Assessing the Validity of CGE Modelled Impacts of the Federal Climate Policies on the Saskatchewan Economy

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Executive Summary

The Federal Government through Environment and Climate Change Canada rely on Computable General Equilibrium (CGE) modeling, specifically the use of an in-house "Environment Canada – Provincial" (EC-Pro) CGE model, to project the economic impacts and greenhouse gas emissions reductions expected from a number of federal policies and regulations including those that comprise the 2020 "Strengthened Climate Plan (SCP)", and the 2021 "Healthy Environment Healthy Economy (HEHE)". Like all models, assumptions and structures are applied by the modeler for computational feasibility, but those same assumptions and structures reduce the potential validity of the model with respect to describing the actual economy and how it will adjust to climate policies. The validity of the ECCC CGE models are likely strongest for the national economy, but the models as currently applied limits their applicability to provincial economies. In its current form, the ECCC CGE model mis-specifies some of the channels for economic adjustment (specifically those related to the factor markets for labour and capital) and in so doing it understates the economic risks and impacts of federal climate polices and regulations for smaller provinces, including Saskatchewan. We show in a CGE model applied to Saskatchewan that under assumptions used for the EC-Pro CGE model, growing oil exports 25% has little impact on Saskatchewan GDP but neither does reducing oil exports by 85%. Re-running the model with mobile labour and capital assumptions shows that increasing oil exports 25% increases GDP by 5% and reducing oil exports by 85% would reduce provincial GDP by 12%. That loss of GDP would drive Saskatchewan's population back to 1 million. There is nothing wrong with CGE models or the EC Pro model. We are making the point that the models must apply core assumptions that align with the ways in which economic adjustment occurs within provincial economies that are integrated and not closed off to each other as the current modelling imposes.

Introduction

The Federal Government has established and strengthened national climate goals to achieve 36% GHG emissions reductions by 2030 and a "Just Transition" to "net zero emissions" by 2050.[3] Under evolving names such as the *Strengthened Climate Plan* (SCP), and more recently *A Healthy Environment and a Healthy Economy* (HEHE), plus measures introduced in the 2021 Federal Government Budget, Canada will use a national price on carbon that will reach $170 per tonne of carbon in 2030, competitiveness sensitive emissions pricing for large emitters (OBPS), coal phase out for electricity generation by 2030, plus other non-price based regulations, subsidies and other incentives to achieve the national emissions reductions. In 2021, the Prime Minister stated that Canada will implement a "hard cap" on emissions from Canada's oil and gas sector.[4] The majority of national emissions reductions are expected to come from oil and gas production, transportation and elimination of coal fired generation of electricity. While GHG reductions targets are national, the policies required to achieve GHG reductions will have different impacts across provinces because of the different industrial structures, a lack of local energy supplies that are not oil, coal and (eventually) gas, and trade exposure. Saskatchewan would be expected to be among the most impacted of provinces under the federal climate policies and regulations given that one-third of its emissions are from oil and gas, one-quarter from an export oriented agricultural sector and another 20 percent from electricity generation. The province's 2021 Growth Plan calls for a 25 percent increase in barrels of oil produced to generate investment and population increase which may not be possible with the sector specific hard cap to be imposed by the Federal Government.

To determine if the economic impacts of federal climate policies for the nation and the provinces and territories, the federal government and many provinces have invested in the capacity to model carbon emissions and adjustments in the economy. The Federal Government through Environment and Climate Change Canada rely on Computable General Equilibrium modeling, specifically the use of an in-house "Environment Canada – Provincial" (EC-Pro) CGE model to project the economic impacts and greenhouse gas emissions reductions expected from a number of federal policies and regulations including those that comprise the 2020 "Strengthened Climate Plan (SCP)", and the 2021 "Healthy Environment Healthy Economy (HEHE)" (Ghosh et al 2012).[5] To date, the models have generally predicted that the transition toward net zero will not be particularly costly for the Canadian economy or for any province even if its traditional industries are restrained from growing, if not contracted. Even the "Just

[3] https://www.rncanengagenrcan.ca/sites/default/files/pictures/home/just_transition_discussion_paper_-_en_-_july_15.pdf "The Government of Canada also recognizes that the transition will have varying impacts across the country, between regions, sectors and demographics. Consequently, the government is taking action to consult early on, and often, with Canadians to ensure that workers and communities can succeed and thrive in the low-carbon economy." Page 2.

[4] https://www.cbc.ca/news/politics/trudeau-cop26-cao-oil-and-gas-1.6232639

[5] Ghosh, Madanmohan, Deming Luo, Muhammad Shahid Siddiqui and Yunfa Zhu (2012), "Border tax adjustments in the climate policy context: CO2 versus broad-based GHG emission targeting", Energy Economics (2012), Vol 34. (sp 2).

Transition" away from fossil fuels production and export is projected to be a relatively bloodless transition for energy producing provinces. The 2021 PBO reports that ECCC modelling suggests that the HEHE climate policies will only reduce Canadian annual GDP growth by 0.05% by 2023.[6] Reducing a positive growth rate means GDP increases but not by as large an annual increment. CGE models from ECCC and other groups are also applied at the provincial level and they similarly show small economic impacts of federal climate policies on provincial economies.[7] Jotham Peters of Navius Research Inc., in critiquing a CGE model of Saskatchewan purporting to show large GDP losses due to carbon pricing alone, suggests that when interpreted correctly, the Saskatchewan model results showed that "a reduction in economic growth of a much smaller — and far more realistic — 0.13 per cent from 2017 to 2022".[8]

Given the long run development of Canada's economy and its resource exporting provinces, the lack of economic impact of policies that will impact export competitiveness is puzzling. Loss of traditional industries in many small subnational economies due to changes in trade policy or technological shocks to competitiveness have been associated with lasting economic and population decline.[9] The lack of modelled impact on provinces most reliant on oil and gas should be of more concern for those provinces as it is expected that for Canada much of the GDP contraction due to policies to reduce GHG emissions will be from a contraction of the oil and gas sector. After all, without oil and gas development and production, Saskatchewan had a stagnant and aging population for decades that was more comparable with the Maritime provinces than neighboring Alberta. After 2000, with oil and gas, potash, uranium and agriculture all booming, Saskatchewan had a fast growing population and GDP and had reversed its population aging. The Government of Saskatchewan's growth plan calls for increasing oil production by 25% but should we believe that that increase in oil for export would not result in stronger economic growth? How could reducing the competitiveness of oil and gas exports not impact the Saskatchewan economy?

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[6] The June 2021 PBO report "BEYOND PARIS: REDUCING CANADA'S GHG EMISSIONS BY 2030" shows that the $170 per tonne carbon price by 2030 and tighter OBPS would result in a 10.8% decline in the oil and gas sector compared to the ECCC reference scenario modelled prior to 2021. The PBO analysis does not include regulations to reduce methane emissions and relies on imputed prices for non-price climate measures like regulations. https://distribution-a617274656661637473.pbo-dpb.ca/1df9b64ac4e1885028a02c05d5f15b82622d3ace28a473159d59301fb636c6e3

7 Jotham Peters (2019) critique of a University of Regina CGE model emphasized how large modelled effects of a $50 per tonne carbon tax on transportation and buildings "would be vastly misaligned with the results from any other computable general equilibrium (CGE) model." As we discuss, the reason a contraction of that size cannot happen in many CGE models as they are currently specified and parameterized. Jotham Peters (2019) "Saskatchewan's carbon tax numbers are in and the answer is … reporting errors", Navius Research, Inc. January, 2019.

8 Jotham Peters (2019) "Saskatchewan's carbon tax numbers are in and the answer is … reporting errors", Navius Research, Inc. January, 2019. "…a carbon tax most likely reduces GDP growth (in Saskatchewan) by 0.13 per cent each year from 2017 to 2022. So, instead of GDP growing by one per cent, it would grow by 0.87 per cent (a big difference from -1.43 per cent)". Navius Research describes the negative impact on GDP as recessionary. That is a misleading interpretation of the loss of long run GDP. Recessions refer to transitory reductions in GDP below potential GDP to which GDP will return. CGE models generate permanent changes, so changes in potential GDP. Negative change in GDP is "de-growth" and not a benign recession. https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/climate-plan-overview/healthy-environment-healthyeconomy/annex-modelling-analysis.html#toc

[9] See Floerkemeier, Spatafora, and Venables (2021) for an overview of the reasons for the persistence of lagging regions in advanced economies, pages 16-17 in particular. Austin, Glaeser and Summers (2018) note the lasting hardship for declining regions following the loss of traditional industries.

We assess that the lack of economic impacts from climate policies for provinces is a product of applying computable models that mis-specify how integrated subnational economies adjust to shocks (whether or not they produce reasonable projections at an aggregate national level). The models in effect have assumed away the problem that federal climate policies create for resource export dependent provinces like Saskatchewan. The lack of economic impacts of climate policies on the national economy may turn out to be true, but that outcome will mask the potentially massive redistribution of jobs, investment and GDP from resource exporting regions to the core central Canadian economy expected between integrated core and periphery economies within a nation.

There is nothing wrong the ECCC, or any other, CGE models for studying the national economy, or in principle for studying provincial economies but whether a model is giving reasonable projections of climate policy impacts on the actual economy requires assessment. In a 2022 Briefing Note, "The ABCs of EEE models for non-modelers", Mark Jaccard argues that when assessing "energy-economy-emissions" (EEE) models, "non-modelers should first ask what is exogenous and what is endogenous, and the answer should make sense for the questions that are being addressed by the model. Then, when assessing exogenous assumptions, the non-modeler should see evidence that these scenario assumptions are internally consistent. Finally, when assessing endogenous model results, the non-modeler should see evidence that the behavioral parameters and technology characteristics (cost, efficiency, emissions, risks) are credible and consistent with best practices".[10]

We have reviewed publicly available information on CGE models used to model the impacts of climate policies on the national and provincial economies. As assessed by a University of Victoria study, the models are impressive in their complexity and detail with respect to sectors.[11] Notably, the models score high on the virtue of allowing for flexible (endogenous) prices that support adjustment to economic shocks with market clearing price adjustments. What is not discussed is that along with flexible prices, there are assumptions of fixed (exogenous) supplies of capital, labour and resources. CGE models allow for perfect mobility of factors between sectors within the provincial economy, but labour and capital are not mobile across provinces. Whether or not flexible prices are a virtue for a model or a limitation is an empirical question. In the actual economies do factor markets in provinces adjust to shocks and policies through price changes, mobility of factors of production or some combination of the two?

[10] Mark Jaccard, "The ABCs of EEE models for non-modelers", January 2022.

[11] Rhodes, E., Craig, K., Hoyle, A., and McPherson, M. (2021). Improving Climate Policy Projections: A Pan-Canadian Review of Energy-Economy Models. University of Victoria. https://www.uvic.ca/hsd/publicadmin/assets/docs/sshrc-report_ee-models.pdf
The fact that validation of a model output is often done as a comparison with the structures of other models, assumed to be correctly specified descriptions of the economies, should be of more interest in the policy discussions over climate policies. CGE models should be validated against the actual economy even if peer reviewed or evaluated in terms of expert opinion of the quality of the modelling.

We identify two critical assumptions about factor market adjustment in CGE models with respect to the impact of climate policies on subnational economies which could be changed to better represent economic adjustment in provinces. First, CGE models applied to Canada, and provinces, have assumed that labour is fixed (inelastic) in supply, freely mobile to other sectors within a region but not across regions. Similarly, capital is exogenous in supply at a national level and may display some degree of mobility across sectors and regions.[12] Second, constant returns to scale technology, inter-regionally immobile factors and no agglomeration economies for a sector's local size means that industries do not spatially concentrate in the larger provinces integrated with the smaller provinces. Economic adjustment to shocks in a periphery economy integrated with a core economy is expected to hollow out as labour, capital and industry migrate from the periphery to the core. In the CGE models, the lack of growth impact of the climate policies is a result of prices adjusting rather than quantities of factors employed. In addition, the model presumes that labour and capital is re-employed in the same province once displaced. In Canada, for the small population provinces, factor prices are fixed and factor supplies are endogenous – that is, these factors move across provinces in sufficient quantity such that small provinces are price takes in factor markets. If larger population provinces have "first mover advantages" for new or emerging sectors, then labour and capital move there. Where a CGE model of Saskatchewan projects that climate policies lower wages, returns to capital and resource income, reducing per capita GDP (with compensating transfers), the empirical regional economics studies suggest that a more likely outcome is that Saskatchewan's population and investment will fall, reducing GDP but not per capita GDP.

To demonstrate the importance of how CGE economic and climate models specify factor market adjustment to declining traditional sectors, we present results of a CGE model for the Saskatchewan economy under assumptions of immobile factors with flexible factor prices, and under the alternative assumption of fixed factor prices and mobile factors of production. We show that the CGE models with fixed factor supply assumptions (as specified) generate low harm counterfactuals (where GDP changes very little) even when faced with what would be considered catastrophic shocks to key industries. Under the alternative assumption of mobile factors the policy shocks have large impacts on the modelled economy that would be interpreted as de-industrialization and de-population.

[12] Official communications that reference EC-Pro results are generally unclear on this point. The EC-Pro model has the functionality to represent a range of capital mobility assumptions from ranging from perfectly mobile to perfectly immobile. However, given the exogenous national supply and associated assumptions, the model generally assumes that capital income is repatriated to the province with the initial endowment regardless of where the capital is endogenously allocated in a counterfactual projection.

Provincial Economies as Described by Eccc Ec-Pro Cge Model

The power of the CGE models like those applied by ECCC is the level of detail in terms of numbers of sectors of production, the model's micro-theory foundations and its computational complexity.[13] The limitations of the models is that the trade-off of having more sectoral detail and complex calculations is that the model relies highly restrictive assumptions that impose a process of economic adjustment that may be reasonable for a national economy but are mis-specified (wrong) for a subnational economy. To understand this trade-off, we first begin with our understanding of the key features of the EC-Pro model.

- EC-Pro describes an open-economy model disaggregated into 13 Canadian provinces and territories, interlinked through bilateral trade and investment flows.
- Each province and territory, considered as regions, are price takers in international markets for exports and imports.
- Economic activities in the regions are described by production from 40+ sectors (where applicable), and by final consumption by the region's "representative single household", and the governments.
    - The Government sector is fixed in size by an assumption of set and unchanging levels of services. This is maintained through a lump sum tax/subsidy between the representative household and provincial government agents. The federal government is not modelled separately.
- There is no population growth in the model.
- Each province/territory/region is represented by a single household whose objective is to maximize its welfare subject to its budget constraint.
- There is no population aging in the model.
- The representative household receives income from supplying three factors of production to the market with which it is endowed: labour, capital, and resources. Resources are specific to natural resource sectors (like crude oil extraction) and are immobile.
    - The representative household is "myopic" meaning decisions do not incorporate expectations of the future including predictable policy changes like an increasing cost of carbon.[14]

[13] See https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/output-based-pricing-system/2022-review-consultation.html#annex1. Ghosh, Madanmohan, Deming Luo, Muhammad Shahid Siddiqui and Yunfa Zhu (2012), "Border tax adjustments in the climate policy context: CO2 versus broad-based GHG emission targeting", Energy Economics (2012), Vol 34. (sp 2).
For a discussion and evaluation of a range of models applied to Canada see Rhodes, E., Craig, K., Hoyle, A., and McPherson, M. (2021). Improving Climate Policy Projections: A Pan-Canadian Review of Energy-Economy Models. University of Victoria. https://www.uvic.ca/hsd/publicadmin/assets/docs/sshrc-report_ee-models.pdf

[14] This is a consequential assumption for many economists. Rational consumers and producers would be expected to change their behavior and decisions in anticipation of policy changes. CGE models like the ECCC's are based on parameter values describing the pre-policy context, or history, which would not necessarily be useful for understanding the impacts of the policy. The Lucas Critique posits that "The expectations about economic conditions and policy that shaped consumer, business, and investor behavior during the periods from which past data are

- The representative household makes its saving/investment and consumption decisions in each period to maximize its welfare based on past states of the economy only, "implying that the role of expectation is limited".
- Sectors employ two or three factors of production: labour, capital and resources when applicable (fossil fuel resources being an important subcategory in the model).
- All sectors are described with nested Constant Return to Scale production functions with constant elasticity of substitution between the three factors of production.[15]
- All firms are perfectly competitive meaning they are price takers in output markets, and in factor markets for the three inputs.
- Labour is inelastically supplied in the model and is mobile across sectors but not across regions/provinces.
    - In some CGE models, the single representative household can choose to supply labour or take leisure creating the possibility for substitution of labour and leisure.
- The supply of capital and investment in new capital are exogenous and built from baseline data and assumed growth paths for sectoral investment. Some versions of the EC-Pro model allow for some mobility of capital between regions but for the most part, capital is inelastically supplied to sectors making up the province's economy.
    - New technologies can costlessly and exogenously diffuse through the economy with investment.
- Capital is immobile across sectors in a given year but will flow towards sectors with higher returns to capital intertemporally, based on the recursive dynamic nature of the model.

Equilibrium conditions

- Equilibrium in the model is characterized by markets clearing for all goods and factors, within all regions/provinces of the model.
- Goods and factor prices are endogenous which ensures that all markets clear. Given the constant returns to scale (CRS) technology and perfectly competitive market structure, zero profit condition in each market is ensured.
- An "income balance constraint" ensures that income of the representative agents equal the expenditure.
- An exogenous level of government services is reconciled with potential changes in tax revenues via a lump sum transfer between the representative consumer and the representative provincial government agent (there is no separately modelled federal government agent).

drawn often will not hold once conditions and policies change". In other words, the Lucas Critique holds that the past data does not allow for meaningful policy evaluation unless the models incorporate expectations formation.

[15] Depending on the nesting structure for a specific industry, the elasticities of substitution between factors of production may be explicit or implicit (as the function of other elasticities of substitution).

- For external closure a constant trade balance condition is imposed between Canada and ROW such that "the value of imports from ROW equals the value of exports from Canada after accounting for a constant benchmark trade deficit or surplus."

Welfare Analysis of Climate Policies in the EC-Pro Model

The EC-Pro model's computational evaluation of climate policy is captured through changes in factor prices, some capital mobility out of the local economy and shifting production from sectors with higher emissions intensity (like oil and gas) to sectors with low emissions (like services). In the case of the labour market, this means that in response to changes in labour demand from the climate policy, the real wage adjusts to be equal across sectors within the region and the equilibrium wage reduces to ensure full employment of the exogenously determined labour supply. Total employment and population size is assumed unchanged by the policy shocks evaluated in the model.

By construction, carbon policies will not create unemployment, outmigration or de-industrialization. The only economic and social costs of carbon policies in these models come from lower income of the single representative household. Recycling of tax revenues through transfers from the federal and provincial governments in the model also means that the loss in GDP largely reflects shifting of labour and capital from higher productivity sectors to lower productivity sectors and any distortions/deadweight losses created by the climate policy. Allowing for a leisure-labour tradeoff (as is done in some CGE models) the economic impact of the carbon policy would grow if reduced wages lead to more time spent in leisure. That is, not all of the reduced income/consumption would be a negative outcome since the resulting non-employment would be voluntary and would not constitute involuntary unemployment. It is also common in CGE modelling to introduce a minimum wage to prevent the labour market from fully adjusting to a policy, or economic shock, which would generate some involuntary unemployment.

Another feature of the EC-Pro model's equilibrium is that factor price differences between regions are not "arbitraged away" meaning regional factor markets are not integrated and the representative household's income is determined by the local demand for the (mostly) endowed supply of labour, capital and resources. Wages and returns on capital can diverge across provinces since they are determined by provincial factor endowments. Relative abundance of labour (more labour per unit of capital and/or resources) in one province versus another will result in lower relative wages. Similarly, when labour and capital shift from capital intensive resource-based industries to less capital intensive service industries, the average wage in the economy will fall. The greater the shift away from capital intensive, or resource intensive, industries the greater the reduction in the wage.

The EC-Pro model limits the potential negative impacts of climate policies for the provincial economy by construction. If wages, returns to capital and goods prices adjust, then labour force, investment and production do not change beyond what comes with sectoral shifts and imposed frictions in the model. Where prices do not adjust, then negative shocks to the economy reduce employment, labour force, investment and production. The ECCC CGE model cannot address the likelihood that climate policies impacting the competitiveness of exporting sectors like oil and gas hollows out the periphery economy reducing population, and accelerating population aging.

Spatially Blind Models

The EC-Pro model used to evaluate the impact of federal climate policies on provincial economies is "spatially blind" yet it is being used to address inherently spatial concerns. Simply put, a model is spatially blind when its outputs and/or methods of adjustment are independent of the location of the economic, or policy, shock being evaluated. In the EC-Pro CGE model, there are no clear links or spillovers with other regions which makes geography irrelevant – when factor markets are not-integrated, geography is not an important dimension of the policy impacts beyond the unit of the region. But even in the case of differences across regions, the main differences in model outputs are a product of region specific endowments of labour, capital and resources. The EC-Pro model does integrate provincial economies through trade in intermediate and final production goods as well as some capital mobility, but labour immobility, adjustment through factor prices and not migration, and constant returns to scale in production make geography an unimportant dimension for evaluating the impacts of climate policies.

Spatially blind models are reasonable when the policy interests are at the national level and labour and resources cannot move easily to other jurisdictions (e.g. other countries). For example, the Federal government may be interested in national changes in GHG emissions and GDP so what matters most is that productive activity shifts between sectors and remains fully employed nationally. A lesser consideration for the national interest is the spatial redistribution of activity within the nation – it may not matter to Ottawa that labour and capital from pulp and paper in New Brunswick shift to the service sector in Ontario because of the climate policies. So long as labour is fully employed in Canada, the national interest may not be concerned with inter-provincial shifting of labour and capital. Indeed, if production has

increasing returns to scale or agglomeration effects, the national interest is served by policies that shift labour and capital from smaller periphery economies to the larger core economy.[16]

The EC-PRO model cannot account for three critical features of the national economy impacting on the growth of the Saskatchewan and other provincial economies with respect to ignoring geography.

1) The integration of provincial labour markets and capital markets means that wages and returns to capital do not adjust to balance factor markets as assumed by the EC-Pro model, **in the actual economy factor mobility and unemployment adjust to balance factor markets.**[17]
2) Constant returns to scale production functions means that economic activity is perfectly divisible and location is solely determined by business costs including factor prices. (Except in the case of sectors with a fixed resource input like crude oil extraction.) If there are increasing returns to scale, or agglomeration effects from industry co-location, then capital, labour and business will spatially concentrate with migration from smaller population peripheries like Saskatchewan to larger core economies like Ontario – people, capital and business leave Saskatchewan for Ontario.[18]
3) **Exogenous investment in the EC-Pro model assumes away perhaps the biggest challenge faced by resource exporting provinces over their histories -- investment attraction. Exogenous investment in each region/province of the model eliminates the challenges a province faces of being distant from market and competing globally from the evaluation of a national policy.** The main impact of federal climate policies on investment in the EC-PRO model is though the effect on domestic savings resulting from changing income of the representative consumer.

[16] Consider that if Saskatchewan had its own CGE model that was spatially blind, loss of industry in Prince Albert resulting in service sector growth in Saskatoon would look like a good outcome for the province at the aggregate level in the model but would be potentially a problematic result of a policy for the province if regional equity is important.
[17] Chambers and Gordon (1966), Emery and Levitt (2002), Coe and Emery (2004, 2012), Emery, Inwood and Thille (2007), Emery and Kneebone (2008), Boyce and Emery (2011), Emery (2013), McKenzie and Ferede (2017).
[18] See Krugman (1991), Floerkemeier, Spatafora, and Venables (2021).

Adjustment In Factor Markets in the Ec-Pro Model and in Resource Exporting Provinces

Regional immobility of labour in the model makes labour a "specific factor" of production in the region. This is the assumption that results in market adjustment through factor prices possible since it means that the labour market in a province is supplied inelastically (does not respond to wage changes) and wage changes are independent (not integrated) with other region's labour markets. This means that wages can persistently diverge across regions and there is no tendency toward "factor price equalization". The implications of this assumption are important for evaluating policy like the SCP or HEHE since wage adjustment for market clearing means that the size of the labour force, and population, is unchanged so all policy impacts are through factor incomes changing with factor prices. If a climate policy or regulation can be expected to impact labour demand equally across all provinces then the policy is a "common shock" for the nation with no important regional dimensions. If the climate policy or regulation has differential impacts on labour demand across provinces due to different sectoral compositions of the economy, or differences in elasticities of substitution between energy sources, and sectors, then the SCP is introducing region specific shocks which in the ECCC model have permanent effects on the labour market that result in persistent cross province differences in wages, returns to capital and resource income.

For small provinces the assumption of labour immobility is a problem for studying economic adjustment to policy changes in small population provinces integrated with larger population provinces. Under an integrated periphery-core relationship, factor mobility is a key feature of that "national economy".[19] [20]

[19] For example, in a 2015 publication based on a version of the EC-Pro model, the authors assert: "Labour supplied to the labour market is perfectly mobile between sectors, but immobile between regions. The assumption of labour immobility between regions is a simplification reflecting empirical evidence on rather limited mobility of labour compared to capital". This is not a valid interpretation of relative immobility of labour since the key matter is the integration of regional factor markets. Christoph Böhringer & Nicholas Rivers & Thomas Rutherford & Randall Wigle, 2015. "Sharing the burden for climate change mitigation in the Canadian federation," Canadian Journal of Economics, Canadian Economics Association, vol. 48(4), page 1364. That rationalization however misses two key points with respect to economic adjustment of the regional economy. First, out-migrants from New Brunswick are much more likely to be 25 to 34 years of age where in-migrants over the past 20 years have a higher frequency of higher age persons (over 45). So the demographic structure of in- and out-migrants is not balanced. The impact of net-migration for the New Brunswick economy has been to hold the population of the province relatively constant since the early 1990s while provincial populations outside of the Atlantic region have increased from in-migration and immigration.

[20] Data on inter-provincial migration, immigration and population change are available from economic dashboards, www.boostnb.com for New Brunswick, and https://www.onens.ca/goals/goal-1-inter-provincial-migration/deep-dive for Nova Scotia. Two other studies that may shed light on some of the determinants of out and in migration for New Brunswick are: Emery, H., McDonald, J.T., & Morissette, R. (2017). The Economic Impacts of Migrating
New Brunswick to Alberta/Saskatchewan and Return to New Brunswick. Fredericton, NB: New Brunswick Institute for Research, Data and Training.. https://nbirdt.ca/nbirdt-files/publications/11/14 and Chan, P.C.W., R. Morissette. 2016. "The Impact of Annual Wages on Interprovincial Mobility, Interprovincial Employment, and Job Vacancies", Statistics Canada, Analytical Studies Branch Research Paper No. 376. The previous two studies used microdata with taxfiler information. We have also used Census microdata to study details of who leaves and who comes to New Brunswick and where they go: Emery, J. C. H., Wang, L., & Daigle, B. (2019). The impact of official bilingualism on the geographic mobility of New Brunswickers: Evidence from 2001 to 2016. Fredericton, NB: New

Second, the size of the migration flows between provinces reflects the integration of provincial labour markets which means that wages in a province following a policy change or an economic shock cannot persistently diverge.[21] Wages do not adjust to bring balance to the provincial labour market – quantity of labour adjustment does. Versions of the EC-Pro model with labour-leisure tradeoffs are not adequate to address this problem since the size of the population remains unaffected by the model's construction. The ECCC modelers already recognize that capital has greater mobility than labour so it should also be recognized that the risk-free return to capital cannot adjust independently in a province meaning capital inflows and outflows are the means of market adjustment. Overall, this means that the economy of a small province like Saskatchewan will adjust to climate policies and economic shocks on extensive margins – population and capital stocks will adjust in the face of unchanging factor prices. If climate policies put downward pressure on wages then labour force and population will decrease, and the population will age given the younger ages of out-migrants.

With respect to sectoral adjustment in response to federal climate policies and regulations, the EC-Pro model ignores the risk that the loss of employment in a province when labour is inter-provincially mobile means that the shift in employment between sectors cannot be assumed to be within the province. The EC-Pro model cannot deal with these risks of regional reallocation of employment as it is structured.

To illustrate how the EC-Pro model projects economic adjustment in any given province, Figure 1 shows a labour market where labour demand is downward sloping, meaning there is a diminishing marginal product of labour due to fixed supply of at least one factor of production.[22] In most models this would be the supply of resources that are associated with land and any other immobile inputs. The supply of labour is fixed at the quantity endowed to the economy. The vertical labour supply curve reflects that with nowhere to move since labour is inter-provincially immobile, and in this case, no leisure-labour trade-off. Labour supply is perfectly inelastic so labour supply is independent of the wage.

In Figure 1 we illustrate how factor supply assumptions can influence the factor market adjustment to a new equilibrium. Suppose that bringing in a climate policy like a carbon price can be represented as an inward shift of the labour demand curve in a province which means employers pass the full cost of the policy as a lower after policy wage.[23] The employer

Brunswick Institute for Research, Data and Training https://nbirdt.ca/nbirdt-files/publications/14/23 . An important study for showing the impacts of corporate tax on investment and wages in provinces is: McKenzie, K., Ferede, E. 2017. Who Pays the Corporate Tax? Insights from the Literature and Evidence for Canadian Provinces, The School of Public Policy SPP Research Papers, Vol. 10(6). http://www.policyschool.ca/wp-content/uploads/2017/04/Corporate-Tax-McKenzie-Ferede1.pdf

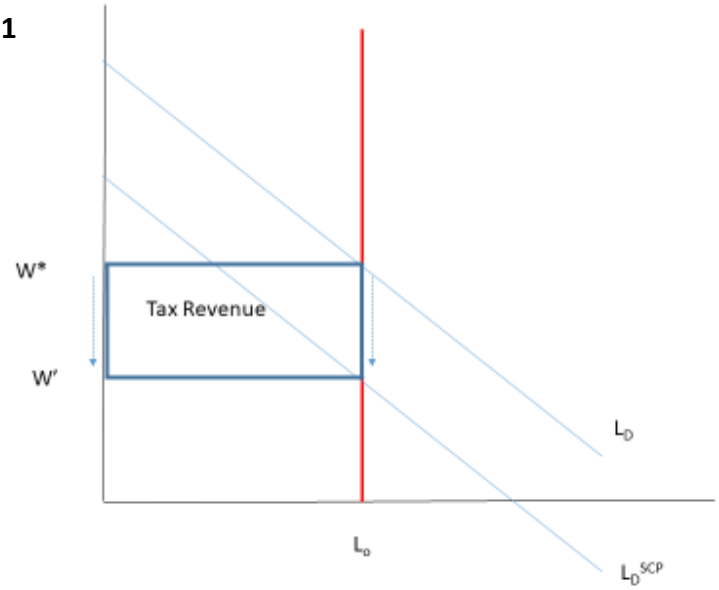
[21] Coe, Patrick J. and J.C. Herbert Emery (2004) "The Dis-Integrating Canadian Labour Market? The Extent of the market Then and Now," Canadian Journal of Economics, 37(4), 879-897. Coe, Patrick J. and J.C. Herbert Emery (2012) "Accreditation Requirements and the Speed of Labour Market Adjustment in Canadian Building Trades," Canadian Public Policy/Analyse de politiques XXXVIII(1), 91-111., Chambers and Gordon 1966.

[22] This could also be due to non-zero opportunity costs for other inputs into the sector.

[23] If low intensity sectors are more labour intensive, then this could end up being an outward shock. See for examples: Yamazaki, A., 2017. Jobs and climate policy: Evidence from British Columbia's revenue-neutral carbon tax. Journal of Environmental Economics and Management, 83, pp.197-216. I think the issue is for a sector that has a relatively high proportion of employment in high emissions intensity sectors. In that case

continues to pay the full wage as before and the gap between what the employer pays and what the worker receives is the policy cost or the "tax". The rectangle between the labour supply curve and the vertical axis, between the wage paid by the employer and that received by the worker is the total tax revenue. The tax revenue in the EC-Pro model is given back to the worker. In this simple case the policy is costless since there is no deadweight loss of the tax and the tax is merely a transfer of employers' aggregate surplus (here the income from resources/land) to labour. In the EC-Pro model the representative household is employer, employee and the owner of resources and also receives a lump sum transfer in order to maintain balance in government revenues and spending. This all makes the transfer even less important. Note, if we make labour demand an aggregate of multiple sectors with differing labour productivity, then we can generate GDP losses that come from shifting labour from higher capital intensity (and emissions) resource industries to lower capital intensity, lower productivity services.

Figure 1



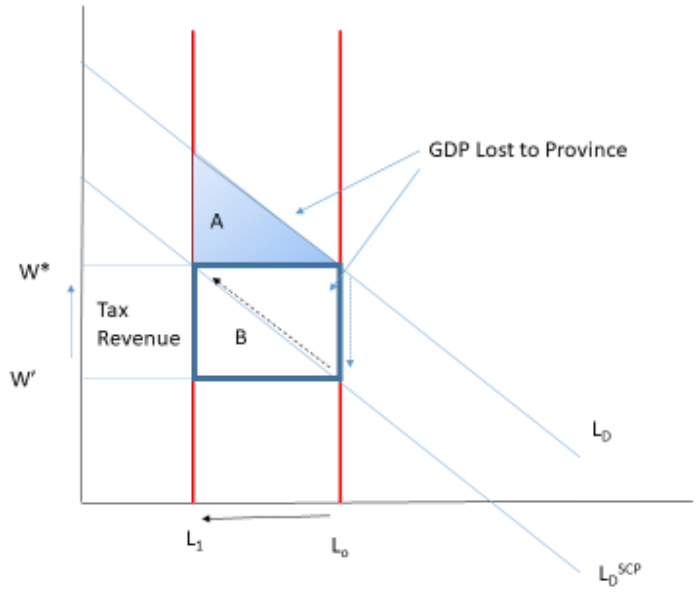
If we consider Figure 1 a short run equilibrium where the supplies of factors of production are fixed, a long run equilibrium would allow for mobility of labour and capital across provinces. Figure 2 introduces the original equilibrium wage w* as the wage available to the worker in other provinces – the alternative wage to the local wage. In Figure 1, the short run effect of the policy was to lower the in-province wage to w'. As shown in figure 2, workers in the lower wage location now have an option to work for that wage or migrate to the other province for the higher wage.[24] Labour exits the province for the higher wage province until labour supply has

the labour shock is negative. (If memory serves Yip 2018 gives some related empirical evidence): Yip, C.M., 2018. On the labor market consequences of environmental taxes. Journal of Environmental Economics and Management, 89, pp.136-152.

[24] In a small open economy with mobile capital, following Chambers and Gordon (1966) and Boyce and Emery (2011) modelling changes in L is the same as modelling changes in L/K since the labour to capital ratio is fixed in equilibrium. Boyce, John R. and J.C. Herbert Emery (2011) "Is a negative correlation between resource abundance and growth sufficient evidence that there is a `resource curse'?" Resources Policy 36(1), 1-13. Emery and Kneebone (2008) have a growth accounting exercise showing that Saskatchewan's economy has grown through input accumulation – growing labour and capital endowments.

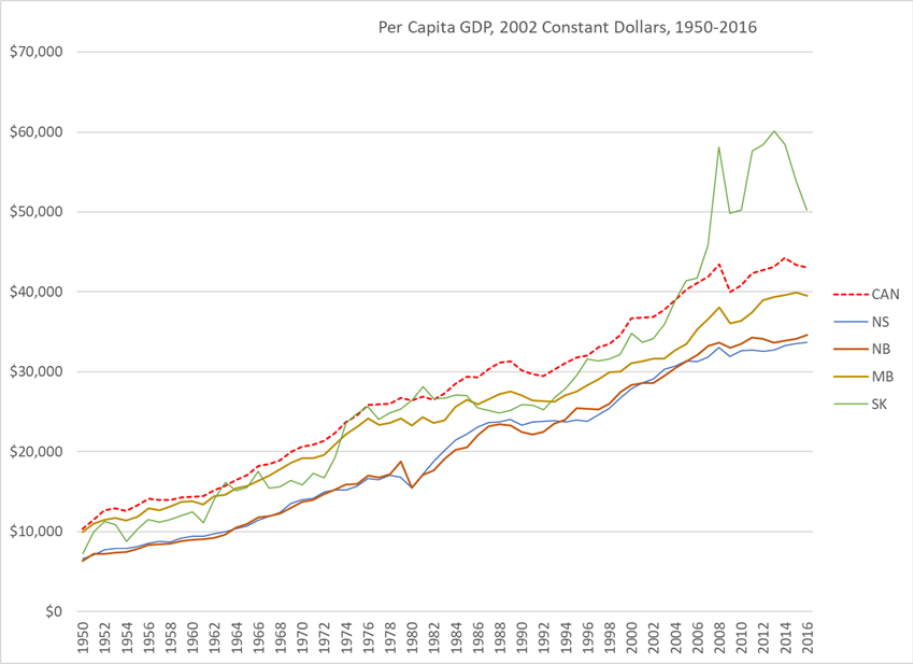
fallen enough that wage returns to w*. Now the climate policy has a GDP cost that includes the wage bill of the labour at w* that is no longer in the province because of the policy, and the loss of employers' surplus (resource income) due to the loss of labour supply. The adjustment to the policy comes from adjustment of factor quantities and not factor prices. The long run impact where labour and capital are mobile is a contraction of the provincial economy as labour and capital shift to locations which offer higher returns. Note that the tax revenue, still recycled/transferred to the remaining labour is much smaller than in Figure 1. The only case where Figure 1 applies is if the policy shock happens to have the same impact on wages, returns to capital and resource prices in all provinces – the shock to labour demand must be relatively similar so that the there are no important differences in wages across provinces.

Figure 2



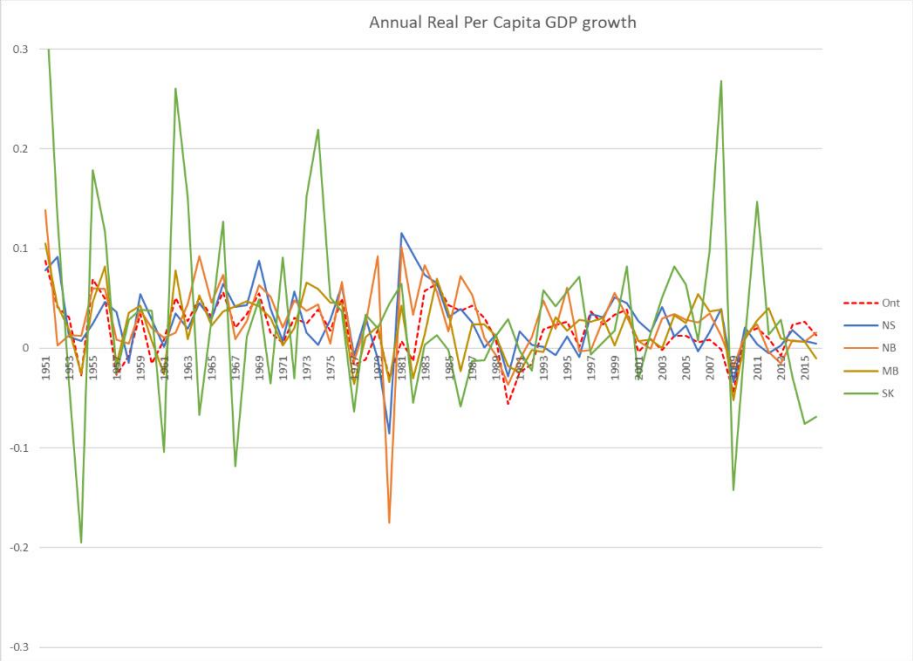
The EC-Pro model can be represented as a decomposition of GDP growth into contributions from growth in population and growth in per capita GDP. If the EC-Pro model is a reasonable abstraction, then per capita GDPs should be moving independently across provinces reflecting the role of province specific wage, capital returns and resource prices. Population growth contributes nothing to GDP growth by construction of the model. Instead, what we see in Figures 4 and 5 is that per capita GDPs across provinces having stable differences and roughly common movements suggesting integrated factor markets across provinces and lack of independent changes in factor prices. Saskatchewan does demonstrate a higher volatility of per capita GDP but prior to 1994, its growth was not higher than for the other provinces. Since 1994 and the rise of exports per capita GDP has risen considerably but so long as export values are changing, the per capita GDP is not at the long run equilibrium which is what CGE models project (Boyce and Emery 2011).

Figure 4



NOTES: Authors' calculations using Statistics Canada. Table 36-10-0229-01 Long-run provincial and territorial data and Statistics Canada. Table 18-10-0005-01 Consumer Price Index, annual average, not seasonally adjusted.

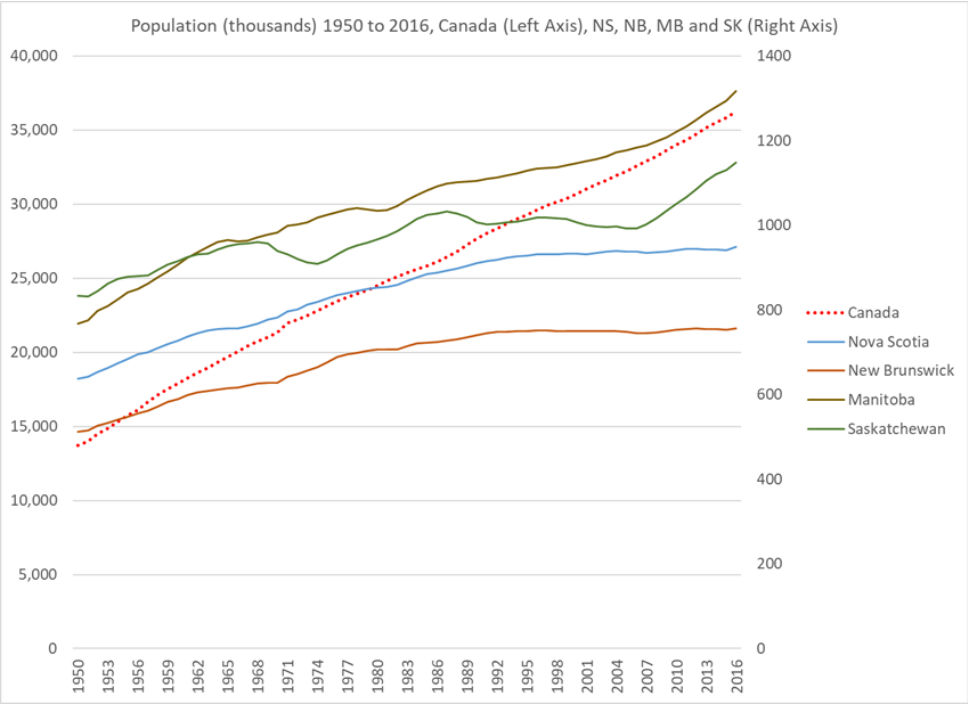
Figure 5



NOTES: Authors' calculations using Statistics Canada. Table 36-10-0229-01 Long-run provincial and territorial data and Statistics Canada. Table 18-10-0005-01 Consumer Price Index, annual average, not seasonally adjusted.

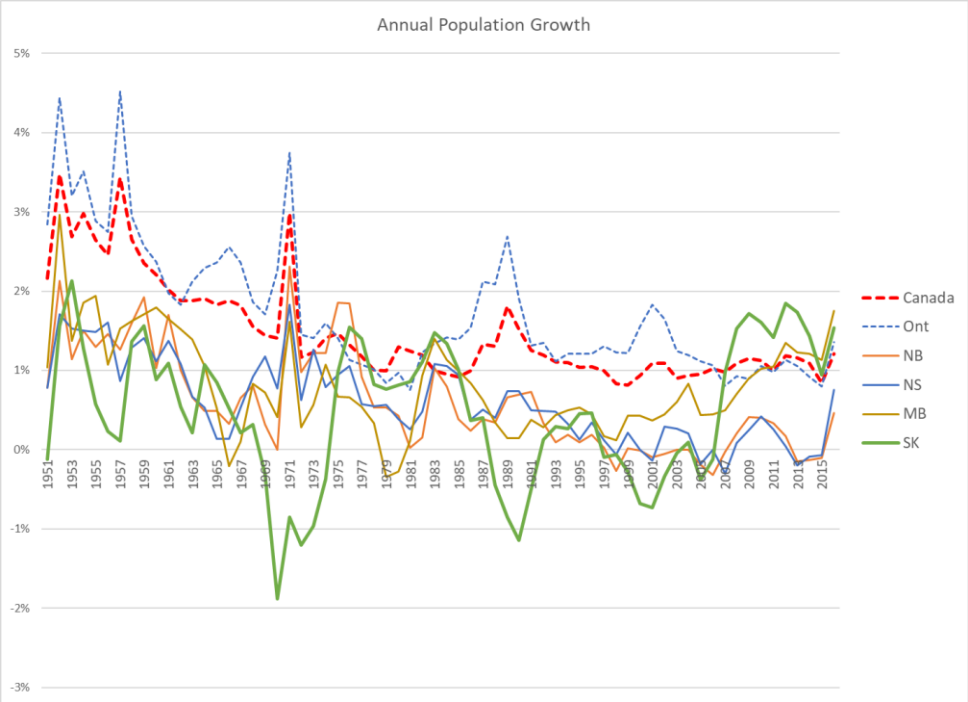
Figure 6 and 7 shows population growth has different trends across provinces. Saskatchewan's population size was stagnant, like that of Nova Scotia and New Brunswick, from 1965 to 2005. Saskatchewan's large sustained gains in GDP appear to be more a function of population increase than per capita GDP growth coincident with the investment boom in the province associated with oil and gas, potash, uranium and agriculture export demand.

Figure 6



NOTES: Authors' calculations using Statistics Canada. Table 36-10-0229-01 Long-run provincial and territorial data and Statistics Canada. Table 18-10-0005-01 Consumer Price Index, annual average, not seasonally adjusted.

Figure 7



NOTES: Authors' calculations using Statistics Canada. Table 36-10-0229-01 Long-run provincial and territorial data and Statistics Canada. Table 18-10-0005-01 Consumer Price Index, annual average, not seasonally adjusted.

Constant Returns to Scale and Sectoral Mobility in the ECCC Model

An important reason that the EC-Pro model would project limited impact of SCP on a provincial economy is that labour and capital can only shift from one sector to another within the province. This is the result of constant returns to scale production technologies in all sectors combining with fixed, regionally immobile supplies of inputs and adjustable factor prices. The model's results change fundamentally if there are in fact internal economies of scale (average costs fall with increasing quantity produced) or external economies of scale (agglomeration effects that confer cost advantages to locations with clusters of firms or larger populations).

Constant returns to scale (CRS) in production is a common assumption in economics for economic modelling since it simplifies the modelling exercise considerably. CRS is a necessary condition to support perfectly competitive industry assumptions with zero profit conditions and it eliminates the problem of "space" or geography in the model. With CRS, production is perfectly divisible in the sense that average costs are constant so you can distribute production activity wherever the market dictates but there are no advantages or disadvantages to the scale of production. There is no economic gravity pushing for concentration of industrial activity. With CRS, there is lesser importance of worrying about where production will occur.

With increasing returns to scale where there are cost advantages to producing on a larger scale, or through agglomeration effects of a larger number of firms co-located in a place, space becomes an important consideration in economies integrated by trade and factor mobility. Paul Krugman shows that introducing increasing returns to scale to a two-region model generates a core-periphery relationship where economic gravity pulls capital and labour from the periphery region to the core.[25] National economic growth is a product of the concentration of economic activity in the larger core economy and the hollowing out of the smaller periphery economy in terms of its population and capital stock. The increased scale of production in the core, and agglomeration effects create cost advantages for producers in the core over producers in the periphery. Only an immobile portion of the labour force where workers cannot transition from the resource industries to other sectors (immobile peasants in Krugman's model) keep the periphery economy in existence.

As a recent 2021 IMF study observed, in advanced economies with lagging regions, loss of a tradable industry like in oil and gas, does not easily translate into the emergence of other sectors to employ the displaced workers in the same region resulting in persistent non-employment (falling labour force participation) and population decline.[26] The IMF study observes that the plight of lagging regions in advanced economies like Canada is the product of international competition and technical change driving large and persistent regional disparities. These external shocks to the economy are sector and place specific, much as the federal climate policy shocks to regions will be, "hitting a sector in which some areas have had a traditional comparative advantage, such as textiles, shipbuilding, extractive industries and, in some cases, the automobile industry". That makes these shocks a negative and persistent impact on lagging regions. The authors ask "How do places adjust to these shocks, and how is it that, in some cases, the impacts are so persistent?" The authors summarize that adjustment mechanisms may fail for several reasons including downward rigidity in nominal wages due to institutional frictions and the setting of national rather than regional norms, resulting in unemployment.[27]

[25] Paul Krugman "Space: The Final Frontier" Journal of Economic Perspectives—Volume 12, Number 2—Spring 1998—Pages 161–174.
[26] Holger Floerkemeier, Nikola Spatafora, and Anthony Venables (2021) "Regional Disparities, Growth, and Inclusiveness" IMF Working Paper, Institute for Capacity and Development, WP/21/39, pages 16-17.
[27] Note, some CGE models impose a minimum wage below which the wage cannot fall. The rigidity discussed in the IMG report is at the pre-shock nominal wage which implies less capacity for wage adjustments to buffer against a negative shock.

The IMF study raises that negative shocks can have persistent effects on lagging regions even when wages are flexible and full employment is possible. The authors ask what sectors are likely to replace those that have been lost and highlight the challenge of shifting labour between sectors within the region:

> "Many of the traditional industries that have been hit by these changes involved highly sector-specific skills that are not attractive to potential inward investors. And, fundamentally, agglomeration economies often operate at the sectoral level ("economies of localization"). This means that sectoral clusters form (for instance, in finance, technology, and the creative industries), and that the first-mover problem is strong in such sectors. Those areas that have lost traditional tradable sectors do not offer an internationally competitive environment for these new sectors. These areas do however, if wages are low enough, offer an environment for non-tradable sectors supplying the domestic economy—for instance, back-office operations, warehousing, local food processing, and public sector administration. Such areas have therefore tended to fill up with these non-tradable sectors, often offering low-skill and low-wage jobs. The difficulty of setting up new tradable sectors (especially those with localization economies) means that it is possible for a country to end up both with regional disparities and with an inefficiently small tradable goods sector. This is a low level equilibrium trap, brought about by the first-mover problem." (pages 16-17)

This experience of lagging regions in advanced countries cannot be generated with a CGE model that assumes immobile factors of production and CRS.

How Important Are These Modelling Issues for Understanding the Impact of Climate Policies on Saskatchewan?

To demonstrate the importance of assumptions of factor mobility, and factor supply endogeneity, for the projected outcomes of climate policies, we use a version of the CGE model first developed in 2018 and applied to a number of regional economic contexts since 2018.[28] A brief explanation of the key considerations of the model follows, but interested readers are directed to Fellows et al. (2018) for a more thorough discussion of the model and a full equation listing. We use the Fellows et al. (2018) model to demonstrate the sensitivity of CGE modelled impacts of shocks on economic outcomes and we in no way suggest that we are using a model that is an alternative to the EC-Pro. **The EC-Pro model is rigorous, peer reviewed, and an excellent CGE model. Our point is that the EC-Pro model needs to be applied to provincial economy contexts under alternative sets of assumptions to identify the range of possible economic outcomes to climate policies.**

The Fellows et al. (2018) model represents 32 distinct production sectors in each of the 10 provinces and three additional territories (Yukon, an aggregation of Nunavut and Northwest Territories and an additional region representing Canadian territorial enclaves abroad). In addition to nested constant elasticity of substitution production functions for each production sector, the model also includes three additional aggregation functions representing final production sectors for consumption, investment and government spending goods. Government spending is held constant using the same lump-sum adjustment as described for the EC-Pro model to maintain a calibrated budget surplus or deficit as in the initial model calibration. As with the EC-Pro, the model has separate factor markets for labour, capital, and natural resources. Supply of these factors is either perfectly inelastic or perfectly elastic depending on the version of the model being specified (we run parallel counterfactual simulations on three versions of the model as discussed in more detail below).

Inter-regional and international trade is handled using a workhorse “Armington” formulation (Armington 1969). In this formulation, goods produced by the same sector but in different regions are treated as close but imperfect substitutes. Unlike the more recent version of EC-Pro, the model we employ is static in nature. This means that the modelled simulations are snapshots of the economy, given a set of input assumptions. Therefore, the results do not

[28] Fellows, G.K., Patterson, M., MacFarlane, A., Marriott, L., Carrothers, A. and Krause, J., 2018. Economic loss analysis to Prince Edward Island resulting from a prolonged closure of the Confederation Bridge. Canadian Journal of Regional Science, 41(1/3).Fellows, G. Kent, and Trevor Tombe. (2018) "*Opening Canada's North: A Study of Trade Costs in the Territories.*" The School of Public Policy Publications, 11/17.
Tombe, T., Munzur, A. and Fellows, G.K., (2021). *Implications of an Infrastructure Corridor for Alberta’s Economy.* The School of Public Policy Publications, 14/7.
Herb Emery and G Kent Fellows (2020) "*The economic impact of Alberta for the rest of Canada*" in Jack M. Mintz, Tom Flanagan, and Ted Morton, (eds.) Moment of Truth: How to Think about Alberta’s Future. Sutherland House

provide any insight into the speed at which the economic effects of our modelled shocks will manifest or the implications for longer term growth rates.

The model as employed is calibrated to 2011 input-output data from Statistics Canada, but sensitivity analysis using 2009 and 2010 data show generally consistent results.

We use the model to evaluate the impact of changes in oil exports for Saskatchewan ranging from a 25 percent permanent increase in export values down to the elimination of oil exports from the province. We do not model a specific climate policy but our illustrations are consistent with the application of a hard cap on oil and gas production at current output levels, or the impact of a complete phase out of oil and gas from the Saskatchewan economy that could be the extreme result of climate policies and/or a loss of competitiveness.

We run three versions of the model, each with a specific set of parameter assumptions. These are:

1) CGE with Perfectly Inelastic Factor Supply

   We use assumptions that labour and capital are immobile across provinces and factors prices adjust to clear factor markets as in most CGE models used to evaluate Canadian climate policies.

2) CGE with Perfectly Elastic Factor Supply

   Factor prices are held fixed and quantity adjustments endogenously adjust to clear factor markets however, the income generated by changes to labour and capital supply do not accrue to the representative agents (this is analogous to a type 1 IO model).

3) Pseudo IO-Model

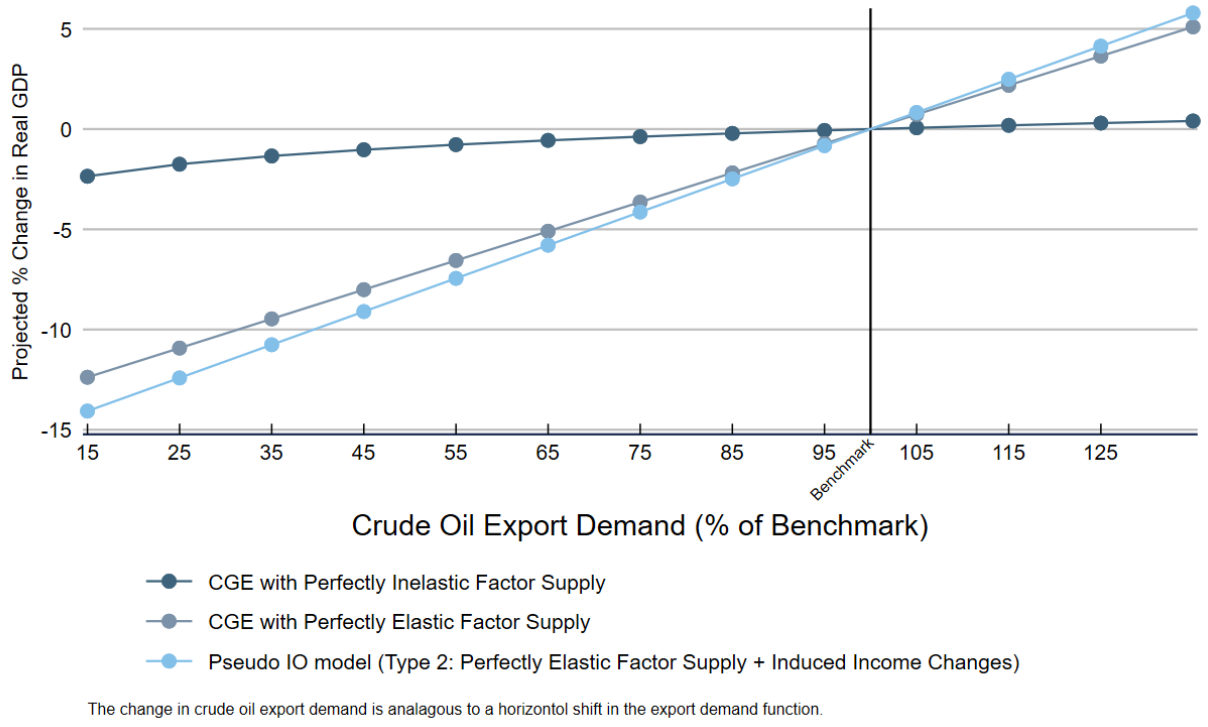
   Factor prices are again held fixed and we allow for induced effects wherein the income related to the endogenous changes in labour supply do accrue to the representative consumer (this is analogous to a type 2 IO model).

Thus, the CGE is our illustration of what the models highlighted by Navius Research are generally showing which are the small projected impacts of climate policies on a province's GDP growth. The Pseudo-IO model illustrates what happens to model outputs when economic adjustments reflect what we know about regional economic adjustment for smaller provinces in Canada. In this case, the negative impacts on GDP, employment, investment and resource revenues are large as we would expect from the published research on regional economic growth and adjustment.

Figure 8 shows that in the CGE model with immobile labour and capital, there is little impact of rising or falling oil exports on Saskatchewan GDP. If the province pursues its goal of a 25 percent increase in oil production, then the model says the gains to the province's GDP would negligible. A massive decrease in the value of oil exports from current levels of 85% would only reduce GDP by around 2% which suggests a negative growth rate of GDP as opposed to slower growing GDP. The Fellows et al. (2018) model does not include a temporal dimension for the speed of adjustment to the new economic equilibrium so we cannot translate the loss of GDP into an annual growth rate. We believe that these sizes of effects align with the results from other CGE models that Navius Research referred to in its critique of the University of Regina's CGE model.

The lack of large economic impacts in CGE models is not a problem of CGE models, but the assumptions the modelers choose to apply. CGE models under assumptions of immobile factors of production do not produce large changes in GDP. The Pseudo-IO model shows what happens with the CGE modelled impacts on the Saskatchewan economy when economic adjustment occurs through labour and capital mobility. Now the impacts of the province's goal of increasing oil production by 25% would be projected to increase GDP by 5%. A loss of 85% of oil export value would permanently reduce Saskatchewan GDP by around 12%.

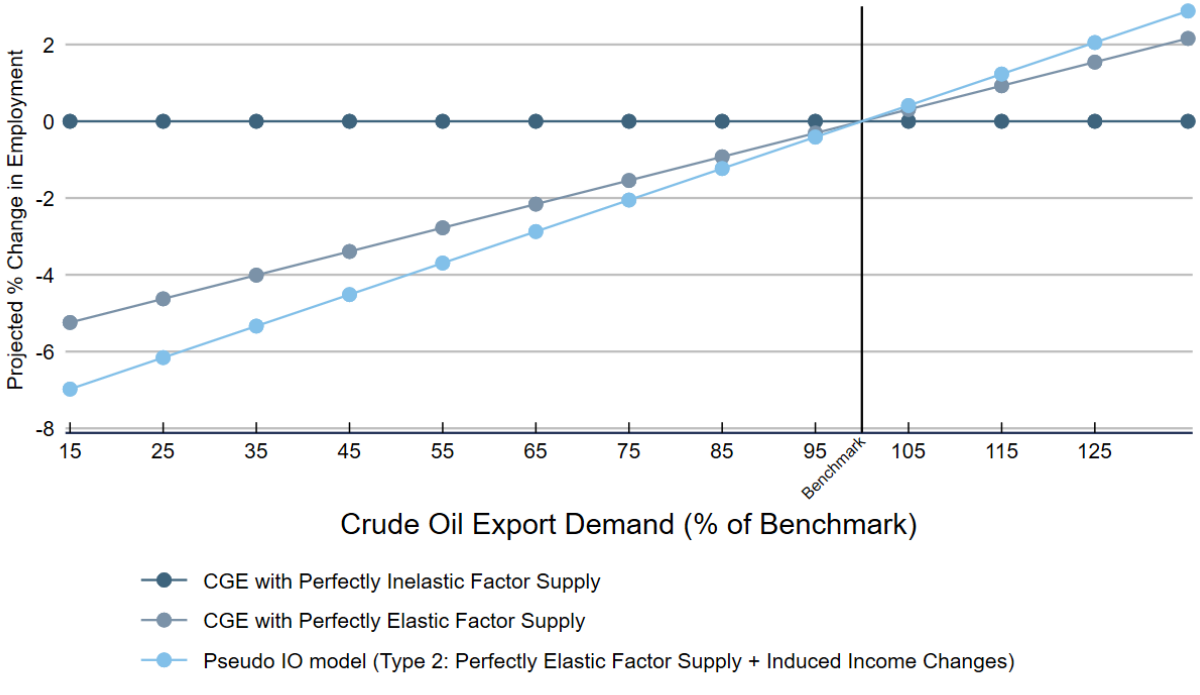
Figure 8



The change in crude oil export demand is analagous to a horizontol shift in the export demand function.

Figure 9 shows the changes in employment associated with a range of changes in oil exports. By construction, CGE models with inelastic labour supply generate no changes in employment (unless frictions are introduced). The Pseudo-IO model with elastic labour supply projects that a 25% increase in oil exports would increase employment by 2%, and an 85% reduction would result in an over 5% reduction in employment. These changes should be interpreted as driving population change since labour is migrating to other provinces when oil exports decline, and move to the province when oil exports increase. Since per capita GDP does not adjust in the Pseudo-IO model run by assumption, the changes in GDP translate to changes in Saskatchewan's population size. If oil exports increased 25% then Saskatchewan's population would increase to 1,260,000. If oil exports decrease by 85%, then Saskatchewan's population will fall back to 1,060,000.

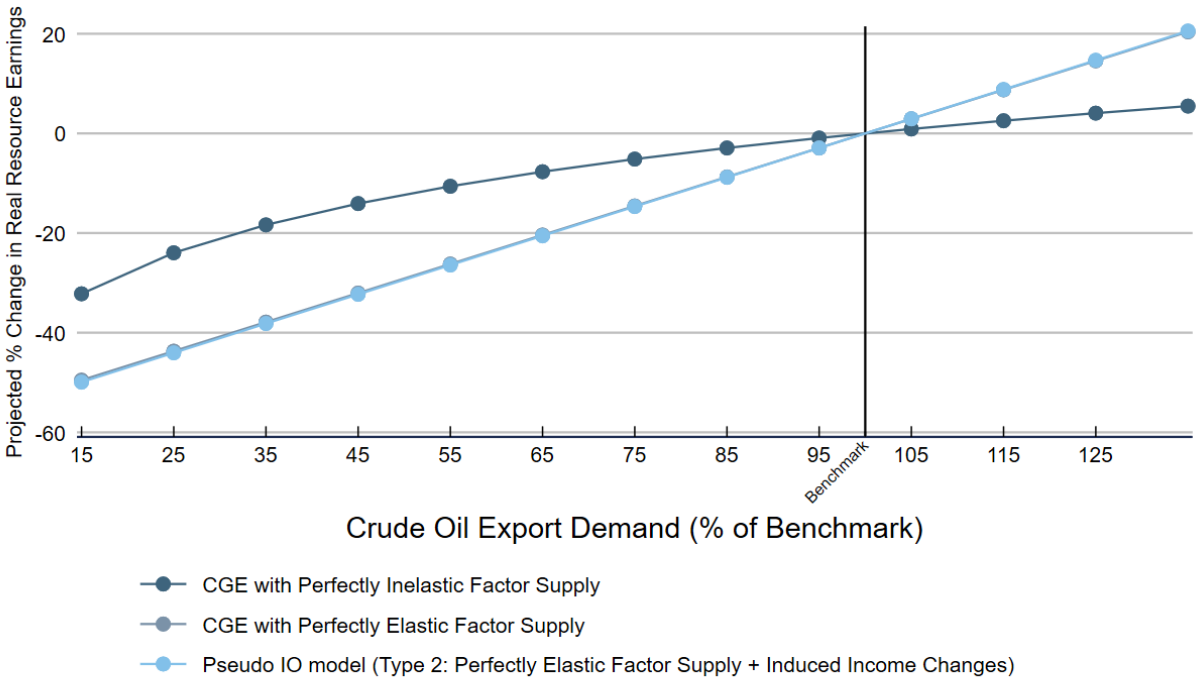
Figure 9



The change in crude oil export demand is analagous to a horizontol shift in the export demand function.

Figure 10 shows the changes in the income of the resource factor of production. Here we see that the CGE model does generate more sizeable changes with large reductions in oil exports, but small gains from increasing oil exports. The Pseudo-IO model shows gains in resource revenues from increased exports and larger decreases than with the CGE assumptions in the resource revenues as oil exports fall. Chambers and Gordon (1966) showed that with mobile labour between sectors and regions, the biggest impact of export demand was on the income of "land" or resources which is immobile. In concrete terms, the earnings of resources should be associated with the resource revenues of the provincial government and the value of real estate in the province. In the latter case, population change is a bigger driver of land prices.

Figure 10



Resource Earnings are modelled as a Ricardian rent on resources.
The change in crude oil export demand is analagous to a horizontol shift in the export demand function.

Conclusion

There is nothing wrong the ECCC or any other CGE models for studying the national economy, or in principle for studying provincial economies. Whether a model is giving reasonable projections of climate policy impacts on the actual economy requires assessment. In a 2022 Briefing Note, "The ABCs of EEE models for non-modelers", Mark Jaccard argues that when assessing "energy-economy-emissions" (EEE) models, "non-modelers should first ask what is exogenous and what is endogenous, and the answer should make sense for the questions that are being addressed by the model. Then, when assessing exogenous assumptions, the non-modeler should see evidence that these scenario assumptions are internally consistent. Finally, when assessing endogenous model results, the non-modeler should see evidence that the behavioral parameters and technology characteristics (cost, efficiency, emissions, risks) are credible and consistent with best practices".[29] We believe that the current application of CGE models to Canadian provinces, including Saskatchewan are not applying assumptions that reasonably represent how these subnational economies will adjust in response to Canada's aggressive climate goals and policies to reach them. The modeled projections showing little impact of Canada's decarbonization on the economies of Saskatchewan and other provinces are the result of exogeneity assumptions in the model. Under a different set of assumptions that more reasonably represent what we know about subnational regional economic adjustment, the model could generate sizeable, and potentially economically devastating, economic impacts of climate policies for smaller, periphery provincial economies and sizeable gains for the larger core economy provinces like Ontario.

For studying provincial economies, CGE models need to apply different assumptions than they currently are using. Models must allow for labour and capital mobility across provinces and introduce agglomeration effects to identify how policies that shift production away from resource based industries to services will regionally redistribute employment and population. CGE model outputs are highly sensitive to these high level assumptions about factor market adjustments and spatial impacts of policy changes and economic shocks. The models should be used to assess the ranges of potential impacts of climate policies. The range of outputs under different assumptions should be validated against what we know about regional economic adjustment in Canada, and not simply in terms of the agreement of outputs with other CGE models.

The CGE models with assumptions of fixed factor supplies and flexible factor prices are not appropriate for evaluating the impacts of climate policies on resource exporting provinces like Saskatchewan. Under assumptions like fixed factor supplies the models are also not useable for answering questions about the spatial distribution of climate policy burdens across provinces

[29] Mark Jaccard, "The ABCs of EEE models for non-modelers", January 2022.

when analysis is focused on the national economy. This means that the likely impacts of the suite of climate policies and actions under the SCP and HEHE on Saskatchewan should be considered as not known. Based on how the economy actually adjusts to economic and policy shocks, the climate policies pose important risks to the provincial economy that may trigger slower population growth, more rapid population aging and much lower GDP.

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