in the treated community, Y_{1t} , differ from the predicted outcomes

of the synthetic control counterfactual, Y_{jt} for $j \neq 1$, constructed as a weighted combination of all the other communities, with weighting $W = (w_2, \dots, w_{J+1})$:

$$\tau_{1t} = Y_{1t} - \sum_{j=2}^{J+1} w_j Y_{jt} \quad (1)$$

Pre-intervention characteristics are represented by a $k \times 1$ vector X_j , including lagged outcome variables. The optimal weights W^* come from the solution to minimizing the sum of squared differences between treated pre-intervention characteristics and non-treated pre-intervention characteristics. These characteristics are similarly weighted by vector v_m . Thus, we are seeking to find W^* that solves:

$$\min \sum_{m=1}^k v_m (X_{1m} - X_{0m}W)^2 \quad (2)$$

The aim is to choose V such that it maximizes the predictive power of our pre-intervention characteristics. I use the V^* that minimizes the mean squared prediction error, as is standard in most synthetic control analyses ([Cunningham, 2021](#)):

$$\min \sum_{t=1}^{T_0} \left(Y_{1t} - \sum_{j=2}^{J+1} w_j^*(V) Y_{jt} \right)^2 \quad (3)$$

Abadie ([2021](#)) outlines a set of requirements for the appropriate use of synthetic control methods. (1) For the synthetic control estimator to detect changes in outcomes, the effect must be large compared to the normal volatility of the outcome. If an outcome only has a small effect or, under normal circumstances, would vary substantially, the synthetic control estimator will not be able to estimate the change. (2) There needs to be small differences in characteristics between the treated and control communities, such as convex hull conditions. That is, the communities that make up the donor pool need to be able to approximate the treated community's pre-treatment characteristics. (3) There needs to be an adequate comparison group to compare the treated community to. (4) There cannot be interference from the treatment, and (5) no anticipation. (6) There needs to be a combination of units not affected by treatment that can adequately predict pre-treatment characteristics of the

treated unit - the *convex hull condition*. (7) An adequate time horizon needs to be available for outcomes to have reasonably seen a change from their pre-period state, and (8) there needs to be adequate data on predictors and outcomes aggregated at the community level. Finally, there needs to be sufficient (9) pre-treatment and (10) post-treatment periods.

Choosing a pool of counterfactual communities needs to meet requirements 2-4. The main specification draws from a pool of 17 communities in the Northwest Territories, including every community that consistently has a population of over 100¹. I exclude Fort McPherson and Tsiigehtchic for all of my analyses. These are both on the Dempster Highway, which connects the Inuvik Tuktoyaktuk Highway to the rest of Canada, and I anticipate spillover effects in these communities. For the same reason, when considering Tuktoyaktuk as the treated unit, I exclude Inuvik. For crime outcomes, data is only available in communities with a police detachment. I exclude Whatì because it obtains an all-season road shortly after Tuktoyaktuk, during the study period.

4.2 Inference

Because I only consider a single treated unit, standard confidence intervals constructed under the assumption that large sample statistics are likely to be inappropriate. Abadie, Diamond and Hainmueller (2010, 2015 & 2021) propose inference based on permutation techniques. They set up a set of placebos by comparing all the other counterfactual units ($j = 2$ to $j = J + 1$) to the synthetic control. The synthetic control analysis is then done for each community in the donor pool, including the treated community - either Tuktoyaktuk or Inuvik - in the pool. This creates a distribution of placebo outcomes. If the treated unit falls to the extreme of these other placebo units, there is evidence that treatment has affected the outcome compared to the control.

To formally test this I once again follow Abadie, Diamond and Hainmueller (2010, 2015 & 2021) who compare the pre-treatment fit of the predicted synthetic control to the realized outcomes to the post-treatment fit. Like them I use the mean squared prediction error (MSPE) to judge the goodness of fit between the synthetic control and realized data. This is the squared difference between the predicted outcomes ($\hat{y}_t$) and actual values of those

¹Published statistics suppress data when communities have a population of less than 100.

outcomes (y_t) in time t : $\text{MSPE} = 1/n \sum_{t=1}^n (y_t - \hat{y}_t)^2$. The ratio of the post-treatment and the pre-treatment MSPE measures how much the outcome has differed from the predicted outcomes in the later period compared to the earlier one. A higher MSPE ratio means the post treatment fit is much worse than the pre-treatment fit. If the treated unit has a much greater MSPE ratio than the placebos this is evidence that the change in outcome is due to treatment. To calculate p-values for the estimated result the MSPE ratio is ranked compared to the placebo MSPE ratios. The p-value becomes the number of communities with a higher MSPE ratio than the treated community, divided by the full donor pool plus the treated unit, $J + 1$.

4.3 Robustness

As a robustness check, I create a smaller pool that only includes communities with seasonal ice roads. Many of these communities are along the route of the proposed Mackenzie Valley all-season road. This address concerns that the choice to build a road to Tuktoyaktuk might be endogenous, as these other communities are waiting for a similar change. They also provide specific information related to what would happen in the absence of a road, as they are more likely to capture shocks such as adverse weather and flight prices than communities that also have all-season road access. I find similar results between the full donor pool and the ice road community pool. The complete set of ice road community donor pool results is in Appendix A. I only include them in the main text if the differences between the two pools lead to different conclusions.

The Inuvik-Tuktoyaktuk Highway opened in November 2017, but construction began in 2014, which is likely to violate requirement 5, no anticipation. Anticipated effects are more likely to impact some outcomes more than others; for instance, impact assessments predicted road construction would create 1,086 one-time jobs ([GNWT Department of Transportation, 2010](#)), so the income and employment effects are likely to be seen before the opening of the road. Using the earlier treatment date, however, may also be inappropriate, as issues arise with calculating the mean-squared prediction error ratios if assigned treatment is either before or after the true treatment date. If the assigned treatment date is too early, the prediction may do quite well from 2014-2018 because no change has occurred, making the

MSPE ratio too low because we have overestimated the fit in the post-treatment period. Two issues arise if treatment actually occurred in 2014, but I assume treatment occurred in 2017. The first is that the MSPE in the pre-period may be too large if outcomes are already changing. Once again, this will underestimate the MSPE ratio. The second issue is that the weights on control communities may reflect a closer post-treatment fit than a pre-treatment fit. To mitigate this, I run separate analyses using both 2014 as $T_0 + 1$ when road construction began and 2018 as $T_0 + 1$, the first year the road came into year-round effect. The main results for income and employment use 2014 as a treatment year because of the anticipated job creation related to road construction. The main results for crime outcomes use 2018 as the treatment year, as this is the point where entry and exit from the community change. Results using alternative treatment times are presented in the appendix unless conclusions differ substantially, in which case they appear in the main text as well.

5 Data

I study outcomes in five categories: population, income, labour force outcomes, traditional economic activity and crime. The data is aggregated at the community level and published by the Northwest Territories Statistics Bureau. The source of the data varies by outcome. Annual population data comes from the census and annual territorial population estimates. Annual income data comes from the Statistics Canada T1 Family File. Labour Force outcomes come from the Canadian Census and the Northwest Territories Community Survey, and the Northwest Territories Community Survey is also the source for data on traditional economic activity. The Census and NWT Community Survey are each administered every 5 years. The first census year included is 2006, and the first NWT Community Survey year included is 2004. The study period starts in 2004, ten years prior to the construction of the ITH. The latest year varies depending on data availability for each outcome and ranges from 2021 to 2024. A detailed table of outcomes used in this analysis, their definitions, sources and years observed is included in Table 1.

The categories I study are linked to the community’s identified hopes and fears regarding the opening of the ITH, as well as other economic studies on the socioeconomic effects of

infrastructure development, as noted in Section 3. They also meet the feasibility requirements needed for identification in a synthetic control setting, as noted in Section 4, except for the traditional economic activity outcomes. Traditional economic activity outcomes have only one observation after the opening of the ITH. However, those living in the Inuvialuit Settlement Region consistently discuss the importance of traditional economic activity for the social and cultural well-being of the community. Suggestive evidence about these categories, even if it is not causal, is a crucial consideration when evaluating the overall effects of socioeconomic well-being in the region.

I include all outcomes as covariates to predict the synthetic control weights and include additional data that do not meet the requirements for the synthetic control estimator, but provide useful information on community characteristics that can predict outcomes. A list of covariates, their source, and the years available can be found in Table 4.

5.1 Population

Important to understanding changes in income and employment outcomes is understanding how the opening of the ITH affects population and age demographics. Figure 2a shows Tuktoyaktuk's population as a whole. From 2004-2010, the population declines, and then increases steadily after 2011. Table 2 shows significant increases in Tuktoyaktuk's population after the ITH opens, jumping from an average of 921 people before the ITH opens to 1009 after representing a 9.6% growth in population. The significance of this change is also higher than the other donor pools.

Breaking up the population changes by age also shows interesting demographic shifts. The NWT Statistics Bureau provides population estimates broken down into seven categories, from 0-4, 5-10, 10-14, 15-24, 25-44, 45-59 and 60 plus. These age categories do not directly map onto other definitions of working age populations in the published data; for instance, the low income variable in this analysis looks at low income status between 18-64, and the labour force includes the population over 15. Given the limitations from these categories, I consider a rough working age population of 15-59, which is the grouping that most closely matches the working age population in the other two categories. Figure 2d shows a share of population by those 60 and over, those 15-59 and those 14 and under. The figure shows

a compression of the share of those aged 15-59 between the older and younger groups. The population between 15-59 also increases from 2011 until 2016, but then falls and levels out, floating just above 600 people starting in 2019 as shown in Figure 2b. The over-60 population continues to rise, as shown in Figure 2c. This rise is striking when comparing the percent of the population age 15-59 in the two donor pools used in the synthetic control.

Regardless of whether or not the ITH is causally responsible for these population changes, which is discussed more in the results section, all the results need to be read in this context. A decrease in the share of those in the working age category might cause shifts in family income on its own, as those who are retired are more likely to have a fixed income, and households may be larger because they include more children. It may also bias labour force statistics. Changes in labour force statistics might be because of shifts in retirement, not changes people are making in their ‘working-aged’ years.

5.2 Labour force outcomes

Unemployment and labour force participation rate data come from the Canadian Census and the Northwest Territories Community Survey ([NWT Bureau of Statistics, n.d.-c](#); [Statistics Canada, 2001](#)). Both occur at 5-year intervals, which corresponds to either a two or a three-year interval between each observation. Because the Labour Force Survey is conducted regionally in the Canadian Territories, this is the only consistent option for community-level labour force outcomes. Each outcome reflects the labour force status of the people living in Tuktoyaktuk, not necessarily people coming from other communities to work in Tuktoyaktuk. The largest confounding factor for labour force participation and the unemployment rate in the post-treatment time period is the COVID-19 pandemic. Because of the coarse measurement of labour force variables, the three post-treatment years can be seen as the pre-pandemic observation in 2019, the pandemic observation in 2021, when varying magnitudes of lockdown orders were in place for most of the year, and the post-pandemic observation in 2024.

The average labour force participation rate is much lower in Tuktoyaktuk compared with the donor pools both before and after the opening of the ITH, as shown in Table 2. The participation rate falls before and after the ITH opens by 3.8 percentage points, which is a

larger jump than the other pools. The unemployment rate also falls, and the fall is more pronounced than the other pools, dropping 6.1 percentage points compared to 3.9 and 4.2, respectively. Looking at Figure 3, both the labour force participation rate and unemployment rate fall in 2021, which coincides with the great resignation - the period of people leaving the labour force after the Covid-19 pandemic. All pools appear to recover to close to their pre-pandemic levels by 2024. The unemployment rate falls starting in 2021 across all pools, and that fall persists into 2024.

5.3 Income

Included in the main analysis are three income variables at the census family level and three income variables at the individual level. Aggregating income in a community using multiple variables gives insight into the distributional changes in income, and some of the possible mechanisms through which income is or is not changing because of the ITH. Annual community-level family income statistics come from the T1 family file, produced by Statistics Canada and published by the Northwest Territories Statistics Bureau ([Northwest Territories Bureau of Statistics, n.d.](#)). The data includes every person who files taxes. Tax filing rates are very high in the Northwest Territories, with 89% of people aged 15 and over filing taxes in Tuktoyaktuk, 99% in Inuvik and 95% in the Northwest Territories overall. ([Statistics Canada, 2022b, 2022c, 2022d](#)). These high rates are likely because of benefits received when filing taxes, including the Northern Living Deduction, a tax deduction of at least \$11 a day per person ([Canada Revenue Agency, 2022](#)), and the Northwest Territories cost of living offset ([Canada Revenue Agency, 2017](#)). Despite the high level of income filing rates, there is still a possibility that these income statistics underestimate material well-being because of a large country food and traditional economic activity sector.

Analysis at the family level allows for distribution in family structure where household income is shared by different members. The three variables included are the percent of families earning less than \$ 35 000 a year and the % of families earning more than \$75 000 per year, and average family income, with data available from 2004-2023. Though \$75 000 a year represents the upper threshold for income in the analysis, with 28.24% of households earning this in the pre-ITH period and 42.68 % of people earning this in the post ITH-

period, this is below the market basket measure of poverty in the Inuvialuit Settlement Region for a family of two adults and two children, calculated at \$84,516 a year ([Northwest Territories Bureau of Statistics, 2025](#)). Results for household incomes above \$100 000 and median incomes are in Appendix A. These give a more complete sense of the changes in income distribution; however data available is truncated to 2012-2022, and conclusions do not change across these outcomes, therefore, I only include them for robustness instead of as main results.

The shortcomings of using only family income are that it includes both employment and transfer income and does not account for changes in family composition and demographic shifts, which likely coincide with the opening of the ITH as discussed in Section 5.1. Measurements of individual income are therefore also used, including low income status, low income status for those 18-64, and employment income. Predictions were that the ITH would create more jobs, thus bringing employment and employment income to the community. Isolating the effects on the working-age population and on employment income is therefore important to get a sense of the ITH's income through the channel of employment. Statistics Canada provides a comparative measure of low incomes, the low-income cutoff – fifty percent of the median Canadian income. The advantage of using the low-income cutoff is that it gives a sense of how well Tuktoyaktuk's low-income population is doing using a measure that adjusts for incomes – including incomes from employment and transfers – across the country. Given that prices in the North of Canada often face their own specific inflation rates, and are much higher than the rest of Canada, this is a way to control for overall income growth without relying on the Canadian CPI. It is also the outcome with the most well-defined working-age population, so we can consider how many working-age individuals are considered low income; therefore, I consider low-income status among the full population, as well as those between 18 and 64, in order to understand income changes for working-age individuals.

When looking at just the pre-treatment and post-treatment averages for these variables, as shown in Table 2, there is an overall improvement across income outcomes. Comparing this to the other two pools, though, shows a higher magnitude of growth in average and employment income, with the exception that Tuktoyaktuk's average employment income

risers more than the average ice road pool, rising by \$5 902 a year from \$32 880 to \$38 782. In contrast, the ice road communities rise only \$4 759 from \$57 013 to \$51 773. The percent of those with a low income (both the full sample and restricted age group) falls in Tuktoyaktuk. Overall incomes in Tuktoyaktuk are lower than the averages across the other pools, low income status indicators are higher, and the percent of families earning less than \$35 000 is higher, showing Tuktoyaktuk's position of lower incomes than the rest of the territory.

Figure 4 shows time series of income variables for Tuktoyaktuk, the average annual value for both the full NWT communities pool and the ice road donor pool. Across the variables, income increases in 2020, while the percent of families earning less than \$35 000 declined. The percent of those who have low income status dips in 2020 across all pools regardless of age group, then starts to rise again in 2021 and on. This rise is likely a function of COVID-19 emergency transfer payments across the country. Although the rise in employment income increases across pools during this time, the rise in Tuktoyaktuk appears much steeper, though it does not catch up with the means from the other pools.

5.4 Crime

Crime data comes from the Canadian Uniform Crime Reporting Survey (UCR), which publishes data on police reported crimes. It is compiled at the community level by the Northwest Territories Statistics Bureau in rates per 1000 population ([NWT Bureau of Statistics, n.d.-a](#)). I study crime in five broad categories: (1) traffic crimes, (2) violent crimes, (3) property crimes, (4) other criminal offences, and (5) other federal statutes. The first four categories are all violations of the Canadian criminal code. Other federal statutes include criminal violations in acts such as the Firearms Act, the Controlled Drugs and Substances Act, and the Youth Criminal Justice Act ([Department of Justice Government of Canada, 2021](#)).

Table 5 shows the average number of offences of the five main categories from 2010 to 2023 across the Northwest Territories, broken down into the top five detailed offences in each category. For violent crime, this is primarily level 1 assaults, uttering threats and level 2 assaults – assault with a weapon or bodily harm, with these categories making up 81% of

violent crimes. 82.1% of traffic crimes in the Northwest territories are the operation of a motor vehicle while impaired by alcohol. Mischief, which is the wilful damage or destruction of property, including cultural property and hate crimes, makes up 82.5% of property crimes. The most common violation in the other criminal code category is disturbances of the peace and failure to comply with orders, which make up 85.5% of violations. Cocaine trafficking and cannabis related offences pre-legalization make up 82.4% of other federal statute violations.

Table 3 shows the means of crime rates by category before and after the opening of the ITH for Tuktoyaktuk, the larger pool of eligible communities in the Northwest Territories, and the smaller ice road pool. Other federal statute violations fall in Tuktoyaktuk and across the ice road community pool, while barely changing on average across the Territory. The fall is likely caused by the legalization of cannabis in Canada in 2018. All other crime categories rise across each pool. In Tuktoyaktuk, the rise is much more pronounced than the averages of the other pools, with more than twice the increase in crime in the property crime and traffic crime rates compared to the other two pools, violent crime and other federal statutes increasing by around 1.5 times that of the full NWT pool and more than twice that of the other ice road community pool.

Violent crime

The top individual offence within the category of violent criminal code violations is level one assaults, making up 54.8% of the total crimes in the category. Level one assaults are ‘common assaults’ and are the lowest level of assault in the Canadian code. Uttering threats and level 2 assaults make up the next most prevalent violent crimes with 15.4% and 11% of total violent crimes, respectively, as displayed in Table 5. Following this are indecent/harassing communications and level 1 sexual assaults. Intimate partner violence and family violence are included in other violent crime categories in the Canadian criminal code, so this study cannot look at the effects of new road development on family violence. Tuktoyaktuk starts with a much higher violent crime rate than the averages of the other two groups from 2004-2010, but comes closer to their averages from 2010 until the road opens, as shown in Figure 5a. The violent crime rate then jumps higher than the other groups during road construction, reaching a maximum in 2021 of 385 violent crimes per 1000 population, which is relatively

high, and 200 incidents higher per 1000 than the average across the communities in the full NWT pool. This spike corresponds with the COVID-19 pandemic, after which violent crimes started to fall to almost the same levels as the other two pools in 2024.

Traffic crime

The operation of a vehicle while impaired by alcohol accounts for 82.1% of total criminal traffic violations in the Northwest Territories, and all other violations within this category occur less than 50 times per year on average across the Territory. Table 3 shows that Tuktoyaktuk sees more than three times as many traffic crimes on average after the Inuvik-Tuktoyaktuk Highway opens, whereas the control communities across the community only see a doubling. Figure 5c shows Tuktoyaktuk following the averages of the other communities in the Northwest Territories and other communities with an ice road fairly closely until 2019, when traffic crimes started to rise above the other two groups. In 2024, the traffic crime rate halves from 165 incidents per 1000 people to 84.

Property crime

Property crime is the category with the most violations across the Territory, with an average of just under 11,000 incidents annually. Mischief is the leading offence in this category, accounting for 82.1% of incidents. It includes the destruction of property and interruption or interfering with the legal use of property ([Legislative Services Branch of Canada, 2024](#)). Total non-vehicle theft under \$5 000 makes up 8.4% of violations, breaking and entering (4.8% of property violations), theft of a motor vehicle and fraud make up less than 2% of violations in this category each. Both the results from Table 3 and Figure 5b show an increase in property crime from 2017 to 2021. After 2021, property crime appears to level off, unlike violent crime, traffic crime and other criminal code violations that start to descend after 2021.

Other criminal code violations

Disturbing the peace made up 71.2% of other criminal code violations. Offences relating to the administration of law and justice make up the next most offences in each category, with

failing to comply with orders accounting for 14.3% of violations, breach of probation 5.5% and other violations against the administration of law and justice 2.2%. The last included offence is uttering threats to property or animals, which accounts for 1.3% of offences in this category. When looking at how other crimes progress over time in Figure 5e, this is because of a jump in other crimes in 2020 and 2021, which falls back to being close to the average across the two control groups in 2023 and 2024.

Other federal statutes

Most other federal statutes fall under the Controlled Substances Act. A significant change to this act occurred during the study period when Canada legalized cannabis nationwide in October 2018 ([Government of Canada, 2018](#)). Because cannabis legalization occurred across Canada, it affected all of the donor pool control communities at the same time that it affected Tuktoyaktuk. Therefore, the synthetic control should still adequately represent what would have happened to the treated communities in the absence of the Inuvik-Tuktoyaktuk Highway. The largest share of federal statute violations was trafficking cocaine, making up an average of 28% of violations, followed by possession and trafficking of cannabis pre-legalization, making up an average of 23.1% and 13.6% of violations, respectively. Other federal statutes and the Youth Criminal Justice Act make up 10.1% and 7.6% of violations on average. Both Table 3 and Figure 5d show that, on average, Tuktoyaktuk has a lower rate of other federal statute violations than the control groups and experiences a decline after the Inuvik-Tuktoyaktuk highway opens. This decline persists while the rest of the Territory sees an increase in other federal statutes starting in 2022.

5.5 Traditional economic activity

The Government of the NWT describes traditional economic activity as “localized economies grounded in traditional practices and abundant natural resources” ([Tourism and Investment Industry, n.d.](#)). It is an important measurement of both cultural and material well-being for Inuit, and links to understandings of well-being for both Indigenous and non-Indigenous settlers in circumpolar regions, as it provides a means of connecting with nature and culture

– both determined to be important across the Arctic and sub-Arctic by circumpolar studies on well-being ([Einarsson, Young, Larsen, & Nilsson, 2004](#)). One of the unique features of the NWT community survey is that it incorporates specific questions on traditional economic activity. The NWT community survey takes place every 5 years, and as such, the pre and post-period outcomes are very minimal. Readers should view the results for these outcomes as suggestive. Running this analysis without including them, however, would underestimate the effects of the ITH on well-being, as the traditional sector is meaningful for both food security and cultural connection.

The study includes three traditional economy outcomes: the percent of the community that trapped, the percent of the community that hunted or fished, and the percent of households that obtained 75% or more of their meat from country food sources. Country foods include food obtained from local land-based activities. The alternative is store-bought meat imported from the South. Participation in these activities is high in the Northwest Territories, with approximately 53% of people hunting or fishing, 37% of people obtaining 75% or more of their meat from country food sources and 13 to 14% of people trapping, as shown in Table 3. In Tuktoyaktuk, there is more fishing and hunting, with an average of 60.21% of people saying they hunted or fished before the ITH opened and 56.32% after. Before the ITH opened, 7.12% of people living in Tuktoyaktuk trapped and 5.97% of people after – about half of the territorial averages. Fewer people consume most or all of their meat from country food sources, though this number rises from 31.83% of the community before the ITH opened to 39% of the community. Important context for the consumption of country foods is the Inuvialuit Regional Corporations’ Country Foods Processing initiative that redistributes country food from hunters to community members who cannot get out on the land ([Inuvialuit Regional Corporation, 2025](#)). This redistribution is meant both as a food security initiative and an income-generating initiative for harvesters ([Brown, 2024](#)).

Figure 6 shows the time series for the traditional economy variables in Tuktoyaktuk and the other two pools. The infrequency of the data means the ability to interpret trends associated with time in general or the opening of the ITH is minimal. However, the percent of the community that obtains 75% or more of their meat from country food sources steadily increased in Tuktoyaktuk over the study period, while falling and then

rising again in the other two pools. The percent of the community who hunted or fished rose across all geographies from 2008 to 2013, then fell in 2018 and appeared to level off in 2023. Tuktoyaktuk appears to follow a similar trend to the other ice road communities when it comes to the percent of the community who trap; however, where both see a fall in the percent who trap in 2018 across the territory, this rose.

5.6 Covariates

The pre-intervention characteristics – also called the covariates in the synthetic control literature – represented by the vector X in equations 2 and 3 include the pre-treatment mean of the outcome studied, all pre-period data for the additional studied outcomes, as well as additional data that does not meet the requirements for synthetic control. These covariates include variables with low magnitudes (deaths by suicide), variables with insufficient post-treatment data (prices), and variables where the anticipated time horizon of the effect of the road is unlikely to be realized at the time of this analysis (high school graduation rates, housing quality and the percent of people who speak an Indigenous language). A list of non-outcome covariates, their sources and the years available is given in Table 4

The preferred specifications for each outcome use all of the available Northwest Territories as control units. Preferred treatment time is decided ex ante by variable category. If it is anticipated that a category of outcomes would be affected by construction, 2014 is used as the preferred treatment year; if it is not, 2017 is used. The minimum MSPE is used to decide between level or demeaned data, and whether the covariates include only the outcome mean or a broader set. Because Ferman and Pinto (2021) propose demeaned data as a solution to poor treatment fit, if the treatment fit is worse in the demeaned analysis, I will use level data for the main specification. Most of the data is either in rates or percentages, so it has in essence already been normalized. Similarly if the outcome is best predicted by past values of itself in the pretreatment period, and using other covariates and the outcome mean does not improve the MSPE, only past values of the outcome will be used as a covariate. Themes across specifications are mentioned in the main results section, presented here. All results - across specifications - are presented in Appendix A.

5.7 Population

Figure 7a shows the preferred specification for the total population and the population between 25 and 60, roughly translating to the working age population.

The total population is higher than predicted for the preferred specification, using all available NWT communities as controls and starting the treatment date when the road opens in 2017. These results are not significant, with a p-value of 0.44.

Tuktoyaktuk has seen a rise in population, but there is no evidence here to say that it changed from what it would have been if the ITH had not been built. A higher than predicted change in Tuktoyaktuk's population persists across specifications, with the realized values consistently higher than the prediction. However, these results are insignificant throughout specifications; in eight of the sixteen different analysis presented in Appendix A. Tuktoyaktuk has the lowest MSPE in the post period of all the placebos, and therefore has a p-value of 1.

When considering only the working age population - those between 25 and 60 - the prediction of population from the preferred specification appears to closely follow the predicted outcomes until 2023-2024, with a slight rise thereafter. The p-value for this specification is 0.56. Across specifications, there are no statistically significant results. The prediction also does not consistently fall either above or below the realized outcomes. These results, similar to the results for the total population, do not indicate a change in the working-age population due to either the construction or opening of the ITH.

Though these results are insignificant, the population dynamics, even if not affected by the road, are important in understanding the dynamics of the other outcomes. A rise in population overall with no rise in population in working age individuals needs to be considered when interpreting family income and labour force participation rates.

5.8 Labour force

Construction of the road was predicted to positively effect local employment, and thereby income, so 2014 is the preferred treatment time for labour force and income results. As in the other analysis, the preferred specifications use all available NWT communities as controls. Labour force results are presented in Figure 8. For all labour force outcomes, using the

outcome as the only predictor yields a lower MSPE in the pre-period, and this is chosen as the preferred specification.

In the preferred specification, labour force participation trends lower than predicted values, except in 2019, where the labour force participation is higher than predicted. The p-value is 0.059, which is the most significant result this analysis can obtain. Similar results occur across the specifications that include the full NWT sample. The results that only include the Ice Road communities are less significant, and the realized values are lower than predicted. Though these results are statistically significant, the interpretation of the change in sign in 2019 is not straightforward. Thus, the significance in this context should not be thought of as a change in mean in either the positive or negative direction, but a change in the predictive power of the synthetic control.

The synthetic unemployment rate is not significantly different from the realized outcomes in any of the specifications, and the preferred specification has a p-value of 0.71. This means there is no evidence in this paper that either the construction or opening of the ITH influenced unemployment rates in the hamlet.

5.9 Income

Impacts anticipated that construction would bring jobs into the community, therefore the preferred specification for all the income variables is 2014. Even when 2017 is used as the treatment time, it appears as though the fit diverges from a close link with the prediction in 2014, and the sign does not change with a changed treatment date, though the power of the analysis does. All income data is nominal. Inflation varies substantially community to community in the Northwest Territories, so comparing nominal income data is easier to interpret than real data. There is also not a consistent annual measure of community prices, so real prices in the communities and real incomes are difficult if not impossible to calculate.

5.9.1 Average and median incomes

Both median family and average family income are generally lower than predicted across specifications, but not statistically significant, with one exception listed below. Regardless

of what donor pool is used to create the synthetic control, predicted incomes rise after the construction of the ITH. Realized outcomes, on the other hand, either do not rise or rise at a slower rate than the prediction.

The results for Average Family Income with 2014 as a treatment date and other ice road communities as the donor pool show as-significant-as-possible results, though they would still be deemed insignificant. Because of the small donor pool, the lowest p-value that can be obtained is 0.167.

The results for median income in 2020 and 2021 are an exception to the rule that family incomes are lower than predicted. Median income rises above the prediction in 2020 and 2021, but this is likely linked to the COVID-19 pandemic and transfers such as CERB are likely large influences in this period. For all other years, they fall below the synthetic control prediction.

Median individual income is consistently lower than predicted across specifications. When using the full NWT donor pool, none of the results are significant, but when limiting the sample to only ice road communities, Tuktoyaktuk's results show the MSPE ratio being consistently the most extreme, or second most extreme. Like the results of average and median and family income the limit to the number of controls this only puts the p-values at 0.167 and 0.33.

5.9.2 Individual employment income

Employment was the mechanism by which the ITH was predicted to increase incomes. Analyzing individual employment income, therefore, is particularly useful to isolate the anticipated effects of the ITH on income. This is particularly true given the change in demographics, with a higher percent of non-working-aged individuals in the community, and the transfer income changes around the COVID-19 pandemic and programs such as the Community Emergency Response Benefit (CERB). Across specifications, there is no trend above or below the synthetic control prediction of employment income, and none of the results are statistically significant. This analysis provides no evidence of a change in average employment income due to the opening of the ITH.

5.9.3 Income distribution

Income distribution is measured in two categories, families making less than \$30 000 and families making more than \$75 000. These are crude measures of income distribution in Tuktoyaktuk. Families making more than \$75 000 should not be viewed as high income families, as the local market basket measure of poverty is \$84 516 for a family with two adults and two children in the Beaufort Delta region of the NWT ([Northwest Territories Bureau of Statistics, 2025](#)). Results with different income distributions were available for a truncated time frame, but they showed poor pre-treatment fit and no changes in conclusions, so are not included in this analysis.

Neither of these distributional categories show trends either above or below the prediction. In the preferred specification for the percent of families making less than \$30 000, shown in Figure 10, Tuktoyaktuk's MSPE ratio is 3 of 17, giving it a p-value of 0.17. Some specifications are significant, but most are not, and given that there is no clear trend above and below the prediction a significant conclusion would only lead to a conclusion that the predictive power is worse than the control communities, not that those who have made less than \$30 000 has changed in a positive or negative direction. For the preferred specification of those families making more than \$75 000, Tuktoyaktuk's MSPE ratio is 13 of 17, with a p-value of 0.76, and none of the specifications show significant results.

5.9.4 Low income status

Measuring the percent of those who are considered to have low income status is a useful measure of income distribution. Low income status highlights the effect of the ITH on those with the lowest income. Low income status also provides reasonable comparisons across Canada that nominal or real income do not as it is calculated as 50% of the median Canadian income. Like the income distribution results these do not show clear trends above or below predictions across specification and the results are not significant. This is true when considering people with low income status across ages, as well as isolating only those who are working aged.

5.10 Crime

For all crime variables, 2017 is used as the preferred treatment date. There are intuitive reasons to use either 2014 or 2017 as a treatment date, however most movement beyond the synthetic control prediction happens after the road has opened in 2017, regardless of which treatment date is used in the analysis. Preferred specifications for crime results are displayed in Figures 13 and 14.

The total of all crimes committed is persistently higher than the synthetic control prediction as shown in Figure 13a, with a spike in 2021 and a p-value of 0.1764. This trend persists across specifications, but the analysis is always insignificant, and in the alternative specifications, less significant than 0.1764.

Traffic crimes show the clearest deviation from the synthetic control prediction across the analyses. Traffic crimes start to rise after the ITH opens, though in some cases, the first two years of the analysis show a synthetic prediction slightly higher than the realized outcomes, with the synthetic prediction also rising in that period. After 2020, traffic crimes in Tuktoyaktuk rose sharply above the prediction, falling closer towards it in 2023. Tuktoyaktuk has the second most extreme MSPE in the preferred specification, putting the p-value at 0.1176 as shown in Figure 13e. This persists across the specifications that use 2017 as a treatment date and the full set of NWT communities in the donor pool. Tuktoyaktuk has the most extreme MSPE ratio when other ice road communities are used in the donor pool and treatment is assigned to 2017, putting the p-value at 0.2. The specifications that use 2014 as a treatment date are generally less significant, with the exception being the analysis that uses the full NWT donor pool and the outcome as the only covariate. Full results can be found in Appendix A.

Violent crime and other criminal code violations follow similar patterns across specifications. In the main specifications, both violent crime and other criminal code violations follow the synthetic control prediction for 2018 and 2019, rise above it in 2020 and 2021, then fall below the prediction again in 2023 and 2024, with a p-value of 0.64 for violent crime and 0.529 for other criminal code violations. This trend is relatively consistent across specifications, with a close fit in the years immediately following the ITH opening, a spike around the

COVID-19 pandemic and a fall below prediction in either 2023 or 2024. Tuktoyaktuk tends to fall in the middle of the distribution of MSPE ratios among the donor pools for both crime categories. This analysis provides no evidence that the road caused a rise or fall in violent crimes or other criminal code violations over this period.

Property crime is higher than predicted across specifications, but none of the results are significant. This could be a result of the power of the test, but looking at the placebo distribution, a number of other communities have quite extreme post-treatment fits compared to the pre-treatment fit. It is possible that there was a structural change across the territory that led to higher MSPEs in the post-treatment than in the pre-treatment

Other federal statutes fall throughout the study period in Tuktoyaktuk, and drop to less than 10 incidents per 1000 people after the ITH opens. This is much lower than the synthetic prediction, which notably increases to more than double the predicted amounts by the end of the study period. The main specification has a p-value of 0.176. The only specification with a lower p-value is when 2017 is used as a treatment, all other NWT communities are used as controls in the donor pool, and the data is demeaned. In this specification, Tuktoyaktuk has the most extreme MSPE distribution with a p-value of 0.0588.

5.11 Traditional economic activity

Data for participation in the traditional economy is collected from the NWT community survey, including observations for the years of 2003, 2008, 2013, 2018 and 2023. This means that the pre-treatment observations go until the year before construction, and the post-treatment observations start the year the road was open for full-year use. Treatment is then the period between the start of road construction and the opening of the ITH for the traditional economic activity variables, and no choice has to be made between those two treatment dates. None of the results for any traditional economic activity variable are significant, however. The results are still included in order to round out an understanding of impacts as they relate to community well-being, as indicated by those living in Tuktoyaktuk and can be found in Figure 15.

Estimates for those who hunted and fished in the last year are consistently below the prediction when using all other communities in the NWT as a donor pool. This is the only

traditional economic activity variable that sees any distinct deviation from the synthetic control prediction; however, it is not significant. Neither the variables for the percent of those who get most or all of their meat from country food sources nor those who have trapped in the previous year follow a trend either above or below the predicted outcome across specifications, and none of the results are significant.

6 Discussion

The new Inuvik-Tuktoyaktuk highway has sparked hopes that it will lead to more local economic opportunities. Much of the past economic literature suggests that communities benefit from increased road access, which is why there is advocacy to increase road infrastructure worldwide. The Inuvik-Tuktoyaktuk Highway has not realized these benefits. I find non-positive impacts on income and employment outcomes, as well as mixed results on crime, with particular increases in traffic and property crimes. Connecting a community with overland infrastructure may not be enough to boost economic conditions. Demographic shifts, changes in the local economy's structure, the COVID-19 pandemic, and other economic forces may complicate achieving positive results. Efficiency gains in transportation may be because of the need for fewer jobs in the community.

The average family income declines with the start of construction of the ITH, and those considered to have low income status in the community increase, both overall and for a subset of the community between ages 18 and 64. The changes observed are not statistically different from zero, with most point estimates indicating an overall negative realization of incomes compared to the prediction. When considering employment income alone, no effect is found with the construction and opening of the ITH.

Labour force outcomes echo these non-positive results. The labour force participation rate does not trend higher or lower than the predicted outcomes. Unemployment, however, appears higher than predicted, though not significantly.

After the road opened, there was a rise in the share of people over 60 in Tuktoyaktuk, while the population between 15 and 60 remained relatively stable, as shown in Figure 2. The higher population of those over 60 leaves open the possibility that people can reside in

Tuktoyaktuk later in life than they previously could, possibly even into retirement. If elders have more choices of where to live, the fall in labour market outcomes may point to a positive outcome related to more choices of where to live. Those who are younger and of working age may decide to relocate elsewhere, rather than in Tuktoyaktuk. It is also possible that a change in family structure may mean that some families also require less income. The income results hold when considering the difference between single-headed families and couple-led families as well, but this does not account for the number of dependants in a household.

Regardless of demographic shifts, the rise in low-income status among individuals in the 18- to 65-year-old age group, along with the lack of change in employment income, follows a non-positive narrative in labour force and income results. Jobs created in Tuktoyaktuk might not mean people in Tuktoyaktuk are the ones who work at the new jobs. People might come in from outside the community to work temporarily, muting local employment effects. It is possible that only a few people benefited from the road opening, and individual benefits were not enough to shift community averages. Unemployment is high in Tuktoyaktuk, and the labour force participation rate is lower than the Canadian average. A low attachment to the labour market may mean that economic changes have had little effect on the ground, and small changes in the economic environment might not be reflected in the averages across the community. It is also possible that, although the ITH might lead to overall efficiency for the economy, this efficiency may come at the cost of jobs. Ice road creation and air transportation are two industries that no longer exist in Tuktoyaktuk, and the other economic opportunities may not have been enough to fill the gaps left by the jobs lost in these areas.

Government predictions of job growth were in oil and gas exploration and tourism. There was a tourist rush when the road first opened, but two summers after its opening, the COVID-19 pandemic struck, which, as stated above, led to a shutdown of tourism in the Northwest Territories. As the COVID-19 shock fades, the community may better capture economic benefits from the new tourist traffic. The ban on offshore oil and gas drilling from 2016 to 2023 meant that the potential economic benefits from this industry were likely not realized. This might not be a problem in this analysis, though, as the COVID-19 shock and ban on offshore drilling also affected the donor pool. COVID-19 affected the entire territory, and the ban on offshore drilling would have impacted other Beaufort Delta communities, which

comprise a significant portion of the prediction for many outcomes in the synthetic control.

Tourism and oil and gas exploration are likely to impact land-based traditional economic activity opportunities negatively. If there is less employment in these sectors than predicted, it may be a positive for the community if there are more opportunities for traditional economic activity.

The Inuvik-Tuktoyaktuk Highway made it easier for people to move in and out of the community, including people who already lived there and people who had never been to the community before. It is unsurprising then that this openness would lead to changes in criminal violations.

The least surprising crime results found in this analysis is that traffic crimes have significantly increased since the road's opening. A new road means more linear kilometres to drive, making traffic crimes more likely. DUIs are also more likely to occur when moving from one community to the next and are less likely without all-season road access because of the short distances between places in Tuktoyaktuk.

A rise in property crime, driven by mischief offences across the territory, is also unsurprising. Given the large influx of tourists reported coming into the territory, more people can damage property, and more are coming through the community without connection to it.

Given comments about the fear that a new road would increase drug trade to Tuktoyaktuk, the decline in 'other federal statutes' - which are driven by violations of the Controlled Substances Act - is surprising. There are a few possible drivers of this. All of the crime data used in this analysis is police-reported crime. New overland access to the community might make it easier for controlled substances to flow into the community without detection. The fall in these crimes could represent difficulty in enforcement, not lower amounts of drugs in the community. Another possible mechanism comes from the demand for controlled substances. Demand for illegal access to controlled substances might decline with a new road. Improved community mental health, more choices in activities and more access to legal substances might lead to a decline in demand for illegal substances. The Inuvik-Tuktoyaktuk Highway could open up opportunities for bringing more alcohol into town, which serves as a substitute for other controlled substances. There are local limits on

how much alcohol someone can bring into Tuktoyaktuk at one time, and the road may make it easier to facilitate a flow of alcohol into the community.

Another surprising feature is that though there is a rise in property crime, violent crime does not increase. Paired with the decline in ‘other federal statutes,’ this suggests a change in the structure of crimes committed compared to an overall increase.

7 Conclusion

Often, infrastructure is seen as a panacea for social and economic development in remote communities. This research indicates that the effects of the Inuvik-Tuktoyaktuk Highway are not ubiquitously positive. In the case of the Inuvik-Tuktoyaktuk Highway, there is no evidence of positive effects on income and labour force outcomes. No statistically significant changes in violent crime, a fall in drug-related crime and offences like the disturbance of the peace would be considered a positive thing for a community. However, rising property crime, driven by mischief offences, is likely to be considered negative, and increases in traffic crime, though seemingly inevitable, create more risk for community members.

The mixed results around crime and the non-positive and not statistically significant results around income and employment paint a picture of community change that is neither wholly positive nor wholly negative. There have been changes in community safety, with a fall in other federal statutes - likely driven by Controlled Substance Act violations, and a rise in property and traffic crimes. Non-positive labour market and income outcomes, with high tourist numbers in the summer, suggest a change in the local economy but a change that might not provide positive economic benefits to the majority of the community. The Inuvik-Tuktoyaktuk Highway, therefore, might not give sweeping positive socio-economic benefits to Tuktoyaktuk but instead relates to a complicated set of changes, some anticipated and some not.

Everyone received the COVID-19 shock, but there may be something specific to the interaction of road and COVID-19. This could be an anticipation of new economic opportunities from openness that failed to materialize because of travel restrictions, compared to other communities who were not anticipating new changes to openness in the

same way. In a sense Tuktoyaktuk had to face the shock that was COVID on the economy that existed, as well as on the economy they were anticipating and starting to build, whereas the other communities had to only face the shock to the economy they had, and not a new potential economy relying on openness. The volatility of new economic opportunity may have been hampered by the pandemic more than established economies.

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8 Figures

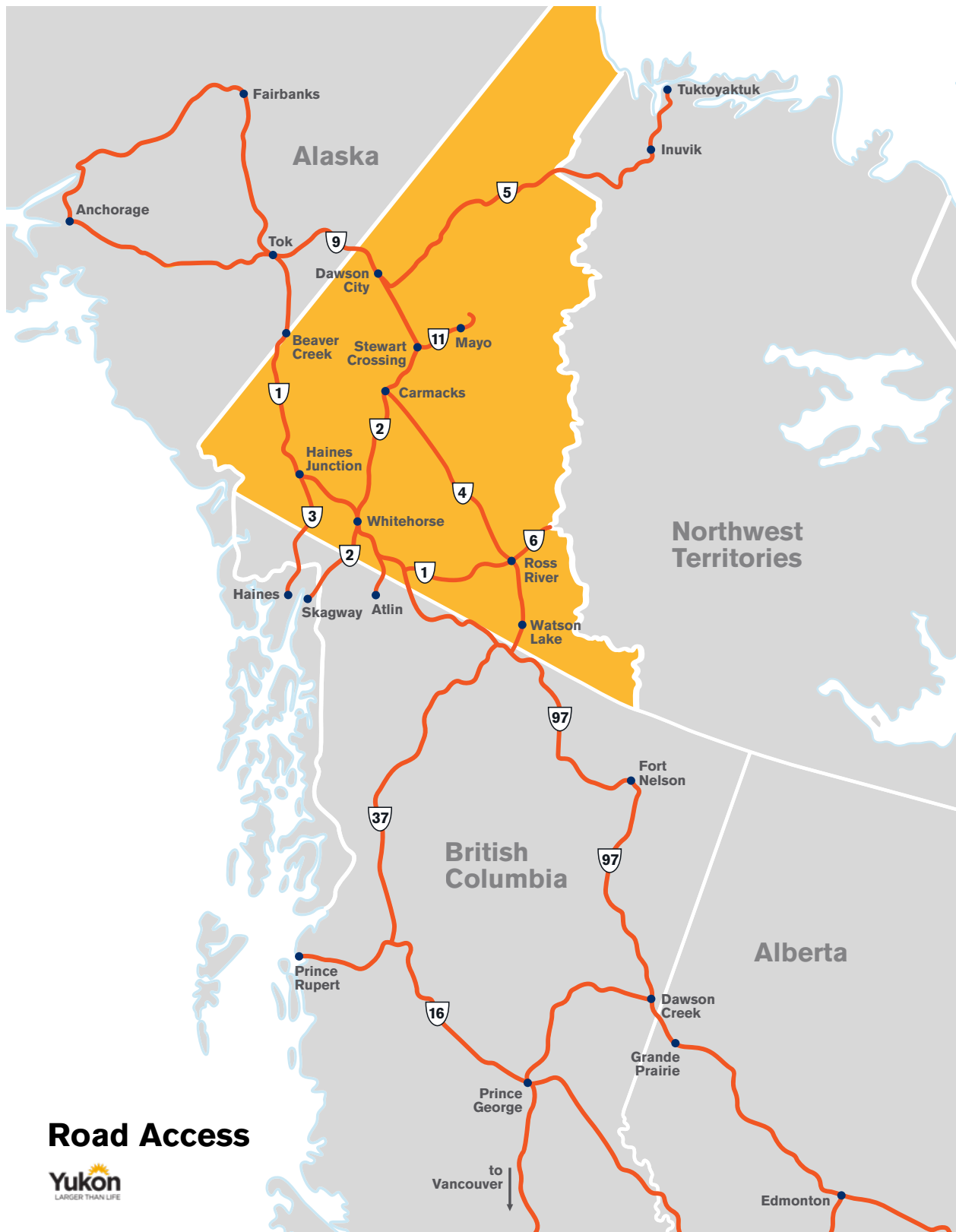
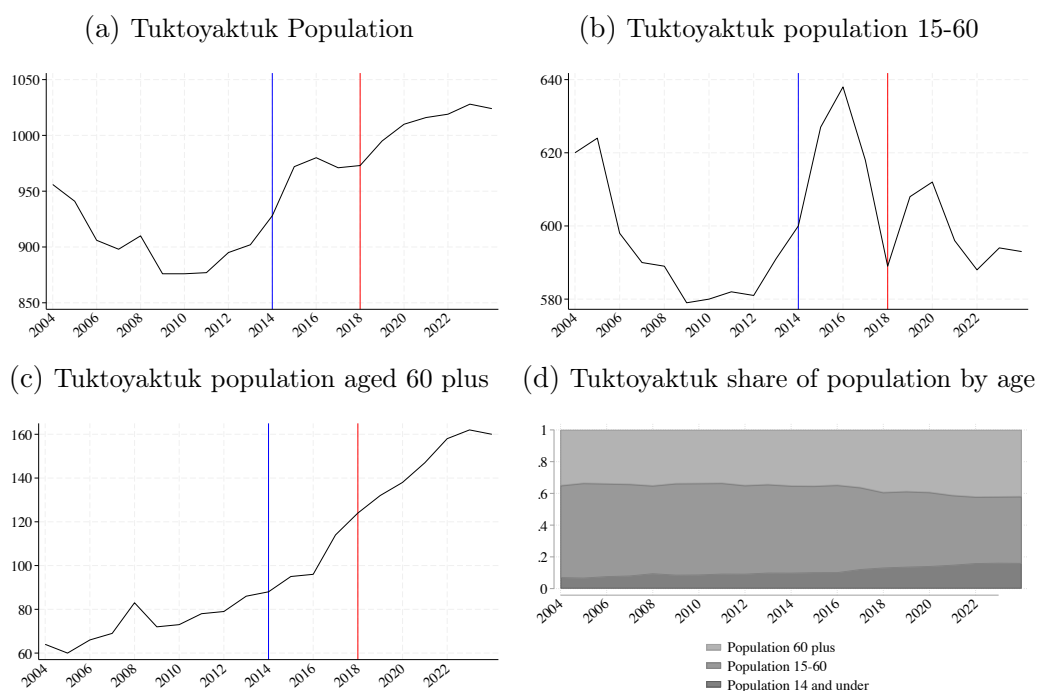


Figure 1: Road Connections to Inuvik and Tuktoyaktuk ([Tourism Yukon, 2017](#))

Figure 2: Summary time series plots population



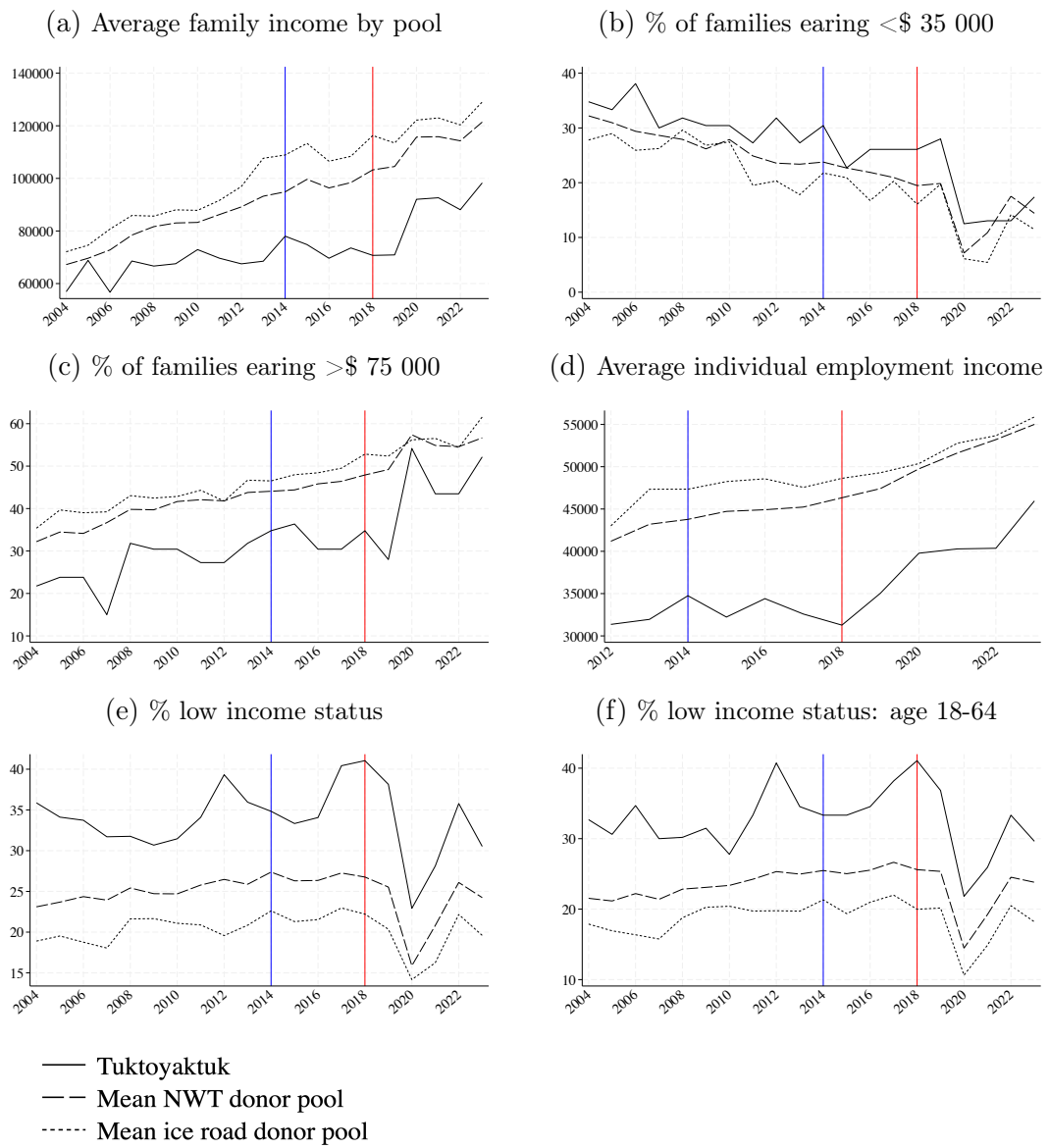
Notes: Annual time series plot of population. Population estimates come from the Northwest Territories Bureau of Statistics. The red line at 2018 indicates the first year the ITH was open. The blue line at 2014 indicates the start of construction.

Figure 3: Summary time series labour force outcomes by pool



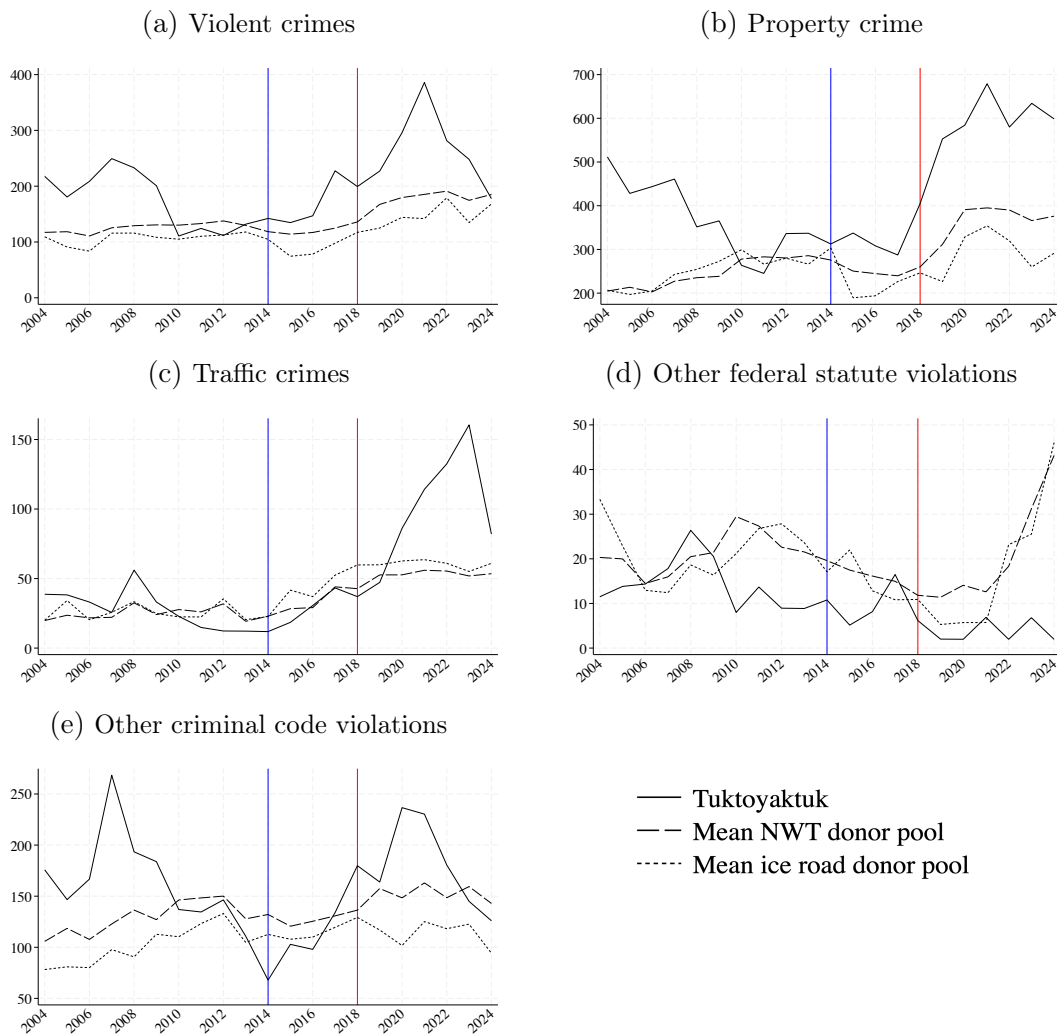
Notes: Annual time series plot of labour force participation rate and unemployment rate. The labour force is those who are 15 years and older who are either employed or unemployed. The unemployment rate is those who are unemployed within those who are part of the labour force.

Figure 4: Time series plots of family income outcomes by pool



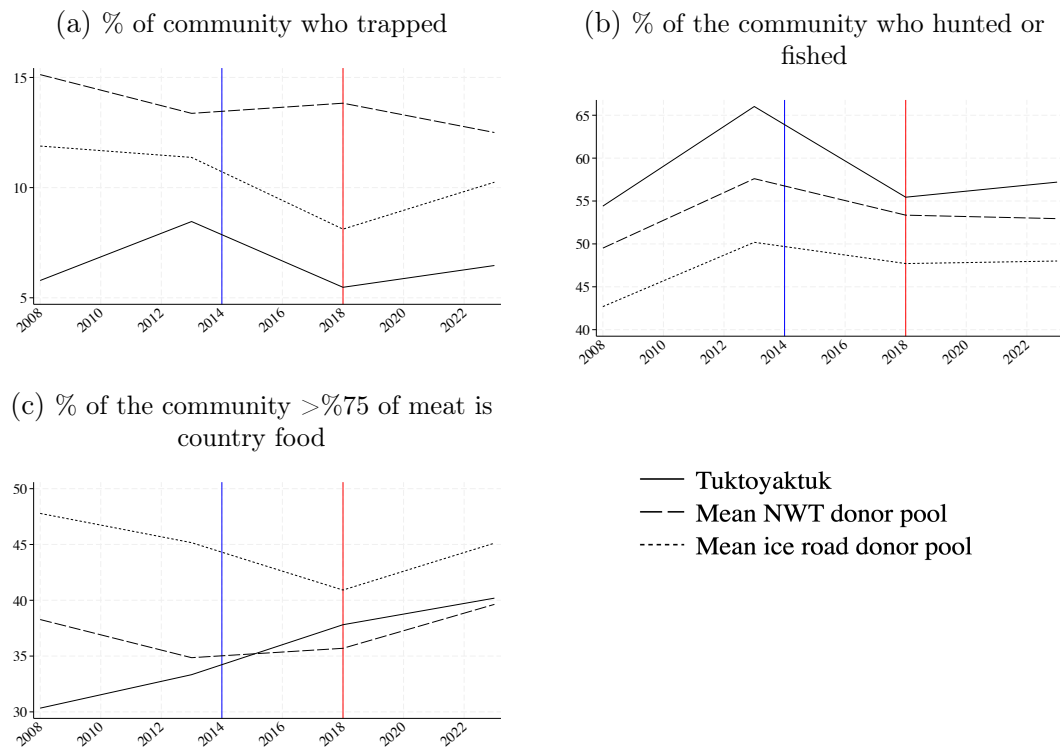
Notes: Annual time series plot of income variables. All income is in nominal Canadian dollars. The % low income status is the percent of the community that receives less than 50% of the median Canadian income. The blue line at 2014 indicates the start of construction. The red line at 2018 indicates the first year the ITH was open.

Figure 5: Time series plots of crime by pool



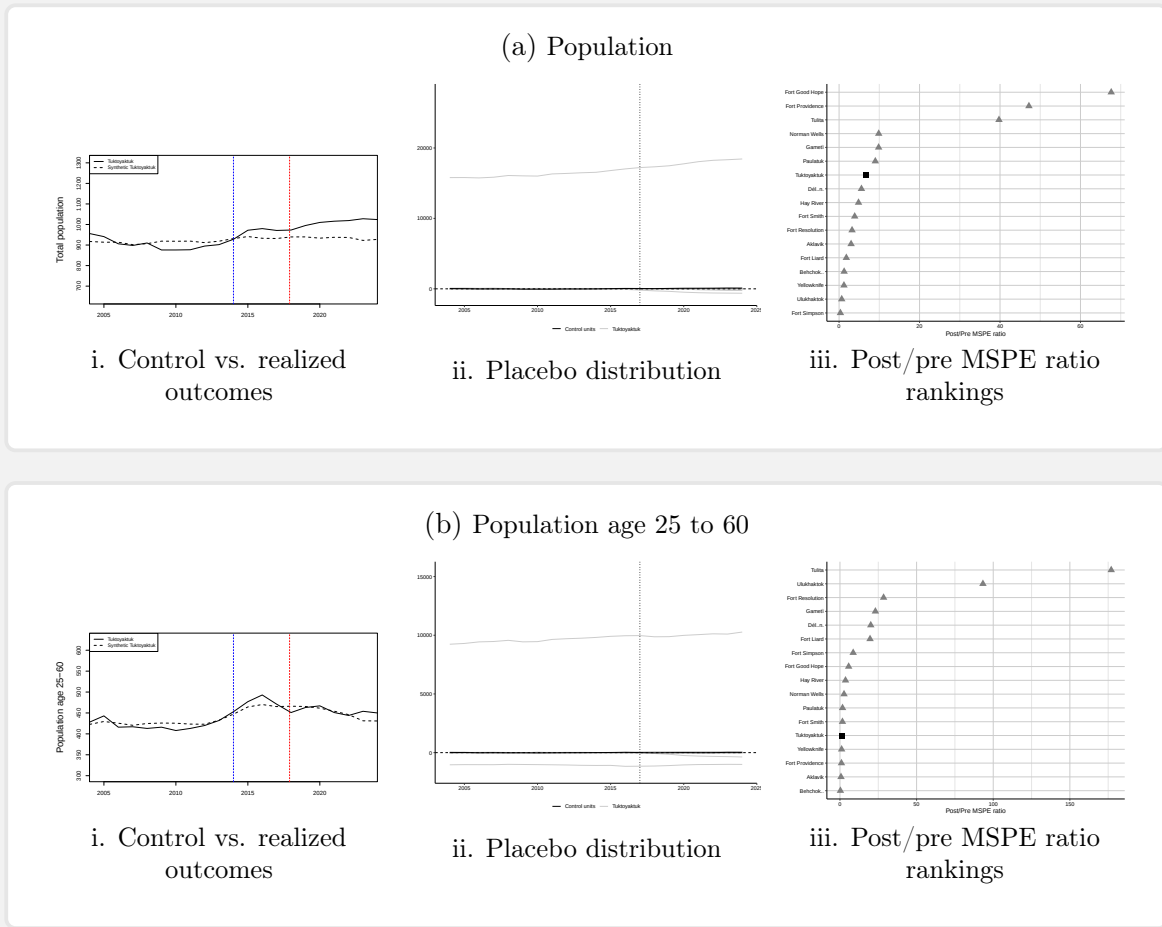
Notes: Annual time series plot of crime. Outcomes are in rates per 1000 population.

Figure 6: Time series plots of traditional economic activity by pool



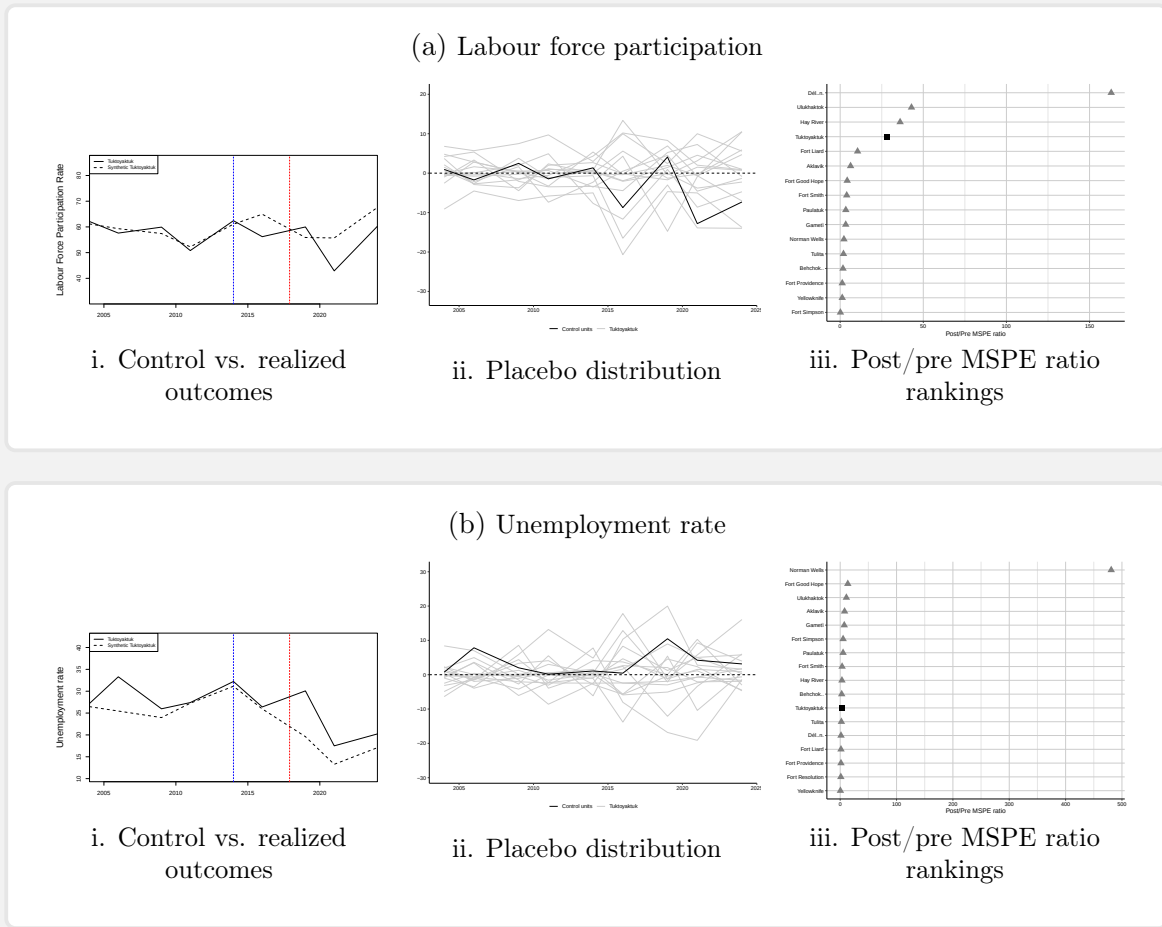
Notes: Annual time series plot of crime. Outcomes are in rates per 1000 population.

Figure 7: Population results – full NWT pool



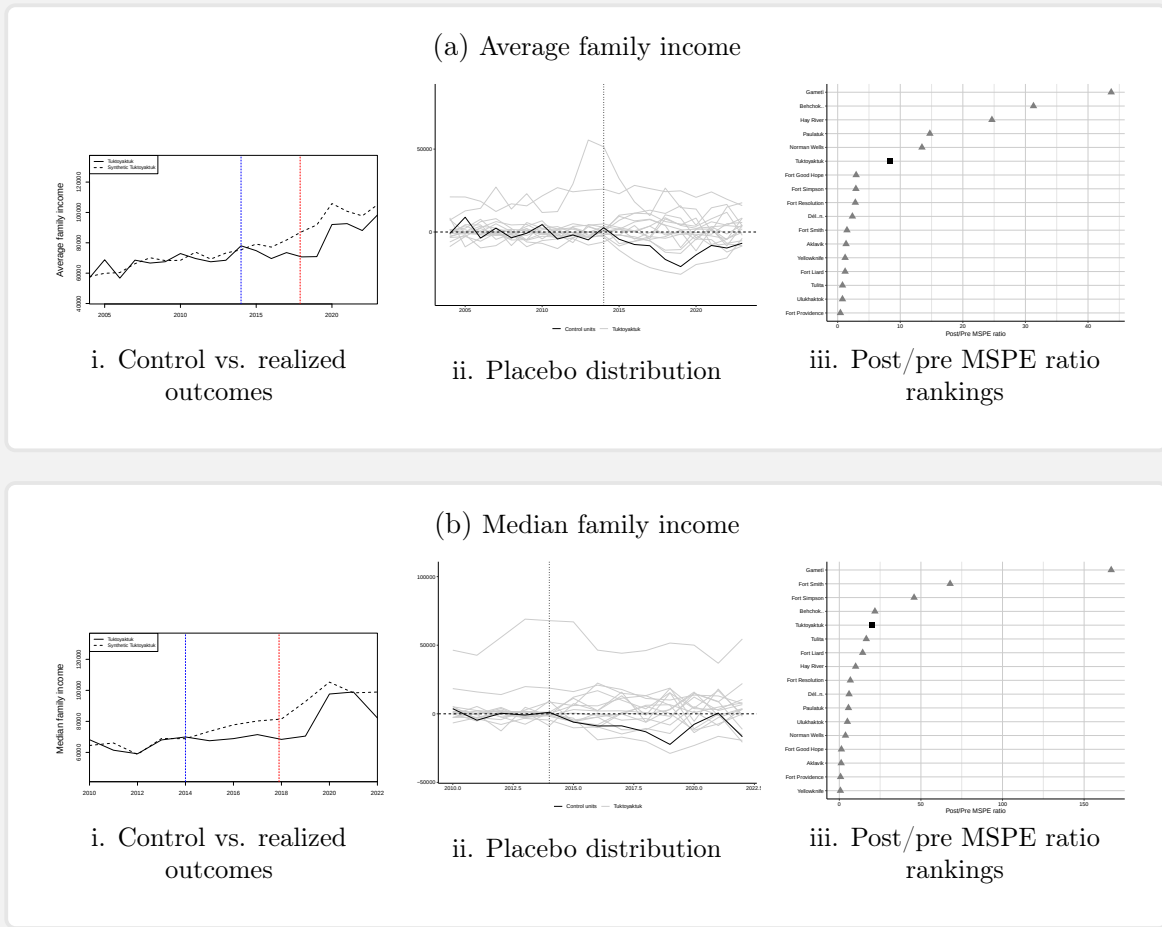
Note: The treatment year in the preferred specification for population outcomes is 2017. The full set of covariates is used in determining the synthetic control. Pre-period optimization is from 2004-2014. The donor pool includes Northwest Territory communities with available data and no anticipated spill overs. Blue line in the control vs. realized outcomes figures show start of construction in 2014 and red line shows the opening of the road in November 2017.

Figure 8: Labour force results – full NWT pool



Note: The treatment year in the preferred specification for labour outcomes is 2014. The full set of covariates is used in determining the synthetic control. Pre-period optimization is from 2004-2014. The donor pool includes Northwest Territory communities with available data and no anticipated spill overs. The blue line in the control vs. realized outcomes figures shows the start of construction in 2014, and the red line shows the opening of the road in November 2017.

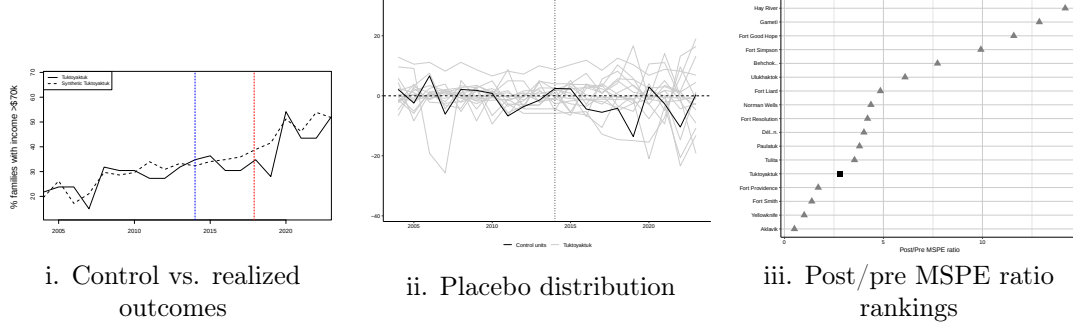
Figure 9: Family income results – full NWT pool – 2014 treatment



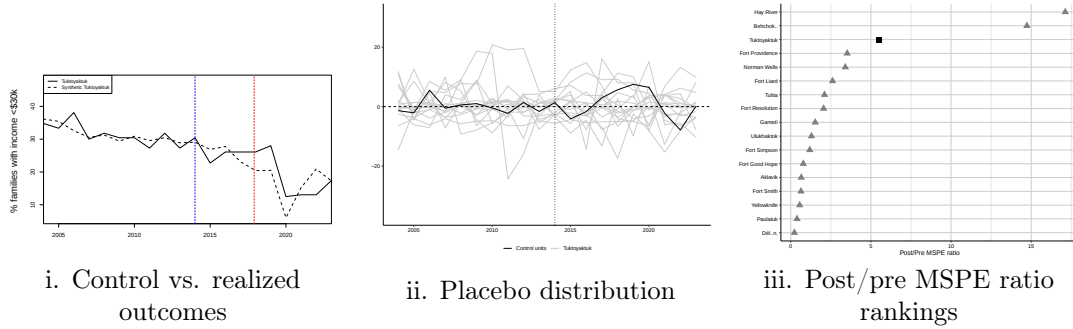
Note: The treatment year in the preferred specification for income outcomes is 2014; however, due to limited data in the pre-period, results for average employment income with both 2014 and 2017 treatment dates are used. The full set of covariates is used in determining the synthetic control. Pre-period optimization is from 2004-2014. The donor pool includes Northwest Territory communities with available data and no anticipated spill overs. The blue line in the control vs. realized outcomes figures shows the start of construction in 2014, and the red line shows the opening of the road in November 2017.

Figure 10: Family income results – full NWT pool – 2014 treatment

(a) Percent of families making more than \$75 000 a year

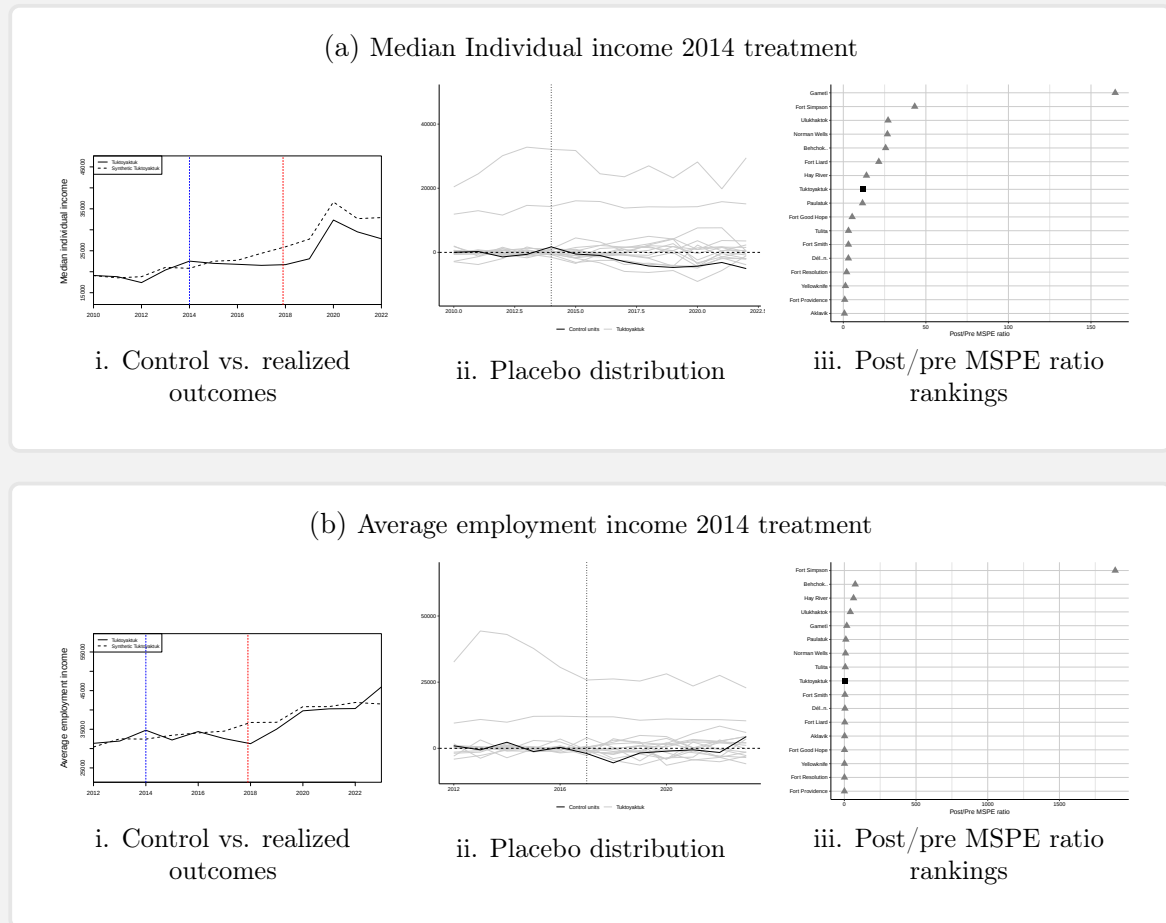


(b) Percent of families making less than \$30 000 a year



Note: The treatment year in the preferred specification for income outcomes is 2014; however, due to limited data in the pre-period, results for average employment income with both 2014 and 2017 treatment dates are used. The full set of covariates is used in determining the synthetic control. Pre-period optimization is from 2004-2014. The donor pool includes Northwest Territory communities with available data and no anticipated spill overs. The blue line in the control vs. realized outcomes figures shows the start of construction in 2014, and the red line shows the opening of the road in November 2017.

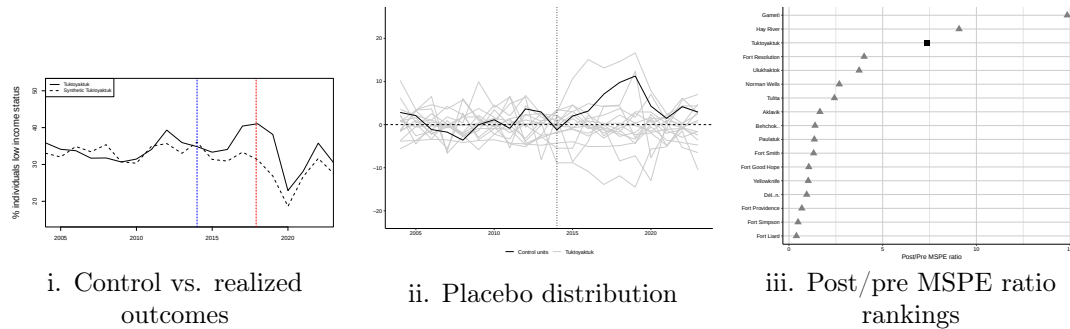
Figure 11: Individual income and employment income results – full NWT pool - 2014 treatment



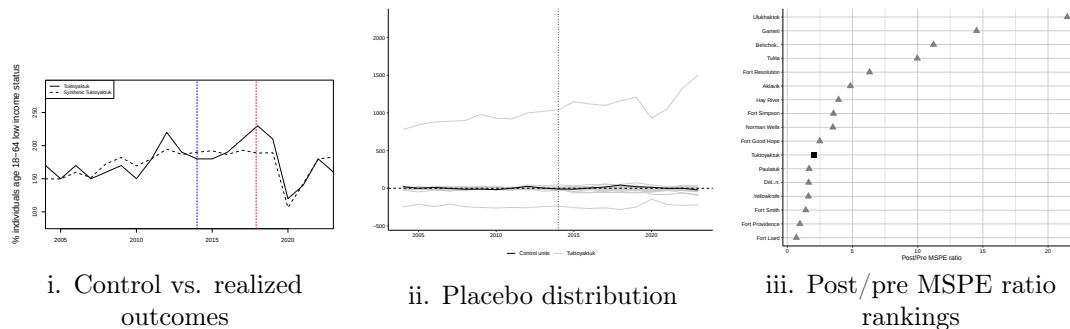
Note: The treatment year in the preferred specification for income outcomes is 2014; however, due to limited data in the pre-period, results for average employment income with both 2014 and 2017 treatment dates are used. The full set of covariates is used in determining the synthetic control. Pre-period optimization is from 2004-2014. The donor pool includes Northwest Territory communities with available data and no anticipated spill overs. The blue line in the control vs. realized outcomes figures shows the start of construction in 2014, and the red line shows the opening of the road in November 2017.

Figure 12: Low income status results – full NWT pool

(a) % of the population who have low income status

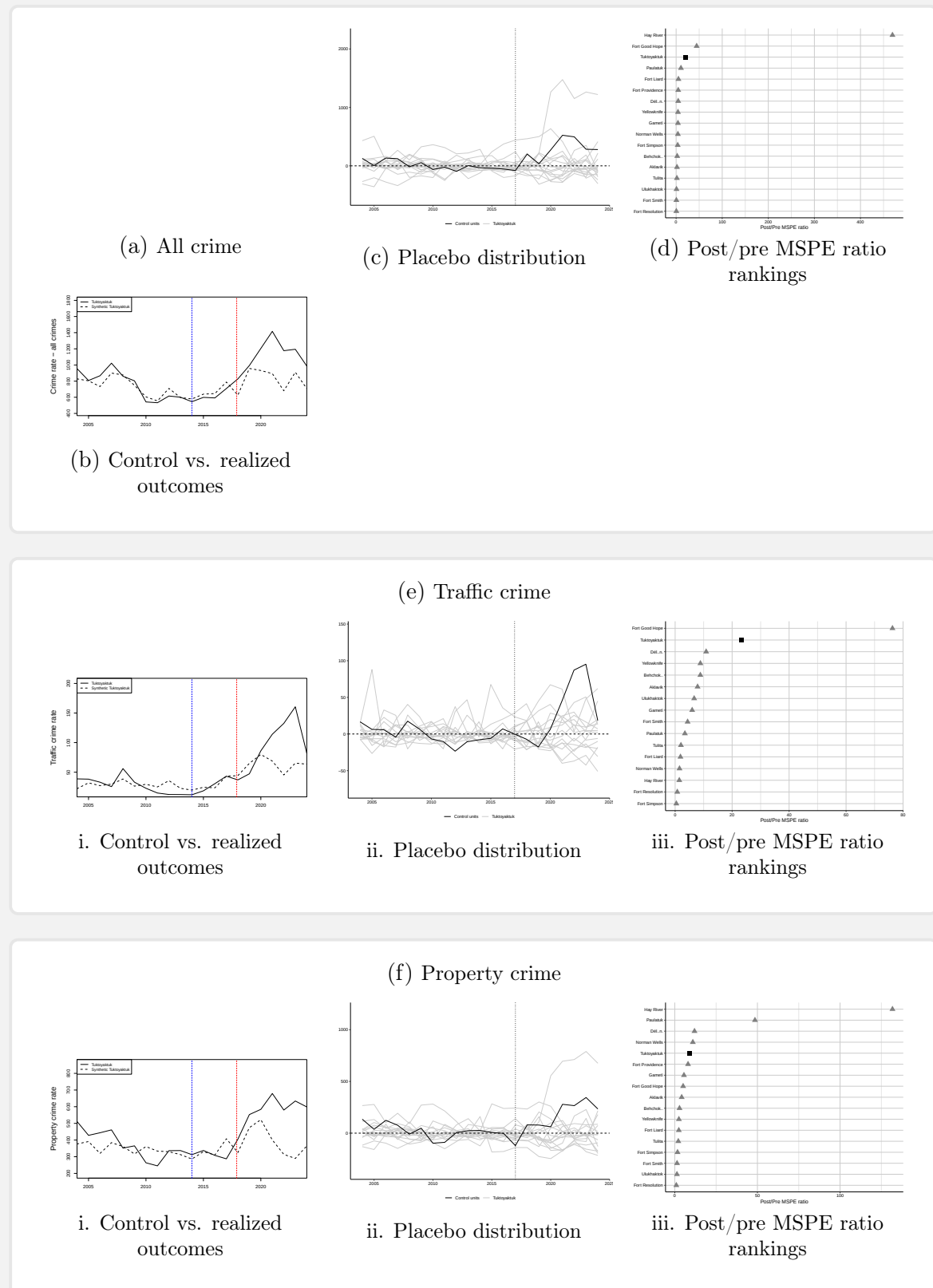


(b) Total number of individuals who have low income status – age 18-64



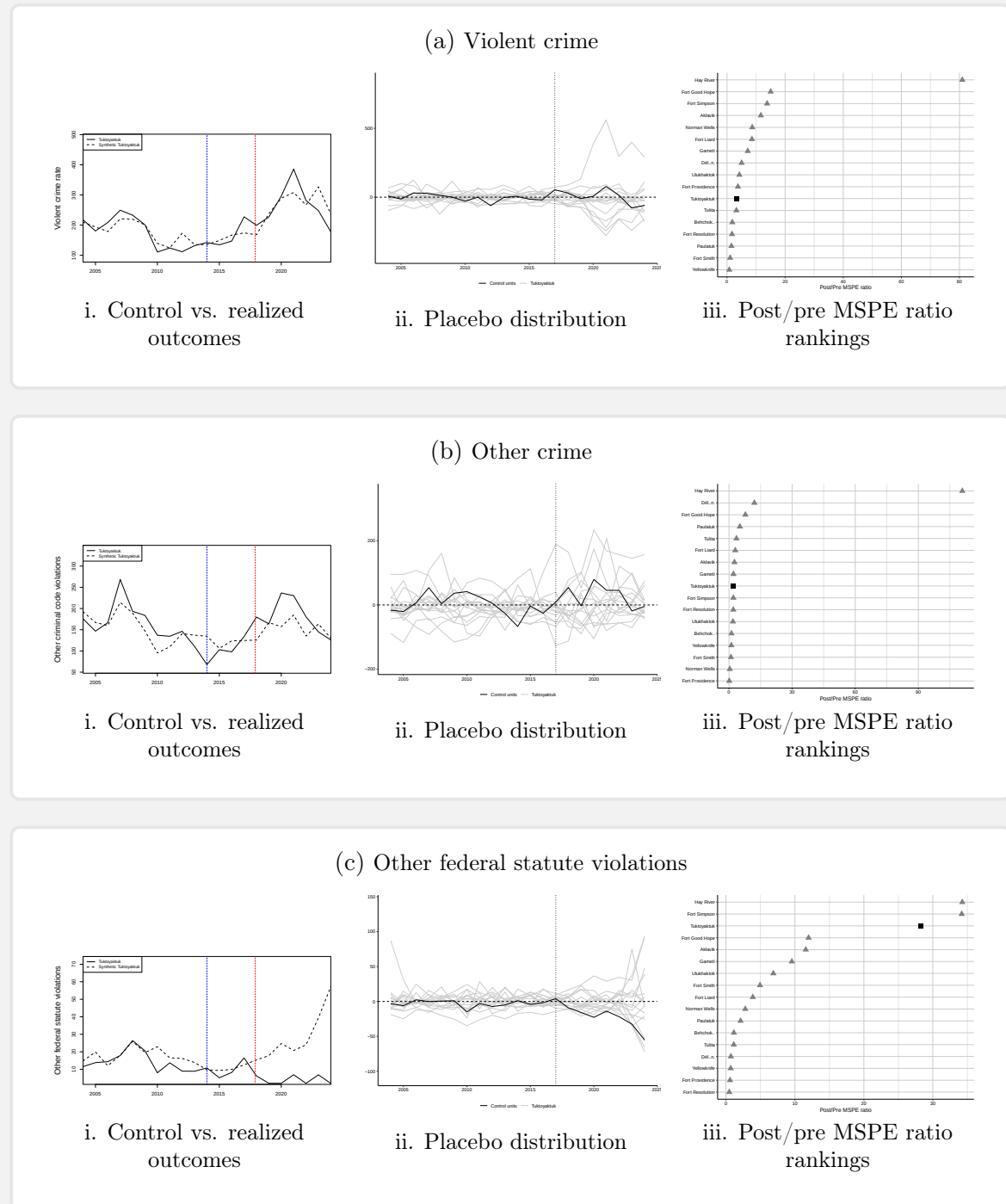
Note: The treatment year in the preferred specification for income outcomes is 2014. The full set of covariates is used in determining the synthetic control. Pre-period optimization is from 2004-2014. The donor pool includes Northwest Territory communities with available data and no anticipated spill overs. The blue line in the control vs. realized outcomes figures shows the start of construction in 2014, and the red line shows the opening of the road in November 2017.

Figure 13: Crime results – all crime, traffic crime and property crime – full NWT pool with 2017 treatment



Note: The treatment year in the preferred specification for crime outcomes is 2017. The full set of covariates is used in determining the synthetic control. Pre-period optimization is from 2004-2014. The donor pool includes Northwest Territory communities with available data and no anticipated spill overs. The blue line in the control vs. realized outcomes figures shows the start of construction in 2014, and the red line shows the opening of the road in November 2017.

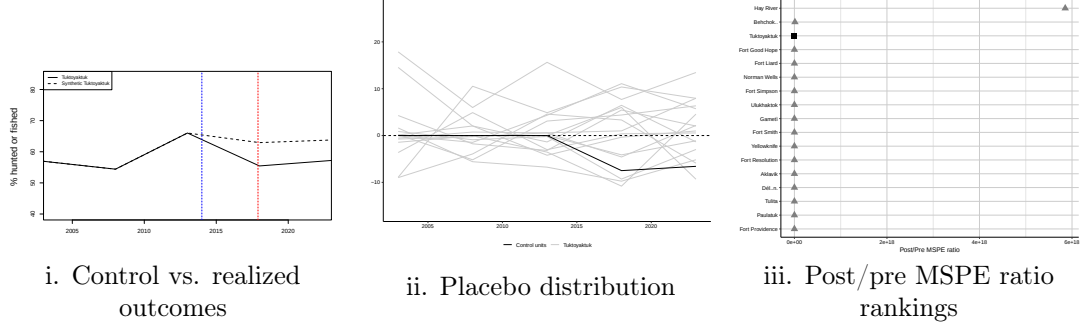
Figure 14: Crime results - Other criminal code violations and other federal statutes - full NWT pool with 2017 treatment



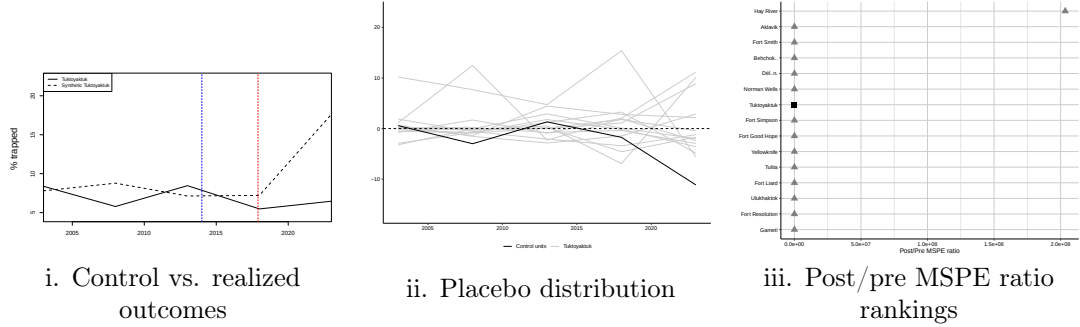
Note: The treatment year in the preferred specification for crime outcomes is 2017. The full set of covariates is used in determining the synthetic control. Pre-period optimization is from 2004-2014. The donor pool includes Northwest Territory communities with available data and no anticipated spill overs. The blue line in the control vs. realized outcomes figures shows the start of construction in 2014, and the red line shows the opening of the road in November 2017.

Figure 15: Traditional economy results – full NWT pool

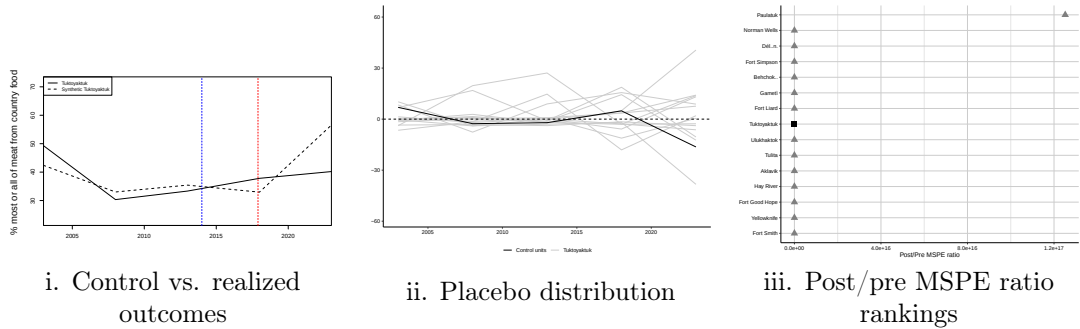
(a) Percent who hunted or fished in the last year



(b) Percent who trapped in the past year



(c) Percent who consumed most or all meat from country food



Note: The treatment year in the preferred specification for labour outcomes is 2014. The full set of covariates is used in determining the synthetic control. Pre-period optimization is from 2004-2014. The donor pool includes Northwest Territory communities with available data and no anticipated spill overs. The blue line in the control vs. realized outcomes figures shows the start of construction in 2014, and the red line shows the opening of the road in November 2017.

9 Tables

Table 1: Outcomes by category, years available and sources

Outcome	Source	Years available
Population		
Population		
Population age 25 to 60	NWT Statistics Bureau population estimates ¹	2004–2024
Population 60 plus		
Indigenous population		
Labour force		
Labour force participation rate	Canadian Census ² and NWT Community Survey ³	2004, 2006,
Unemployment rate		2009, 2011,
Employment rate		2014, 2016, 2019, 2021, 2024
Income		
Average individual employment income		
Percent of individuals with low income status [*]		
Percent of individuals with low income status age 18–64	T1 Family File ⁴	2012–2023
Average family income		
Percent of families with income less than \$35,000		

¹ Population estimates are for the July 1st population of each community and are calculated by the NWT Bureau of Statistics using administrative and survey sources ([NWT Bureau of Statistics, n.d.-b](#)).

² The long form Canadian Census (2006, 2016, 2021) and National Household Survey (2011) provide data on labour force statistics, education, housing, and Indigenous language use ([Statistics Canada, 2022a](#)). Response rates in the Northwest Territories were 91.7% (2021), 96.5% (2016), and 97.6% (2006) ([Statistics Canada, 2021](#)). The voluntary NHS achieved a lower response rate of 83.9% ([Statistics Canada, 2003](#)).

³ The NWT Community Survey (2004, 2009, 2014, 2019, 2024) is administered by the NWT Bureau of Statistics and includes measures of traditional and economic activity.

⁴ The T1 Family File contains annual income information from personal income tax returns ([Statistics Canada, 2025](#)). Informal and traditional economic activity are underreported unless declared.

⁵ The Uniform Crime Reporting Survey records police reported crime at the detachment level ([Statistics Canada, 2024](#)).

* Low income status uses Statistics Canada’s Low Income Measure.

Outcome	Source	Years available
Percent of families with income more than \$75,000		
Percent of families with income more than \$100,000		2010–2022
Median family income		
Median individual income		
Crime		
All crime		
Property crime		
Other Criminal Code violations	Uniform Crime Reporting Survey ⁵	2004–2024
Other federal statutes		
Traffic crime		
Violent crime		
Traditional activity		
Households consuming 75% or more of meat from country food sources	NWT Community Survey ³	2004, 2009, 2014, 2019, 2024
Individuals who hunted or fished in the last year		
Individuals who trapped in the last year		

Table 2: Population, labour force and income outcomes summary statistics before and after the opening of the ITH

	Tuktoyaktuk			Full NWT Pool			Ice Road Pool		
	Before ITH	After ITH	Difference	Before ITH	After ITH	Difference	Before ITH	After ITH	Difference
Population									
Total population	920.6	1009.3	88.7***	1784.7	1823.8	39.1	537.3	550.1	12.7
Population age 25–60	435.7	454.3	18.6**	952.9	953.6	0.7	258.8	275.5	16.7**
Population 60+	80.2	145.9	65.6***	168.3	278.5	110.2**	57.7	81.1	23.4***
Labour force									
Participation rate	58.2	54.4	-3.8	65.2	64.8	-0.5	67.0	67.4	0.4
Unemployment rate	28.7	22.6	-6.1**	20.6	16.7	-3.9**	20.7	16.5	-4.2**
Income									
% families earning < \$35 000	30.04	18.34	-11.70***	26.02	14.88	-11.14***	23.58	12.16	-11.42***
% families earning > \$75 000	28.24	42.68	14.44**	40.48	53.43	12.96***	43.35	55.64	12.29***
Average family income	68 557	85 443	16 887**	85 284	112 503	27 219***	93 443	120 715	27 272***
Median family income	66 816	83 532	16 716**	98 773	121 794	23 021***	114 252	132 796	18 544**
Median individual income	20 448	26 896	6 449**	29 772	38 279	8 507***	32 626	41 381	8 755***
Avg. indiv. employment income	32 880	38 782	5 902**	43 840	50 555	6 716***	47 013	51 773	4 759**
% Low-income individuals 18–64 (%)	33.2	31.4	-1.8	23.8	22.2	-1.6**	19.2	17.4	-1.8**
% low income ¹ individuals	34.38	32.76	-1.62	25.37	23.22	-2.15**	20.67	19.13	-1.54**

Notes: Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Differences reflect pre- to post-intervention changes. Values are rounded to the nearest whole number or dollar. N/A indicates unavailable significance.

Table 3: Crime and traditional activity summary statistics before and after the opening of the ITH

	Tuktoyaktuk			Full NWT Pool			Ice Road Pool		
	Before ITH	After ITH	Difference	Before ITH	After ITH	Difference	Before ITH	After ITH	Difference
Crime									
All crime	717.9	1114.2	396.2***	546.5	753.2	206.7***	498.7	627.2	128.5**
Traffic crime	27.9	94.2	66.3***	26.7	52.1	25.4***	29.5	60.4	30.9***
Property crime	356.4	576.3	219.9***	247.1	355.7	108.6***	243.1	289.5	46.4**
Violent crime	172.9	259.4	86.5**	124.1	174.2	50.1***	101.8	144.3	42.5***
Other federal violations	13.2	4.0	-9.2***	20.1	20.4	0.2	19.9	17.5	-2.4
Other criminal code violations	147.6	180.3	32.7**	128.6	150.9	22.3***	104.4	115.4	11.0**
Traditional activity									
% trapped	7.12	5.97	-1.15	14.25	13.2	-1.05	12	9	-2**
% where 75% or more of meat consumed is country food	31.83	39.0	7.17**	36.57	37.67	1.10	46.47	43.02	-3.46
% hunted or fished	60.21	56.32	-3.89	53.56	53.15	-0.41	46.44	47.86	1.42

Notes: Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Differences reflect pre- to post-intervention changes. Values are rounded to the nearest whole number or dollar. N/A indicates unavailable significance.

Table 4: Covariate variables and sources

Source and years available	Variable
Territorial estimates and census Annually from 1993–2023	Population
Vital statistics Annually from 1995–2022	Number of births Number of deaths
Vital statistics Annually from 2011–2022	Teen births Deaths – external causes ¹ Deaths – suicides
Income assistance data Annually from 2013–2022	Income assistance beneficiaries ² Income assistance cases ² Income assistance payments
T1 family file Annually from 2011–2022	Total income Average personal income % of taxfilers less than \$15,000 % of taxfilers more than \$50,000
Census ³ Every five years from 2006–2021	% of households with 6 or more people % of lone parent families % of houses owned % of households in core housing need % of Indigenous that speak an Indigenous language

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Source and years available	Variable
Census and NWT community survey 2004, 2006, 2009, 2011, 2014, 2016, 2019, 2021	% with high school diploma or more
NWT community survey Every five years from 1999–2019	% of people who hunt or fish % of households who get most or all of their meat from country food sources
NWT price survey 1997, 2000, 2001, 2004, 2010, 2012, 2015, 2019	Prices relative to Yellowknife

¹ Including suicides.

² Monthly averages.

³ In 2011 the Canadian long form census was replaced by the National Household Survey.

Table 5: 2010-2023 average detailed crimes committed by category in the NWT

Incident type	Average incidents	% of crimes in category
Total violent criminal code violations	4168.4	—
Assault, level 1	2283.9	54.8%
Uttering threats	643.4	15.4%
Assault, level 2, weapon or bodily harm	457.2	11.0%
Indecent/Harassing communications	227.6	5.5%
Sexual assault, level 1	188.6	4.5%
Total criminal code traffic violations	1053.2	—
Operation while impaired (alcohol)	864.5	82.1%
Driving while prohibited	44.6	4.2%
Dangerous operation of motor vehicle, vessel or aircraft	34.6	3.3%
Operation while impaired (drugs)	25.1	2.4%
Dangerous operation of motor vehicle evading police	12.1	1.2%
Total property crime violations	10863.5	—
Total mischief ¹	8957.3	82.5%
Total theft under \$5,000 (non-motor vehicle)	911.0	8.4%
Total breaking and entering	522.1	4.8%
Total theft of motor vehicle	200.6	1.8%
Fraud	171.0	1.6%
Total other criminal code violations	6318.0	—
Disturb the peace	4499.9	71.2%
Fail to comply with order	904.9	14.3%
Breach of probation	348.2	5.5%
Other violations against the administration of law and justice	137.2	2.2%
Utter threats to property or animal	81.3	1.3%
Total federal statute violations²	629.2	—
Cocaine, trafficking	176.4	28.0%
Possession, cannabis (pre-legalization)	145.1	23.1%
Cannabis, trafficking (pre-legalization)	85.9	13.6%
Other federal statutes	63.5	10.1%
Youth Criminal Justice Act	47.9	7.6%

Notes: Average crimes committed between 2010-2023 by top 5 detailed offence in each major category

¹ Mischief is the wilful damage or destruction of property, including cultural property and hate crime;

² Federal statutes are criminal offences that are not included in the Canadian criminal code, but are included in other acts including the Firearms Act, the Controlled Drugs and Substances Act, and the Youth Criminal Justice Act.