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IMPLICATIONS OF AN INFRASTRUCTURE CORRIDOR FOR ALBERTA'S ECONOMY

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FOREWORD

THE CANADIAN NORTHERN CORRIDOR RESEARCH PROGRAM PAPER SERIES

This paper is part of a special series in *The School of Public Policy Publications*, examining the potential for economic corridors in Canada. This paper is an output of the Canadian Northern Corridor Research Program.

The Canadian Northern Corridor Research Program at The School of Public Policy, University of Calgary is the leading platform for providing information and analysis necessary to establish the feasibility and desirability of a network of multi-modal rights-of-way across middle and northern Canada. Endorsed by the Senate of Canada, this work responds to the Council of the Federation's July 2019 call for informed discussion of pan-Canadian economic corridors as a key input to strengthening growth across Canada and "a strong, sustainable and environmentally responsible economy." This Research Program will help all Canadians benefit from improved infrastructure development in Canada.

This paper *"Implications of an Infrastructure Corridor for Alberta's Economy"* falls under the Economic Outcomes theme of the program's eight research themes:

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Dr. Jennifer Winter
Program Director, Canadian Northern Corridor Research Program

IMPLICATIONS OF AN INFRASTRUCTURE CORRIDOR FOR ALBERTA'S ECONOMY

Trevor Tombe[†], Alaz Munzur and G. Kent Fellows

KEY MESSAGES

- The benefits of increased pipeline access for Alberta's economy are well known. The benefits of infrastructure corridors, however, go far beyond pipelines. By reducing interprovincial and international trade costs, multimodal infrastructure corridors of road, rail, utilities and communications can potentially create large economic benefits.
- Given that expanded transportation infrastructure capacity can lower trade costs, governments hoping to expand internal trade should explore means of increasing such capacity, especially the possibility of increased rail shipment capacity.
- Priority should be given to infrastructure capacity and policy changes that promote increased trade to underserved markets within the United States and to other international markets.
- Combining rich data on interprovincial trade flows with mode-specific shipment data on volumes, values and shipment costs, we find that rail shipments are a lower cost means of exporting goods for long-distance trade. We estimate that increased rail penetration lowers trade costs by roughly 0.3 per cent for each percentage point of rail's share of shipments.
- We find that lowering trade costs substantially increases Alberta's real GDP through its effect on international and interprovincial trade flows. Infrastructure capacity is particularly valuable, as we find that increasing the share of exports shipped by rail by 10 percentage points may increase Alberta's GDP by nearly 1.5 per cent in the short-run and over 2.5 per cent in the long-run — equivalent to over $9 billion per year in economic activity.
- Governments should expand support for research activities into the feasibility and potential benefits of dedicated multimodal infrastructure corridors in Canada and increase the collection and reporting of relevant data on internal trade to facilitate research into the costs producers and consumers face, and the potential gains from internal trade liberalization.

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RÉPERCUSSIONS D'UN CORRIDOR D'INFRASTRUCTURE SUR L'ÉCONOMIE ALBERTAINE

Trevor Tombe[†], Alaz Munzur et G. Kent Fellows

MESSAGES CLÉS

- Les avantages, pour l'économie de l'Alberta, d'un accès accru aux pipelines sont bien connus. Cependant, les avantages d'un corridor d'infrastructure vont bien au-delà de la question des pipelines. En réduisant les coûts du commerce interprovincial et international, les corridors d'infrastructures multimodales (routes, voies ferrées, services publics et communications) peuvent générer d'importants avantages économiques.
- Étant donné qu'une capacité accrue de l'infrastructure de transport peut réduire les coûts du commerce, les gouvernements qui souhaitent développer le commerce intérieur devraient explorer les moyens d'augmenter cette capacité, en particulier la possibilité d'augmenter la capacité de transport ferroviaire.
- Il faudrait accorder priorité à la capacité de l'infrastructure ainsi qu'aux changements de politique qui favorisent un commerce accru vers les marchés mal desservis aux États-Unis, ou encore vers d'autres marchés internationaux.
- En combinant de riches données sur les flux commerciaux interprovinciaux avec des données sur le volume, la valeur et le coût d'expédition selon le mode de transport, nous constatons qu'il est moins coûteux pour le commerce à longue distance d'exporter les marchandises par chemin de fer. Nous estimons qu'une pénétration accrue du rail permet de réduire les coûts du commerce d'environ 0,3 % pour chaque point de pourcentage de la part expédiée par transport ferroviaire.
- Nous constatons qu'une réduction des coûts du commerce augmente considérablement le PIB réel de l'Alberta en raison de son effet sur les flux commerciaux internationaux et interprovinciaux. La capacité de l'infrastructure est particulièrement précieuse, car nous observons qu'une augmentation de 10 points de pourcentage de la part des exportations par chemin de fer peut accroître le PIB de l'Alberta de près de 1,5 % à court terme et de plus de 2,5 % à long terme, soit plus de 9 milliards de dollars en activités économiques par année.

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- Les gouvernements devraient élargir le soutien aux activités de recherche sur la faisabilité et sur les avantages potentiels des corridors d'infrastructures multimodales au Canada. Ils devraient aussi accroître la collecte et la communication de données pertinentes sur le commerce intérieur afin de faciliter la recherche sur les coûts auxquels les producteurs et les consommateurs sont confrontés, ainsi que sur les gains potentiels émanant d'une libéralisation du commerce.

SUMMARY

Improving access to domestic and international markets can create large economic benefits. Multimodal infrastructure corridors of road, rail, utilities and communications can improve accessibility by reducing interprovincial and international trade costs. Depending on the geographical area they serve and the modes of transport and types of connections they promote, infrastructure corridors can create trade-offs and synergies between different kinds of economic, social, and environmental outcomes. Yet the implied effects can vary across different regions, population segments and industries. A complete review of a proposed infrastructure corridor package involves a rigorous analysis of all of these potential effects. In this paper, we focus more specifically on quantifying potential gains from reductions in trade costs on Alberta's economy and identify the importance of improved access to lower cost transportation options like rail for select commodities. We find that lowering trade costs substantially increases Alberta's real GDP through its effect on international and interprovincial trade flows.

Although interprovincial tariffs on domestic goods are forbidden by the Canadian Constitution, the economic effect of internal non-tariff trade barriers is substantial. Albrecht and Tombe (2016) show that eliminating these interprovincial trade costs would increase Canada's GDP between three to seven per cent. These barriers represent additional costs on Canadian firms and adversely affect their competitiveness in domestic and international markets. High interprovincial trade costs may also pose an additional barrier to entry for foreign firms otherwise willing to enter the Canadian market. As a result of this, Canadian firms end up producing at a less efficient scale and pass the cost of these inefficiencies to consumers. Interprovincial trade costs therefore hurt both producers and consumers.

Gains from improved infrastructure are also amplified by the interconnected nature of industries. Output of one industry is often an input for another industry. Shipments cross provincial and national borders as part of these supply-chain relationships which allow for more efficient production but at the same time create additional trade costs on producers. Infrastructure corridors provide one option to lower these trade costs by increasing transportation capacity, creating savings in travel time and distance, creating better quality physical transport infrastructure, simplifying the regulatory and legislative differences across provinces and territories, and improving access to information, to name a few.

To quantify the potential effect of increased transportation infrastructure on trade costs, we combine rich data on interprovincial trade flows and shipment-level information on volumes, values, and transportation costs by mode. We empirically estimate the potential for increased rail shipment capacity on shipment costs between various internal trade pairs within Canada. Two key results stand out. First, we find that while distance is an important factor, a higher share of shipments by rail is associated with markedly lower trade costs. Specifically, we find a 10 percentage point increase in the share of value shipped by rail is associated with a 3.2 per cent lower aggregate cost of trade after controlling for commodity, source, and destination of shipments. Second, we also find important differences in the relevance of rail across commodities. We find

larger trade costs reductions for coal, mineral products, and fuel oils. The focus on rail is an important one for Alberta since coastal or canal shipping is not a feasible alternative.

As a natural next step, we then evaluate the potential gains to Alberta's economy from increased access to internal and international markets that improved infrastructure might provide. We find that lowering trade costs substantially increases Alberta's real GDP through its effect on international and interprovincial trade flows, in both the short run and the long run. The results show that, in the short run, lower trade costs by one per cent increases real GDP by roughly 0.8 per cent and lower trade costs by five per cent increases real GDP by roughly 4.4 per cent. These correspond to approximately $3 billion to $15 billion per year in additional economic activity in Alberta. We find larger gains in the long-run, equivalent to roughly a one per cent increase in real GDP for each one per cent reduction in trade costs. Gains from lower trade costs come primarily through lower cost access to imported inputs and final goods. There are also gains from increased demand by purchases outside Alberta on goods produced by Albertans. This increases real incomes and productivity, which is captured by the increase in real GDP.

The combined results of lower import costs and an increase in GDP imply an about six per cent long-run increase in real personal income, equal to an extra $6,423 annually for the median Alberta family. This is a level effect and represents a persistent increase, not a one-time bump. That is, GDP is permanently higher and by extension, annual personal incomes are also permanently higher. Although we don't explore the infrastructure investment options for lowering the trade costs by these levels, the corresponding impacts on real GDP of doing so indicate how high the costs of expanding infrastructure could be while still yielding net benefits to Alberta.

An infrastructure corridor could facilitate the expansion of Canada's rail shipment capacity. While many transportation modes could expand within such a corridor — including roads, pipelines, transmission lines and so on — our data allow us to specifically quantify the extent to which Alberta's economy could gain from more access to lower cost shipment options like rail. Rail shipment costs are lower than truck transportation when distances are sufficiently long. We find that each one percentage point increase in the share of non-air trade sent by rail is associated with a 0.32 per cent lower trade cost. This implies that if the share shipped by rail increased by 10 percentage points, then trade costs to and from Alberta would, on average, decline by 3.2 per cent.

Expanding the rail capacity is particularly valuable for Alberta, since increasing the share of exports shipped by rail by ten 10 percentage points may increase Alberta's GDP by nearly 1.5 per cent in the short-run and over 2.5 per cent in the long-run — equivalent to over $9 billion per year in economic activity. This is a relatively large increase in economic productivity — equivalent to roughly $4,500 per household, on average, per year — and, in addition, it abstracts from other potential sources of gains, such as increased labour migration into the province.

The combined increase in GDP and lower import costs from increased rail penetration imply an increase in real personal income. It is more modest here at approximately 3.3 per cent (rather than six per cent), but still very significant and equal to an extra $3,419 annually for the median Alberta family. As before, it is important to note that this is a level effect and represents a persistent increase and permanently higher annual GDP and annual personal incomes.

Our analysis is only a first step and explores only one potential effect of expanding infrastructure capacity. Overall, the potential for positive economic effects from multi-modal infrastructure corridors is compelling and warrants additional investigation. Governments can play a role by supporting expanded research activities into the feasibility and potential benefits of dedicated multimodal infrastructure corridors in Canada. In addition, though we made progress using detailed shipment-level data, there are shortcomings in coverage and detail that constrain the scope for potential research. Governments should therefore increase the collection and reporting of relevant data on internal trade to facilitate research into the costs producers and consumers face, and the potential gains from internal trade liberalization. Despite the value of expanding research capacity, our analysis points clearly towards the potential gains from internal trade liberalization. Expanded transportation infrastructure capacity can lower trade costs, and therefore governments hoping to expand internal trade should explore means of increasing such capacity, especially the possibility of increased rail shipment capacity.

RÉSUMÉ

Améliorer l'accès aux marchés nationaux et internationaux peut apporter d'importants avantages économiques. Les corridors d'infrastructures multimodales (routes, voies ferrées, services publics et communications) favorisent l'accessibilité puisqu'ils réduisent les coûts du commerce interprovincial et international. En fonction de la zone géographique qu'ils desservent, ainsi que des modes de transport et des types de connexions qu'ils facilitent, les corridors d'infrastructure peuvent générer des synergies entre divers types d'activités économiques, sociales et environnementales. Cependant, les effets implicites peuvent varier selon les régions, les segments sociaux ou les industries. Ainsi, l'examen complet du modèle de corridor d'infrastructure proposé implique une analyse rigoureuse de tous les effets potentiels. Dans cet article, nous nous efforçons plus particulièrement de quantifier les gains potentiels d'une réduction des coûts du commerce sur l'économie de l'Alberta. Nous relevons aussi l'importance d'un meilleur accès à des choix de transport moins coûteux, comme le train, pour certains produits. Nous constatons qu'une réduction des coûts commerciaux augmente considérablement le PIB réel de l'Alberta en raison de son effet sur les flux commerciaux internationaux et interprovinciaux.

Bien que les tarifs interprovinciaux sur les produits nationaux soient interdits par la constitution canadienne, l'effet économique des barrières commerciales internes non tarifaires est considérable. Albrecht et Tombe (2016) montrent que leur élimination augmenterait le PIB du Canada de 3 à 7 %. En effet, ces barrières représentent des coûts supplémentaires pour les entreprises canadiennes et nuisent à leur compétitivité sur les marchés nationaux et internationaux. Les coûts élevés du commerce interprovincial peuvent également constituer un obstacle supplémentaire à l'entrée d'entreprises étrangères sur le marché canadien. Par conséquent, la production des entreprises canadiennes se fait à une échelle de moindre efficacité et le coût de cette inefficacité se répercute sur les consommateurs. Les coûts du commerce interprovincial nuisent donc tant aux producteurs qu'aux consommateurs.

Les gains découlant d'une amélioration de l'infrastructure sont également amplifiés par l'interconnexion entre les industries. La production finale d'une industrie constitue souvent le point de départ d'une autre industrie; les marchandises expédiées traversent les frontières provinciales et nationales. Ces relations de chaîne d'approvisionnement rendent plus efficace la production, mais elles créent en même temps des coûts commerciaux supplémentaires pour les producteurs. Les corridors d'infrastructure sont une façon de réduire les coûts commerciaux en augmentant la capacité de transport, en favorisant des économies de temps et de déplacement, en créant une infrastructure de transport physique de meilleure qualité, en simplifiant les différences réglementaires et législatives entre les provinces et les territoires et en améliorant l'accès à l'information, pour ne citer que quelques exemples.

Pour quantifier l'effet d'une infrastructure de transport accrue sur les coûts commerciaux, nous combinons des données riches sur les flux commerciaux interprovinciaux avec des données sur le volume, la valeur et le coût des expéditions selon le mode de transport. Nous estimons empiriquement le potentiel d'une augmentation de la capacité

d'expédition ferroviaire sur les coûts d'expédition entre divers partenaires commerciaux au Canada. Il en ressort deux principaux résultats. Premièrement, nous observons que si la distance est un facteur important, une part plus élevée des expéditions par chemin de fer est associée à des coûts commerciaux nettement inférieurs. Plus précisément, nous constatons qu'une augmentation de 10 points de pourcentage de la part expédiée par chemin de fer est associée à une réduction de 3,2 % du coût global du commerce, et ce, après avoir tenu compte du produit, de la source et de la destination des expéditions. Deuxièmement, nous constatons également d'importantes différences de la pertinence du chemin de fer selon les produits. Nous observons une réduction plus importante des coûts commerciaux pour le charbon, les produits miniers et le mazout. L'accent mis sur le chemin de fer est important pour l'Alberta, car la navigation côtière ou par canal n'est pas une solution envisageable.

Nous évaluons ensuite les gains potentiels qui découlent d'un accès accru aux marchés intérieurs et internationaux grâce à une amélioration de l'infrastructure. Nous constatons qu'une réduction des coûts du commerce augmente considérablement le PIB réel de l'Alberta, et ce, en raison de l'effet sur les flux commerciaux internationaux et interprovinciaux, à court et à long terme. Les résultats montrent qu'à court terme, une baisse des coûts du commerce de 1 % augmente le PIB réel d'environ 0,8 %, tandis qu'une baisse de 5 % des coûts du commerce augmente le PIB réel d'environ 4,4 %. Cela correspond à environ 3 à 15 milliards de dollars par année d'activité économique supplémentaire en Alberta. Nous observons des gains plus importants à long terme, équivalant à une augmentation d'environ 1 % du PIB réel pour chaque réduction de 1 % des coûts du commerce. Ces gains proviennent principalement d'un accès à moindre coût aux intrants et aux produits finaux importés. Il y a aussi des gains en raison d'une demande accrue d'achats à l'extérieur de l'Alberta de biens produits par les Albertains. Cela augmente les revenus réels et la productivité, ce qui se traduit par une augmentation du PIB réel.

Les résultats combinés d'une baisse des coûts d'importation et d'une augmentation du PIB se traduisent par une augmentation à long terme d'environ 6 % du revenu personnel réel, ce qui équivaut à 6 423 $ de plus par année pour la famille médiane albertaine. C'est là un effet de niveau qui représente une augmentation constante, et non un soubresaut ponctuel. Autrement dit, le PIB est plus élevé de façon permanente et, par conséquent, les revenus personnels annuels le sont aussi. Bien que nous ne nous penchions pas sur les choix d'investissement dans l'infrastructure pour abaisser les coûts commerciaux à ce niveau, les effets sur le PIB réel indiquent à quel point les coûts d'expansion de l'infrastructure peuvent s'élever tout en procurant des avantages nets à l'Alberta.

Un corridor d'infrastructure pourrait faciliter l'expansion de la capacité d'expédition ferroviaire au Canada. Alors que de nombreux modes de transport pourraient se développer le long d'un tel corridor – notamment des routes, des pipelines, des lignes de transport, etc. – nos données nous permettent de quantifier précisément dans quelle mesure l'économie de l'Alberta bénéficierait d'un meilleur accès à des modes d'expédition à moindre coût comme le train. Les frais de transport ferroviaire sont inférieurs à ceux du transport par camion lorsque les distances sont suffisamment

longues. Nous constatons que chaque augmentation d'un point de pourcentage de la part du commerce non aérien acheminé par chemin de fer est associée à une réduction des coûts du commerce de 0,32 %. Autrement dit, si la part expédiée par chemin de fer augmentait de 10 points de pourcentage, les coûts du commerce à destination et en provenance de l'Alberta diminueraient en moyenne de 3,2 %.

L'augmentation de la capacité ferroviaire est particulièrement intéressante pour l'Alberta, car une augmentation de 10 points de pourcentage de la part des exportations transportées par chemin de fer peut accroître le PIB de l'Alberta de près de 1,5 % à court terme et de plus de 2,5 % à long terme, ce qui équivaut à plus de 9 milliards de dollars par année en activité économique. Il s'agit d'une augmentation appréciable de la productivité économique – équivalant à environ 4 500 $ par ménage, en moyenne, par année –; augmentation qui, en outre, ne tient pas compte d'autres sources potentielles de gains, comme l'augmentation de la migration de main-d'œuvre vers la province.

La hausse du PIB, combinée à une baisse des coûts d'importation résultant d'une pénétration accrue du rail, se traduit par une augmentation du revenu personnel réel. Le chiffre est plus modeste ici, à environ 3,3 % (au lieu de 6 %), mais tout de même très important, et cela équivaut à 3 419 $ de plus par année pour la famille médiane albertaine. Encore ici, il est important de noter qu'il s'agit d'un effet de niveau qui représente une augmentation durable et permanente du PIB annuel et des revenus personnels annuels.

Notre analyse n'est qu'une première étape et se penche sur un seul effet de l'expansion de l'infrastructure. Dans l'ensemble, le potentiel des effets économiques positifs attribuables aux corridors d'infrastructures multimodales est convaincant et justifie des recherches supplémentaires. En ce sens, les gouvernements peuvent jouer un rôle en soutenant des activités de recherche sur la faisabilité et les avantages des corridors d'infrastructures multimodales au Canada. En outre, bien qu'il y ait amélioration dans l'utilisation des données détaillées sur les expéditions de marchandise, il y a des lacunes dans la couverture et le détail desdites données, ce qui limitent la portée potentielle de la recherche. Les gouvernements devraient donc accroître la collecte et la communication de données pertinentes sur le commerce intérieur afin de faciliter la recherche sur les coûts auxquels les producteurs et les consommateurs sont confrontés, ainsi que les gains potentiels d'une libéralisation du commerce intérieur. Indépendamment de l'intérêt pour une augmentation de la capacité de recherche, notre analyse indique clairement les gains potentiels de la libéralisation du commerce intérieur. L'élargissement de la capacité de l'infrastructure de transport permet de réduire les coûts du commerce, c'est pourquoi les gouvernements qui souhaitent développer le commerce intérieur devraient explorer les moyens d'augmenter cette capacité, en particulier la possibilité d'augmenter la capacité de transport ferroviaire.

INTRODUCTION

The benefits of increased pipeline access for Alberta's economy are well known. The benefits of infrastructure corridors, however, go far beyond pipelines. By reducing interprovincial and international trade costs, multimodal infrastructure corridors of road, rail, utilities and communications can potentially create large economic benefits. In this paper, we quantify the potential economic gains in Alberta from reductions in trade costs and identify the importance of improved access to lower cost transportation options like rail for select commodities. We find that lowering trade costs substantially increases Alberta's real GDP through its effect on international and interprovincial trade flows.

Based on the specific needs of the communities they intend to serve, infrastructure corridors can include a variety of modes to create an entirely new network or upgrade a pre-existing network by creating new links and gateways. Multimodal infrastructure corridors are costly initiatives. As the extensive literature review by Roberts et al. (2020) shows, depending on the geographical area they serve and the modes of transport and types of connections they promote, infrastructure corridors can create trade-offs and synergies between different kinds of economic, social and environmental outcomes. Yet the implied effects can vary across different regions, population segments and industries. A complete review of a proposed infrastructure corridor package involves a rigorous analysis of all of these potential effects. In this paper, we focus more specifically on quantifying the potential gains of reduced trade costs on Alberta's economy.

The evidence from existing literature suggests that on average, infrastructure corridors have significant economic benefits, including higher real income, improved allocative efficiencies, higher levels of investment and productivity, savings from lower trade costs and opportunities for industrial diversification (Roberts et al. 2020). Infrastructure corridors provide these economic benefits mainly by improving access to domestic and international markets. In Canada's case, infrastructure capacity has been at the centre of internal trade initiatives since Confederation. Although interprovincial tariffs on domestic goods are forbidden by the Canadian Constitution, the economic effect of internal non-tariff trade barriers is substantial. Albrecht and Tombe (2016) show that eliminating these interprovincial trade costs would increase Canada's GDP between three to seven per cent. Beaulieu et al. (2003) provide a detailed summary on the nature of internal non-tariff trade barriers in Canada. These barriers represent additional costs on Canadian firms and adversely affect their competitiveness in domestic and international markets. High interprovincial trade costs may also pose an additional barrier to entry for foreign firms otherwise willing to enter the Canadian market. As a result of this, Canadian firms end up producing at a less efficient scale and pass the cost of these inefficiencies to consumers. Interprovincial trade costs therefore hurt both producers and consumers.

Gains from improved infrastructure are also amplified by the interconnected nature of industries. Output of one industry is often an input for another industry. Shipments cross provincial and national borders as part of these supply-chain relationships

which allow for more efficient production but at the same time create additional trade costs on producers. Albrecht and Tombe (2016) find that the economic gains from reductions to trade costs are larger for industries like agriculture, chemicals and mining, which operate in highly integrated geographic supply chains. Infrastructure corridors provide one option to lower these trade costs by increasing transportation capacity, creating savings in travel time and distance, creating better quality physical transport infrastructure, simplifying the regulatory and legislative differences across provinces and territories, and improving access to information, to name a few.

To quantify the potential effect of increased transportation infrastructure on trade costs, we combine rich data on interprovincial trade flows and shipment-level information on volumes, values and transportation costs by mode. We empirically estimate the potential for increased rail shipment capacity on shipment costs between various internal trade pairs within Canada. Two key results stand out. First, we find that while distance is an important factor, a higher share of shipments by rail is associated with markedly lower trade costs. Specifically, we find a 10 percentage point increase in the share of value shipped by rail is associated with a 3.2 per cent lower aggregate cost of trade after controlling for commodity, source and destination of shipments. Second, we also find important differences in the relevance of rail across commodities. We find larger trade costs reductions for coal, mineral products and fuel oils, for example. The focus on rail is an important one for Alberta as a Prairie province since coastal or canal shipping is not feasible in Alberta or Saskatchewan (as it is in the rest of Canada).

We go beyond quantifying the potential trade cost reductions from increased infrastructure capacity and attempt to quantify the potential economic gains that might result. Our particular focus is on the province of Alberta. To accomplish this, we use a detailed computable general equilibrium model of Canada's economy developed by Fellows et al. (2018). We find that lowering trade costs substantially increases Alberta's real GDP through its effect on international and interprovincial trade flows. Infrastructure capacity is particularly valuable, as we find that increasing the share of exports shipped by rail by 10 percentage points may increase Alberta's GDP by nearly 1.5 per cent in the short run and over 2.5 per cent in the long run — equivalent to over $9 billion per year in economic activity. An important qualification on this figure is that it largely represents gains outside of Alberta's oil and gas sector. As indicated, we focus our projections here on increasing Alberta's rail capacity which presents only limited benefit to the oil and gas sector (which is generally reliant on pipeline infrastructure). Previous work has indicated that the benefits of additional crude oil pipeline capacity could be as high as $13 billion annually, depending on the state of international oil markets (Fellows 2018).[1] As such, the projections produced here can be considered as separate from the economic impacts of pipeline access.

[1] The $13 billion figure is based on analysis using 2018 and prior Alberta and world oil prices. Significant reductions in global oil prices would likely moderate this estimate.

The remainder of the paper proceeds with a brief review of Alberta's import and export patterns, and of mode-specific shipment data from Statistics Canada, followed by our empirical estimates of the effect of infrastructure on trade costs. We then provide a brief description of the model used to quantify potential gains before discussing at greater length the economic effects of lowering trade costs. We pay particular attention to gains from increased rail shipment capacity.

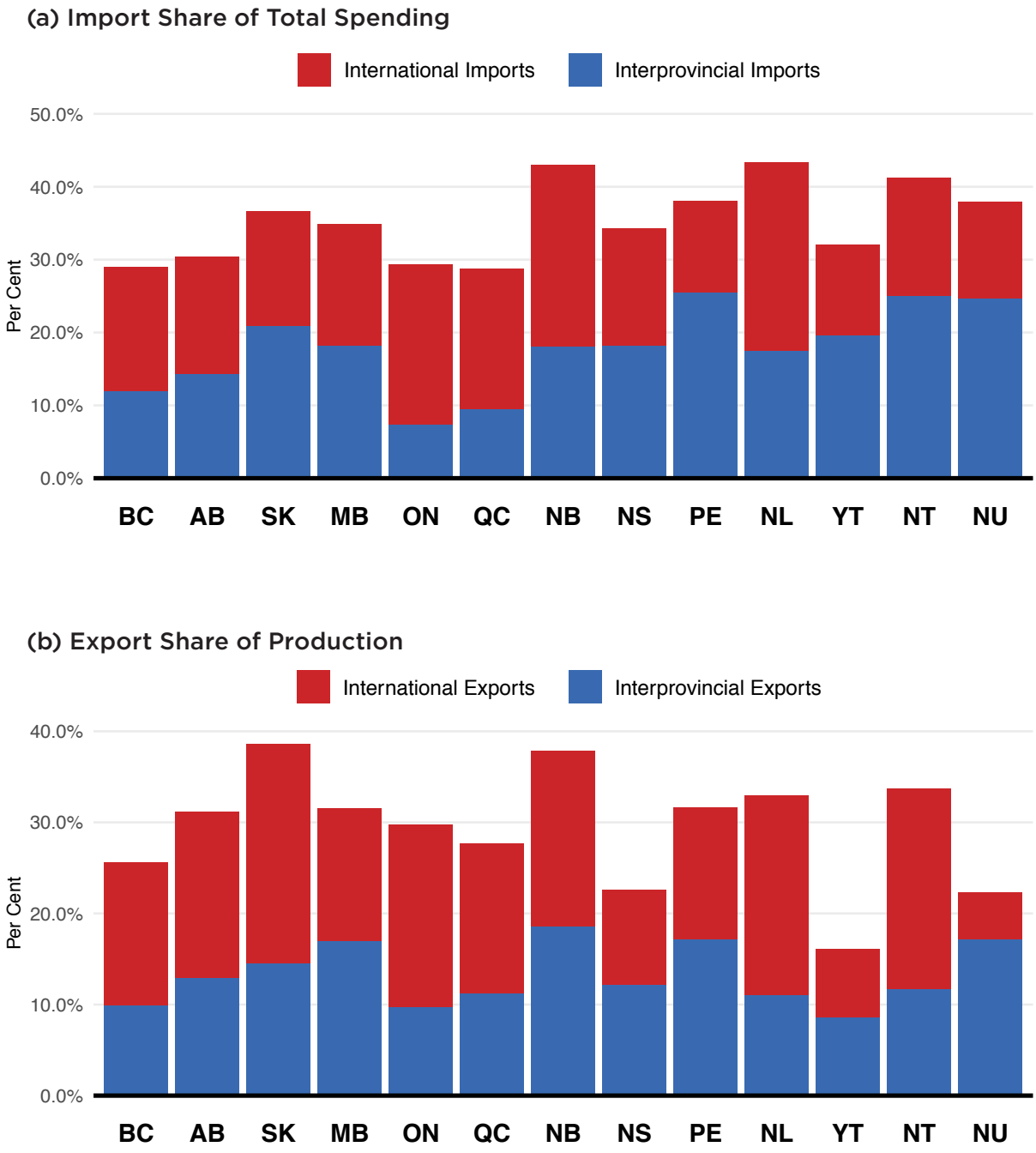
ALBERTA'S EXISTING TRADE PATTERNS

Before proceeding to a discussion of the potential implications an infrastructure corridor might have for Alberta's economy, a review of its current trade patterns is necessary. To that end, this section summarizes imports and exports by commodity, sector and destination for Alberta over time. We use two separate data sources, each with a different focus. In one, aggregate trade flows from Statistics Canada's provincial economic accounts. In the other, shipment-level data from Statistics Canada's freight analysis framework. The former has the advantage of broad sectoral coverage but does not distinguish modes of transport or within-province flows. The latter has a more aggregate commodity classification, but distinguishes between rail, road and air shipments. It also has selected coverage of within-province shipments. Together, they paint a rich picture of Alberta's trade within Canada.

INTERNAL AND INTERNATIONAL TRADE BY SECTOR

Trade is central to all provincial and territorial economies in Canada. The share of production that is exported approached 27 per cent in 2016, with 17 per cent of production exported internationally and 10 per cent exported to another Canadian province or territory. The share of spending by businesses and individuals on inputs and consumption imported from elsewhere is equally large. Overall, 28 per cent of spending is allocated to imports, with 18 per cent coming from other countries and 10 per cent from another Canadian province or territory. We display the import and export shares for all regions of Canada in Figure 1 using the latest data from Statistics Canada.

Figure 1: International and Interprovincial Trade Flows in Canada (2016)



Source: Own calculations from Statistics Canada data table 12-10-0088-01.

For most provinces, imports are between 1/4 and 1/3 of spending and exports are roughly 1/4 of output. For Alberta, total exports are equivalent to roughly 1/2 of total GDP. International exports are more important than interprovincial, but even the latter is equivalent to over 1/5 of Alberta's GDP in 2016.

Alberta is like other large regions in terms of how important imports and exports are for its economy, but there are important differences across sectors. In Table 1, we plot the import share of spending and the export share of output for a broadly aggregated set of sectors. We separately report shares for Alberta and the national average. We order the sectors in terms of their share of overall Alberta production. Resources — the largest sector in terms of production — exports nearly 3/4 of its production, a higher share than Canada as a whole. Alberta's import share of resources is also substantially lower than Canada overall, at 16 per cent compared to 56 per cent, respectively. For both Alberta and Canada, manufactured goods are heavily traded — with a large majority of both production and spending allocated to sales in, or purchases from, another jurisdiction. Even for sectors that do not trade physical goods — such as the professional, scientific and technical services sector — trade is important. Infrastructure corridors that we focus on in the quantitative analysis to come will take the form of measures to ease the flow of goods, but infrastructure like increased broadband internet penetration can boost trade in services.

Table 1: Import and Export Shares, by Sector (2016)

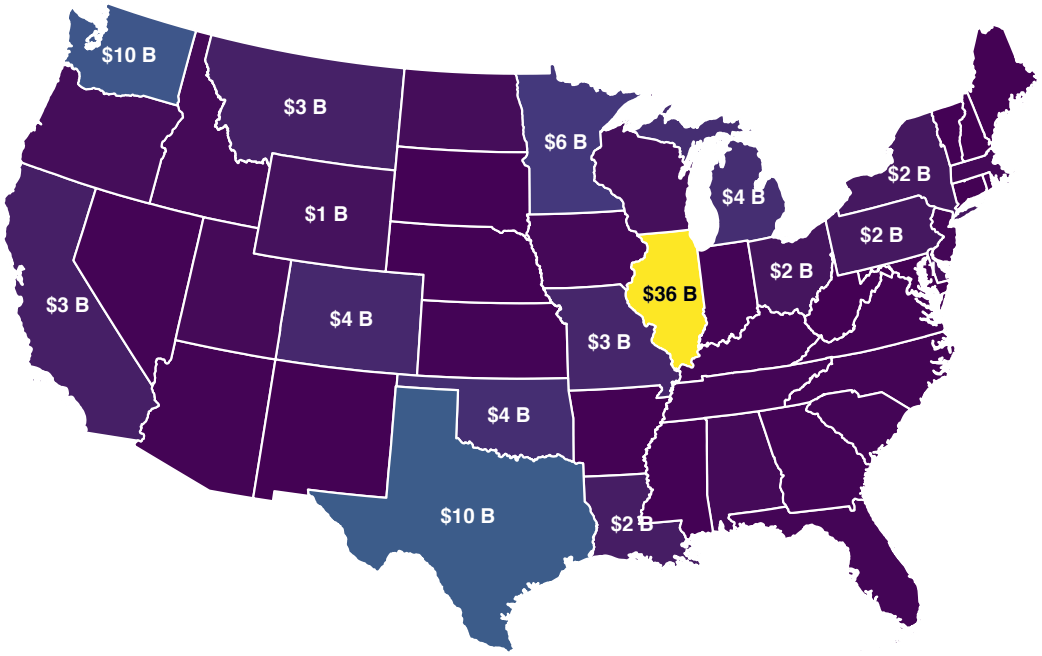
Sector	Share of Total Output (per cent)		Import Share of Spending (per cent)		Export Share of Output (per cent)	
	Alberta	Canada	Alberta	Canada	Alberta	Canada
Resources	14.0	4.0	16.1	56.2	74.3	70.1
Construction	12.9	8.9	0.0	0.0	0.0	0.0
Manufacturing	12.4	18.8	73.0	72.3	58.2	65.8
Finance and Real Estate	9.4	11.9	24.4	18.0	12.1	16.0
Prof., Sci. and Tech Services	5.6	6.2	30.3	22.1	20.2	25.3
Government Services	5.5	6.8	0.0	0.0	0.0	0.0
Transport/Warehousing	5.1	4.8	32.3	30.1	45.7	40.0
Health	4.6	5.3	1.3	1.2	0.7	1.0
Owner-Occupied Dwellings	4.6	5.0	0.0	0.0	0.0	0.0
Retail Trade	4.3	4.7	1.2	1.2	5.4	4.3
Admin. and Waste Mgmt.	3.6	3.5	29.7	29.9	16.0	29.0
Wholesale Trade	3.5	4.4	39.2	32.3	37.4	45.6
Agriculture	3.3	2.6	23.1	33.5	32.8	41.4
Hotel and Restaurant	2.5	2.7	25.3	30.3	24.0	25.5
Education	2.4	3.1	3.4	3.0	3.7	5.6
Other Services	2.2	2.2	6.4	9.5	19.8	9.0
Info and Cultures	2.0	2.7	28.6	26.3	21.0	25.1
Utilities	1.3	1.8	0.7	1.6	0.4	5.9
Arts, Entertainment and Rec	0.7	0.7	24.4	28.9	15.7	22.6

Alberta's trade is dominated by products that rely on effective transportation infrastructure. Its manufactured goods, resources and agricultural products alone accounted for nearly 70 per cent of Alberta's total exports — a larger share than for Canada as a whole. Alberta's imports are similarly reliant on effective transportation

infrastructure. Nearly 60 per cent of Alberta's total imports are manufactured goods alone. Shipping such goods over long distances at relatively low cost requires access to rail capacity and effective highway infrastructure.

In terms of markets for its exports and sources of its imports, Alberta's trade is highly concentrated. Exports to the United States, which in 2019 accounted for over $103 billion and 88 per cent of Alberta's total exports, are dominated by only a few states. In Figure 2, we illustrate Alberta's exports to each of the 48 continental states. Half of the province's exports are accounted for by only three states: Illinois, Texas and Washington. The first of these three alone account for over 1/3 of Alberta's total exports. Infrastructure — and oil pipelines in particular — account for this. In 2019, exports of oil to the United States approached $85 billion and major pipeline networks directed much of that to refineries (especially those in the Midwest). Infrastructure is a critical determinant of trade patterns.

Figure 2: Alberta Exports to the United States in 2019



Source: Own calculations from Industry Canada's Trade Data Online. Only states with more than $1 billion in export sales have specific values listed.

Relative to other provinces, Alberta's export market diversification across U.S. states is unusually low. One measure of diversification that is useful to illustrate this fact is the Herfindahl–Hirschman Index. This measures the sum of squared export shares across U.S. markets. More intuitively, the inverse of this index is a measure of the "effective number of states" to which a province exports. That is, it is the number of states that, if they each accounted for an equal volume of exports, would have the same Herfindahl-Hirschman Index value as we observe in the data. We find Alberta exports to the equivalent of 6.5 U.S. states, which is the third fewest in Canada. Only Newfoundland and Labrador, which exported to 5.5 effective states, and New Brunswick, which

exported to 6.3 effective states, had a more concentrated set of U.S. export markets than Alberta. For Canada as a whole, exports are spread across the equivalent of 17 states. Alberta's high level of concentration makes its exporters (in particular those in oil and gas) susceptible to idiosyncratic shocks in those relatively few markets. Increased infrastructure access to markets beyond the United States — such as to the West Coast, to Hudson Bay or to the East Coast — may be one factor in helping facilitate Alberta's export market diversification. To be sure, Alberta's low export diversification is driven by oil and gas exports. Excluding those export products, we find Alberta exports to 16 effective states, which is in line with the national average for non-oil exports. But Alberta's exports are also dominated by relatively few products. Indeed, aggregating exports into roughly 100 products (technically, at the HS-2 level), we find Alberta effectively exports only 1.5 products compared to the national average of nearly 8.[2] Transport infrastructure capacity to other markets (potentially rail in particular) may also help enhance Alberta's export product diversification.

While these data are important to understand the pattern of trade to and from Alberta producers and consumers, another data source provides a different, and in many ways richer, picture of flows between major cities and by mode of transport. We turn to this next.

FREIGHT SHIPMENT DATA

To distinguish imports and exports by mode of transport and to capture trade between cities within provinces, we turn to Statistics Canada's Canadian Freight Analysis Framework (CFAF).[3] An important shortcoming of these data is certain cells are suppressed to meet the confidentiality requirements of the *Statistics Act*. Much of this data suppression concerns air freight. We therefore focus on truck and rail shipments in this analysis.

There is wide variation in the type of mode shipment that Alberta producers use across export destinations. As we saw in the previous section, the top destination for Alberta exports is the United States, and trucks and rail shipments account for roughly similar shares of total value. For exports to British Columbia — Alberta's top internal market destination — rail accounts for nearly 2/3 of shipment value to Vancouver but fewer than 1/5 of shipments to the rest of the province. To neighbouring Saskatchewan, trucks account for over 90 per cent of shipment value. But to more distant markets, such as Quebec and Ontario, rail is a significant mode of transport. Nearly 60 per cent of exports to Montreal, for example, are by rail. And nearly 50 per cent of shipments to Toronto are by rail. Table 2 also reveals within-Alberta trade, between Calgary, Edmonton and the rest of the province. For these within-province shipments, trucks are overwhelmingly the dominant mode of transport. Excluding these within-province

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2 At the finest level of internationally consistent product detail (the HS-6 level), with 4,712 unique product codes in 2019, we find that Alberta exports effectively two products compared to a national average of 18.4. Alberta's level of export product diversification is lower than all other provinces.

3 These data are available for 2011 to 2017 in Statistics Canada data table 23-10-0142-01.

shipments, we find over 34 per cent of exports (by value) from Alberta are by rail and 24 per cent of imports are by rail.

Table 2: Shipments from Alberta, by Destination (2017)

Destination	Rail ($M)	Truck ($M)	Total ($M)	Rail Share (per cent)
Calgary, Alberta	$169	$159,639	$159,807	0
Rest of Alberta	$1,121	$81,917	$83,038	1
Edmonton, Alberta	$1,450	$31,205	$32,655	4
United States and Mexico	$14,594	$13,936	$28,530	51
Vancouver, British Columbia	$10,100	$6,512	$16,612	61
Rest of British Columbia	$2,718	$11,947	$14,665	19
Rest of Saskatchewan	$515	$8,545	$9,060	6
Winnipeg, Manitoba	$233	$7,163	$7,396	3
Saskatoon, Saskatchewan	$302	$4,923	$5,225	6
Toronto, Ontario	$1,962	$2,162	$4,125	48
Northwest Territories	$134	$3,025	$3,159	4
Rest of Ontario	$723	$2,198	$2,921	25
Montreal, Quebec	$1,367	$966	$2,333	59
Rest of Manitoba	$257	$1,614	$1,871	14
New Brunswick	$313	$190	$503	62
Rest of Quebec	$196	$228	$423	46
Hamilton, Ontario	$58	$225	$284	21
Oshawa, Ontario	$21	$166	$186	11
Prince Edward Island	$0	$179	$179	0
Halifax, Nova Scotia	$121	$33	$155	79
Rest of Nova Scotia	$21	$109	$130	16
Newfoundland and Labrador	$0	$100	$100	0
Yukon	$0	$88	$88	0
Quebec, Quebec	$43	$39	$82	52
Windsor, Ontario	$6	$13	$19	32
Nunavut	$0	$0	$0	0

Alberta's exports to certain major cities are not the end of the line but are instead hubs through which shipments make their way to foreign markets abroad. The Port of Vancouver, for example, handles 50 per cent of Canada's container traffic. Montreal, Prince Rupert, Halifax and Saint John are the three other dominant container ports. Prince Rupert is particularly notable. Connected to Alberta by Canadian National rail service and, of course, by truck, Alberta exports significant quantities of goods (mainly resources and agricultural products) through this port, especially after the Fairview Terminal was completed in 2007 (Prince Rupert Port Authority, n.d.). To what extent increased rail capacity could contribute to lowering trade costs and increasing trade flows to and from Alberta will be the subject of our quantitative analysis.

But before turning to the scope for lower trade costs, note also that there is considerable variation in the use of trucks versus rail shipments between different commodities. Excluding shipments within Alberta, Table 3 displays the share of shipment value that flows by rail for the major commodity categories within the CFAF data for exports and imports. Coal exports are almost exclusively exported by rail and the majority of agricultural products ship by rail as well. Other commodities where rail is a meaningful share of exports include fuel oil, crude oil and plastic and chemical products. Imports by rail are especially high for transportation equipment, such as cars and trucks, but no commodity category has a majority of imports shipped by rail.

Table 3: Rail Share of Shipments to and from Alberta (2017)

	Rail Share (per cent)	
	Exports	Imports
Agriculture	55.0	4.0
Transport Equipment	16.8	43.1
Metals	3.3	13.9
Coal	99.0	5.0
Food	10.5	9.4
Forest Products	3.6	0.7
Fuels and Crude Oil	25.6	6.1
Minerals	6.1	10.3
Misc. Products	2.7	5.1
Other Mfg. Goods	0.8	2.5
Plastic and Chemicals	30.9	13.5
Waste and Scrap	28.9	5.7

SCOPE FOR LOWER TRADE COSTS

In the previous section, we've seen that Alberta's trade is highly concentrated in terms of its trading partners and the industries it trades in. In this section, we explore by how much Alberta could gain from partially eliminating its barriers to trade. As theory suggests, in the absence of trade costs, trade is driven by productivity differences between partners. This increases competition between producers, ensures efficient allocation of resources, lowers prices and increases households' income. Barriers to trade hinder trade flows from being driven purely by differences of production costs across partners. Explicit tariffs and fees, geographical characteristics, existing transport infrastructure and regulatory and administrative differences contribute to these trade costs. In addition to direct initiatives like subnational, national and international trade agreements to eliminate trade costs, improving existing infrastructure and creating new transportation networks can also enhance trade and create economic opportunities for Alberta.

When it comes to reducing trade barriers, a multimodal infrastructure corridor provides many opportunities for Alberta and Canada in general. As we presented in the previous section, Alberta exports significant quantities of agricultural goods and resources through ports in the East and West and imports manufactured goods. Improving the access to and from Canada's interior to these tidewater ports can create economic opportunities and reduce reliance on a small number of markets. One example is the difficulties with market access in the oil and gas industry. Because of limited pipeline capacity, the main destination for Alberta's oil is the U.S. The costs associated with pipeline tolls to transport Alberta's oil to the U.S. refineries are a serious issue for Alberta. Fellows (2018) measures the annual loss of revenue due to these costs as $13 billion. Another study by the Van Horne Institute (2015) focuses on the manufacturing industry and points to the challenges of cross-country moves of mega supplies that limit manufacturing growth in the Canadian interior due to the lack of a uniform high-load corridor.

A multimodal infrastructure corridor can create new economic opportunities and improve standards of living, especially in isolated communities, by providing broadband internet access, easing barriers to labour mobility and improving access to services. Using the U.S. interstate highway system as an example, Michaels (2008) quantifies the economic effect of new urban-rural connections on reducing barriers to trade in rural communities. The results show a seven to 10 per cent higher income per capita in the rural counties with highway access relative to other rural counties.

But while reducing trade costs may boost aggregate productivity and economic activity, in the short term the effects can be heterogeneous. Some producers, geographic areas or population groups may gain more relative to others or some may even experience economic losses. Roberts et al. (2020) point to the evidence on these heterogeneous economic effects in the literature and suggest policy-makers consider complementary interventions in order to mitigate these trade-offs between economic outcomes. Our paper contributes little in this area and instead focuses on aggregate implications and outcomes.

EFFECT OF INCREASED RAIL PENETRATION ON TRADE COSTS

Lowering the cost of shipping goods from one location to another lowers the cost of trade. Infrastructure with low marginal costs of shipment, however, may come at higher up-front costs or be less economical for short-haul shipments. To quantify the relative costs of shipping by truck versus rail for various distances, we use the CFAF data once again. Specifically, we estimate the average cost of trade between various origins and destinations in Canada and how those costs vary between truck and rail. To that end, we regress trade costs on distance, an indicator for whether the shipment is undertaken by truck or not, and an interaction effect between distance and truck. The latter will allow us to estimate whether, and by how much, distance increases trade costs by more for shipments by truck than by rail. In addition, we include fixed effects

for year, origin and destination provinces, and the commodity shipped. For added clarity, the specific regression equation is given by the following expression:

$$log(\tau^{j}{}_{ni,m,t}) = \delta \log(d_{ni}) + \gamma \ T_m + \ \beta(\log(d_{ni}) \times T_m) + \alpha_t + \alpha_n + \alpha_i + \alpha^{j} + \epsilon^{j}{}_{ni,m,t},$$

for origin n, destination i, commodity j, mode m, year t, and where T_m is an indicator variable for whether a given shipment is made by truck instead of rail and d_{ni} is the geographic distance between the origin and destination regions. We estimate this regression on well over 15,000 observations of shipment data between 2011 and 2017 in Canada and display the results in Table 4.

Table 4: Regression Results

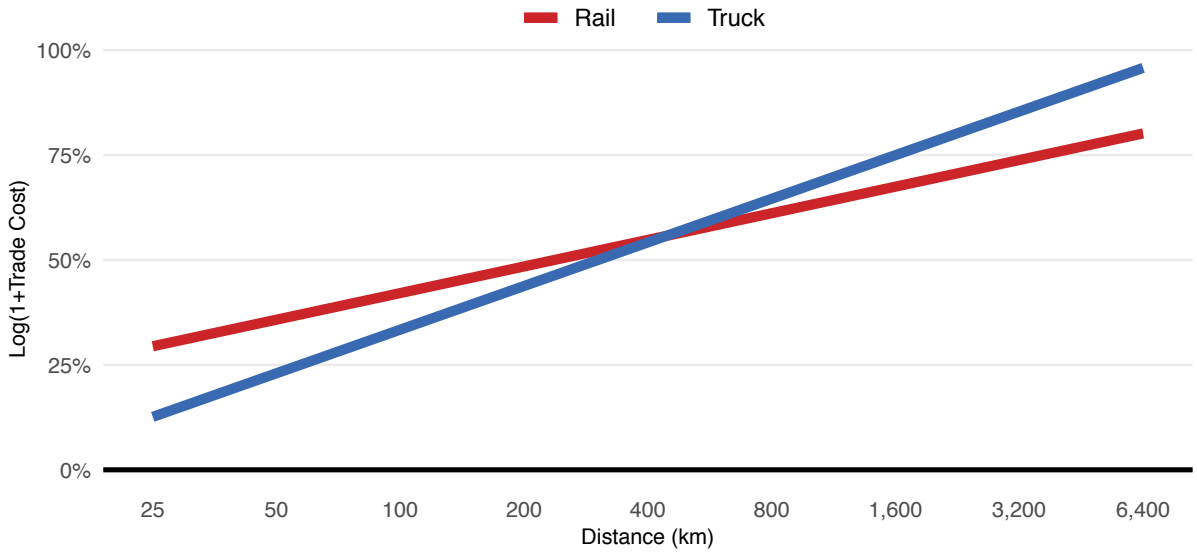
	Dep. Var.: Log(1+TradeCost)		
	(1)	(2)	(3)
Log(Distance)	0.133***	0.134***	0.091***
	(0.005)	(0.005)	(0.008)
Truck		0.088***	-0.357***
		(0.007)	(0.075)
Log(Distance) x Truck			0.059***
			(0.01)
Year FEs	Yes	Yes	Yes
Origin FEs	Yes	Yes	Yes
Destination FEs	Yes	Yes	Yes
Commodity FEs	Yes	Yes	Yes
Observations	15,467	15,467	15,467
R2	0.29	0.3	0.300

Note: Standard errors in parentheses, and *p<0.1; **p<0.05; ***p<0.01.

We find, not surprisingly, that the cost of shipping increases with distance. On average, as reported in column 1, each 10 per cent increase in distance is associated with a 1.3 per cent increase in the cost of trade. As discussed, we quantify trade costs as a share of the value of products shipped, so this is an economically meaningful increase. Controlling for mode does not change this average relationship between trade costs and distance but reveals in column 2 that trucks have nine percentage points higher trade costs than rail shipments — controlling for distance, origin, destination, commodity and year. Finally, column 3 displays the more important results. This reveals that trade costs for shipments by truck increase more quickly with distance than shipments by rail. The coefficients reported in the table mean that for each 10 per cent increase in distance, truck shipments experience a 0.6 percentage point larger increase in trade costs than shipments by rail. To visualize this more intuitively, we plot the implied relationship between distance and trade costs for the two modes in Figure 3. It reveals that for distances beyond 500 kilometres, the average cost of trade by rail is lower than by truck. To the extent that rail shipment capacity can increase, this can facilitate lower cost trade transactions across relatively larger distances. In

the quantitative analysis to come, we will specifically explore the potential gains from increasing the share of shipments to and from Alberta that can be done by rail instead of truck.

Figure 3: Regression Estimates of Trade Costs vs. Distance, by Mode of Shipment



Note: Displays results of regression of shipment costs on distance by mode. See text for details.

One approach to quantifying the aggregate gains from increased rail penetration in trade is to examine the link between a province's trade costs and its rail share of shipments, controlling for other factors that may matter for costs and mode choice, such as distance, destination and commodity. To that end, we regress our measure of trade costs on (the log of) distance and control for year, commodity, origin and destination characteristics that may matter but do not vary over time. Specifically, we estimate

$$log({\tau^j}_{ni,m,t}) = \delta \log(d_{ni}) + \gamma \quad {r^j}_{ni,t} \quad + \alpha_t + \alpha_n + \alpha_i + \alpha^j + {\epsilon^j}_{ni,m,t},$$

where ${r^j}_{ni,t}$ is rail's share of shipments from region n to region i at time t for commodity j. We estimate, as before, that distance is an important factor but here we also estimate that a higher share of shipments by rail is associated with markedly lower trade costs. Specifically, we find that a 10 percentage point increase in the share of value shipped by rail is associated with a 3.2 per cent lower aggregate cost of trade. And note that this, importantly, controls for commodity, source and destination of shipments. We also find important differences in the relevance of rail across commodities. Introducing an interaction term into the regression equation above allows us to identify how rail matters differently for different commodities. We report the results for our overall estimate and for selected commodities in Table 5. We see that rail lowers costs even more for coal, fuel oil and crude oil petroleum, and mineral products. There is other variation across other commodity groups, but the importance of resources for Alberta's trade flows motivates a focus on these commodities in our model-based estimates of gains from increased rail infrastructure.

Table 5: Regression Results

	Dep. Var.: Log(1+TradeCost)	
	(1)	(2)
Log(Distance)	0.167***	0.156***
	(0.006)	(0.006)
Rail Share	-0.316***	-0.288***
	(0.017)	(0.033)
Incremental Effect for Selected Commodities (Coefficients on Rail Share x Commodity)		
Coal		-0.277***
		(0.073)
Minerals		-0.294***
		(0.060)
Fuel and Crude Oil		-0.253***
		(0.056)
Year FEs	Yes	Yes
Origin FEs	Yes	Yes
Destination FEs	Yes	Yes
Commodity FEs	Yes	Yes
Observations	10163	10163
R2	0.30	0.32

Note: Standard errors in parentheses, and *p<0.1; **p<0.05; ***p<0.01.

A MODEL OF ALBERTA'S ECONOMY AND TRADE

Before proceeding to detail the potential gains from increased transportation infrastructure to and from Alberta, it is worth describing at a high level the model we use to construct our estimates. As there are no novel innovations in the model in this paper, we point readers to the relevant papers where comprehensive details may be found.

A COMPUTABLE GENERAL EQUILIBRIUM MODEL

The computable general equilibrium (CGE) model we employ belongs to a well-known class of models now in use to simulate the economic effects of projects and policy changes. In simple terms, a CGE model can be thought of as a set of several linked production and demand equations representing supply chains, production linkages, goods and services markets, labour markets, capital markets and resource markets. These equations are accompanied by a representation of government revenue and spending as well as equations representing international export demand and import supply. The comprehensive nature of CGE models ensures internal consistency in the simulated outcomes, which is important given the integrated nature of the Canadian economy. That is, changes that affect one sector and region will have consequences elsewhere in the economy. Using a formal CGE model means that we can identify a measure of the entire economic effect of an implied change in Alberta's trade costs.

We use a CGE model adapted from Fellows et al. (2018) and previously adapted to examine the effect that improved trade infrastructure would have on the economy of Canada's territories (Fellows and Tombe 2018). 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.

The model admits 32 distinct production sectors in each of the 10 provinces plus Yukon, Nunavut and the Northwest Territories. There are three types of factor markets in the model: labour, capital and natural resources.

Labour markets are common to a province. That is, all sectors within a province compete for the same pool of labour. Capital markets are sector specific in the short run, but open to international capital in the long run.

In our short-run simulations, the capital stock in each sector and region is held fixed (which implies that the total amount of capital in the economy is also fixed). With no reallocation of capital across sectors, the return on capital in each sector is distinct and clears the market for each sector individually. To summarize, in the short-run scenarios the capital stock in each sector is exogenous and fixed at the benchmark level and the return on capital in each sector is endogenous.

In our long-run simulations, capital can enter or exit each sector and region at will (consistent with an open international capital market). The return on capital is fixed (assumed to be set in the international market) and the stock of capital in each sector and region becomes endogenous. If a shock increases productivity for a sector/region pair, the equilibrium outcome will result in an increased capital stock in that sector.[4] To summarize, in the long-run scenarios the capital stock in each sector is endogenous (as is the total amount of capital in the economy) and the return on capital in each sector is exogenous and fixed at the benchmark level (assumed to be the return determined by international capital markets).

In all cases, natural resources are sector specific, as they represent rents earned on specific resource inputs (like oil, gas, minerals and renewable resources used in energy generation).

The model's treatment of trade (both intra-national and international) is of particular importance here. All inter-regional trade is represented 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. This treatment is important as it recognizes that a reduction in trade costs (as we are simulating) might lead some (but not all) consumers in other provinces to switch to an imported Alberta variant of a good. The Armington formulation is also consistent with our overall treatment of trade costs (which follows from Albrecht and Tombe 2016) and our approach to estimating changes in trade costs using the CFAF data.

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4 The model defines a set of nested constant elasticity of substitution production functions governing output in each sector and region. These functions directly imply a diminishing marginal product of capital.

The CGE model we use 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 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. As mentioned, the model assumes a fixed labour force in the province. For both reasons, the simulation results presented below should be considered conservative lower bound estimates of the economic gains of reduced trade costs in Alberta.

SIMULATING CHANGES IN TRADE COSTS

The first step to employing our CGE model is to calibrate it using observed data on the state of the Alberta and Canadian economies. Model calibration involves setting specific values for all parameters in the economy such that the equations are collectively able to replicate the actual level of economic indicators including (but not limited to) production, trade, pricing and labour and capital income.

To evaluate the potential gains to Alberta's economy from increased access to internal and international markets that increased infrastructure might provide, we adjust the values of the calibrated parameters governing trade. That is, we adjust parameter values in the Armington function to make trade more efficient in the model. This is the same thing as lowering trade costs since the result is that the delivered cost of a good that is imported to or exported from Alberta is lower. We then re-compute the new equilibrium outcomes (production, trade, pricing, labour and capital income) that are consistent with this lower trade cost reflected as improved trade efficiency.

Our trade cost simulations take two forms. In the simple case, we simulate a set of broad trade cost reductions by simply reducing the cost of all goods and services imported to or exported from Alberta by a fixed amount. The results of this case illustrate the potential gains available from improved infrastructure that facilitates Alberta's trade. The second form is more sophisticated; we make use of the above estimates of rail costs vs. trucking costs and simulate the effect of increases in the share of goods being transported by rail (vs. trucking) into and out of Alberta. The results illustrate the economic gains from expanding the rail shipment capacity, a lower cost alternative to trucking. In this second case, we assume that improved rail penetration would only affect sectors that trade physical goods (rather than services).

QUANTITATIVE ANALYSIS OF GAINS FROM AN INFRASTRUCTURE CORRIDOR

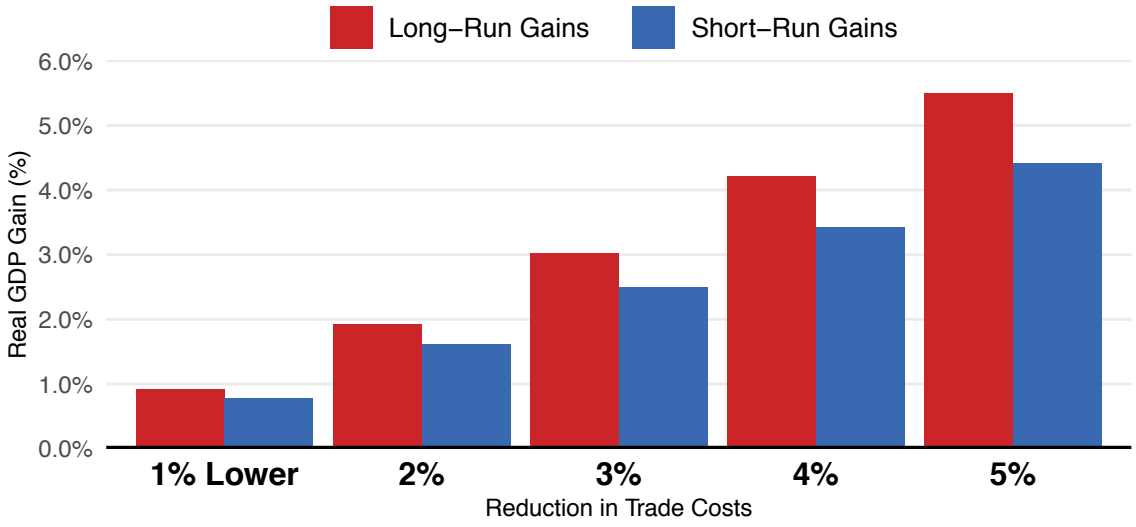
We present three main sets of results. First, we begin our description of the model-based counterfactual estimates of the potential gains from trade liberalization with broad uniform reductions in trade costs. This quantifies how sensitive various outcomes are to trade cost changes. Second, we estimate increasing the share of trade shipped by rail. This might reasonably reflect increasing rail capacity by expanding existing routes or constructing new routes. To the extent that infrastructure corridors may

facilitate such increased capacity, this exercise corresponds to one dimension in which such a corridor may affect Alberta's economy. Finally, recognizing that rail matters differently for different sectors, we simulate sector-specific reductions in trade costs due to increased rail usage. As discussed, we base the latter two experiments on the regression results discussed in a previous section.

BROAD TRADE COST REDUCTIONS

Lower trade costs will increase trade volumes, specialization, productivity and overall GDP. To illustrate by how much any given reduction in trade costs matters for various economic outcomes, we simulate various uniform reductions in trade costs ranging from one per cent to five per cent. These are significant reductions but are less than prevailing estimates of the current magnitude of policy-relevant trade costs. Albrecht and Tombe (2016), for example, find average costs of between 7.8 per cent and 14 per cent for Canada as a whole, and between 4.1 per cent and 7.2 per cent for Alberta. Lowering trade costs uniformly in this way is not grounded in specific estimates of the costs that an infrastructure corridor might alleviate, but instead illustrates the potential gains available from more liberalized trade. We report the gains in Alberta's real GDP as a result of this experiment in Figure 4.

Figure 4: Alberta Real GDP Gains from Uniformly Lower Trade Costs



Source: authors' calculations from a CGE model. See text for details.

Lower trade costs increase Alberta's GDP significantly, in both the short run and the long run. In the short term, we consider the total stock of capital in Alberta as fixed. Gains come primarily through lower cost access to imported inputs and final goods. There are also gains from increased demand by purchases outside Alberta on goods produced by Albertans. This increases real incomes and productivity, which is captured by the increase in real GDP. Lower trade costs by one per cent increase real GDP by roughly 0.8 per cent and lower trade costs by five per cent increase real GDP by roughly 4.4 per cent. These correspond to approximately $3 billion to $15 billion per

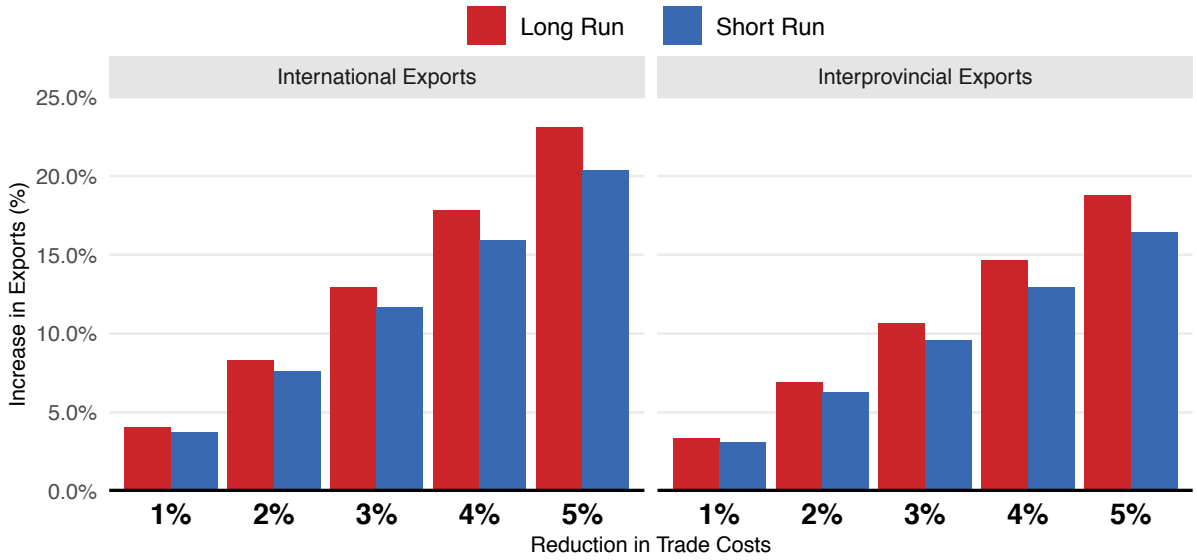
year in additional economic activity. Although we don't explore the infrastructure investment options for lowering the trade costs by these levels, the corresponding impacts on real GDP of doing so indicate how high the costs of expanding infrastructure could be while still yielding net benefits to Alberta. In the long run, we allow for capital accumulation to maintain a real return to capital consistent with global markets for capital. We find larger gains, equivalent to roughly a one per cent increase in real GDP for each one per cent reduction in trade costs. These are significant.

The resulting combination of an increase in GDP and lower import costs implies an up to six per cent long-run increase in real personal income, equal to an extra $6,423 annually for the median Alberta family.[5] This is a level effect and represents a persistent increase, not a one-time bump. That is, GDP is permanently higher and by extension, annual personal incomes are also permanently higher. While the capital adjustments may take time to occur, once they are finalized, and in every year after, GDP and incomes will be higher under the low trade costs scenarios.

Lower trade costs also increase Alberta's trade flows, both internationally and interprovincially. We estimate that, in the long run, each one per cent reduction in trade costs facing buyers and sellers in the province will increase the volume of trade by approximately 3.5 per cent. This is significant. In 2019, for example, Alberta exports approached $120 billion. A 3.5 per cent increase corresponds to over $4 billion in international exports per year for each one per cent reduction in trade costs. Notably, we lower both internal and international trade costs. Increased infrastructure to facilitate trade would benefit both dimensions since, as we've seen, transportation from Alberta to important port cities throughout the rest of the country is a key way in which producers in the province access international markets.

5 The six per cent increase in real income refers to a Hicksian Welfare index (conceptually similar to a money metric utility measure) of 1.062 resulting from a five per cent reduction in trade costs in the long-run scenario vs. a value of one in the benchmark. The median family income in Alberta in 2018 was $103,600 (Statistics Canada Table: 11-10-0190-01). It follows that six per cent of $103,600 is $6,423.

Figure 5: Increase in Alberta Exports from Uniformly Lower Trade Costs



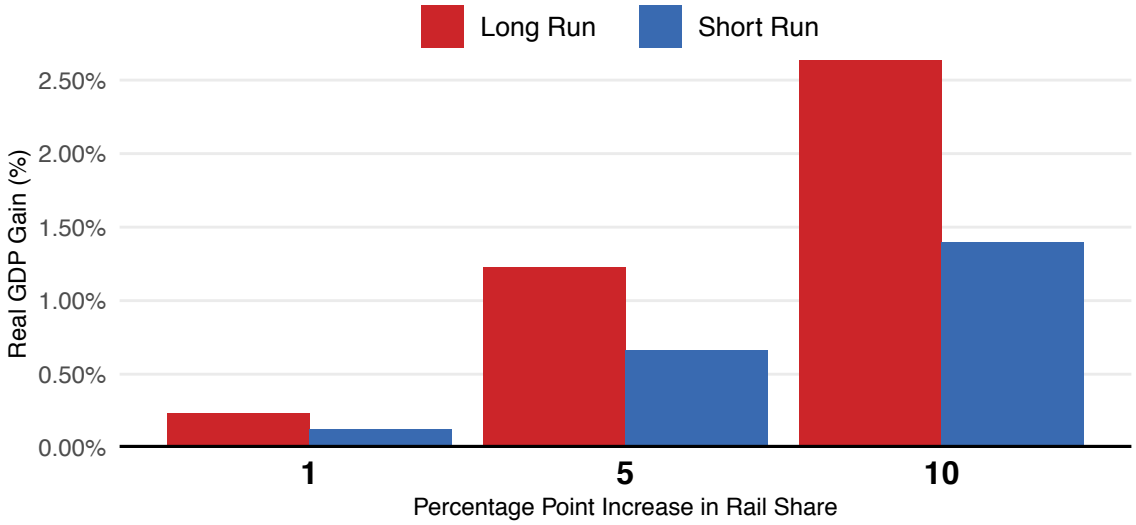
Source: authors' calculations from a CGE model. See text for details.

These estimates are an intuitive representation of the potential magnitudes of gains from lower trade costs. In short, each one per cent reduction in the cost of trading across Alberta's borders increases its real GDP by over $3 billion per year. In the next two sections, we present estimates that are grounded in potential cost reductions that expanded rail infrastructure might entail.

INCREASED RAIL PENETRATION

An infrastructure and transportation corridor could facilitate the expansion of Canada's rail shipment capacity. While many transportation modes could expand within such a corridor — including roads, pipelines, transmission lines and so on — our data allow us to specifically quantify the extent to which Alberta's economy could gain from more access to lower cost shipment options like rail. As reported in a previous section, rail shipment costs are lower than truck transportation when distances are sufficiently long. On average, we found that each one percentage point increase in the share of non-air trade sent by rail was associated with a 0.32 per cent lower trade cost. This implies that if the share shipped by rail increased by 10 percentage points, then trade costs to and from Alberta would, on average, decline by 3.2 per cent. We report the range of potential gains from such increased use of rail in Figure 6.

Figure 6: Real GDP Gains from Increased Rail Shipment Share from Alberta



Source: authors' calculations from a CGE model. See text for details.

Economic gains from expanded rail capacity and shipments are meaningful. A 10 percentage point increase in rail share of shipments potentially increases Alberta's real GDP by over 2.6 per cent. An increase of this magnitude is equivalent to over $9 billion in additional economic activity per year. This is a relatively large increase in economic productivity — equivalent to roughly $4,500 per household, on average, per year — and, in addition, it abstracts from other potential sources of gains, such as increased labour migration into the province. It is also an annual benefit, which if discounted at five per cent per year is equivalent in present-value terms to over $180 billion. The present value of future gains is particularly relevant when evaluating costs and benefits from large-scale infrastructure investments. Importantly, gains in the long run (allowing for sufficient time to accumulate more capital within Alberta) are roughly double the gains in the short run.

There are broader gains for Canada's economy and for other provinces. That is, economic gains accrue to other provinces and do not just shift activity into Alberta. Nationally, for a 10 percentage point increase in Alberta's rail share, we estimate Canada's aggregate GDP would increase by nearly 0.65 per cent — or roughly $15 billion. Of the total gains, Alberta therefore captures 2/3 while the other 1/3 of the gains is found in other provinces. We find British Columbia, for example, gains 0.5 per cent and Ontario gains 0.2 per cent. This implies that nearly 10 per cent of the national gains from increased rail shipment share on Alberta exports accrue to British Columbia and another 10 per cent of the national gains accrue to Ontario. In addition, the two other Prairie provinces of Saskatchewan and Manitoba collectively account for over six per cent of the national gains.

There are potentially additional spillover effects through the federal budget. Increases in real GDP correspond to increases in taxable income and consumption and decreases in expenditures through programs like employment insurance. While our model does not specifically incorporate a rich representation of the federal budget, the

government's own estimates (in its more recent pre-COVID budget in 2019) reports that a one per cent increase in real GDP corresponds to a reduction in its budget deficit by roughly $5 billion per year. The national gains from a 10-point increase in rail's share of exports from Alberta are, as noted, 0.65 per cent. This suggests federal budget implications on the order of $3 billion. While only a crude estimate to provide a sense of scale, economic growth is a key determinant of the federal government's fiscal position. These fiscal gaps may then be distributed to regions throughout Canada through various federal expenditure programs. These fiscal gains also suggest a potential role for the federal government's involvement in financing such infrastructure — as indeed it typically does for large-scale interprovincial initiatives.

Though these aggregate results are meaningful, trade cost reductions from increased rail penetration, however, are not uniform. We previously estimated and reported differences for a number of notable sectors, such as coal, oil and minerals, where trade costs fell by between 0.25 to 0.30 percentage points more per percentage point increase in rail's share of shipments than the overall average trade cost reduction. We estimate a reduction in trade costs for those sectors only and find gains nearly as large as we found for an across-the-board trade cost reduction. The gains are slightly smaller, but only modestly so. Specifically, we find a roughly two per cent increase in real GDP from a 10 percentage point increase in rail's share of shipments.

As with the uniform trade cost reductions discussed above, the combined increase in GDP and lower import costs imply an increase in real personal income. It is more modest here at approximately 3.3 per cent (rather than 6.2 per cent), but still very significant and equal to an extra $3,419 annually for the median Alberta family.[6] As before, it is important to note that this is a level effect and represents a persistent increase and permanently higher annual GDP and annual personal incomes following the shock and the resulting expected capital reallocation.

CONCLUSION AND POLICY IMPLICATIONS

By reducing interprovincial and international trade costs, multimodal infrastructure corridors of road, rail, utilities and communications can potentially create large economic benefits. Combining rich data on interprovincial trade flows with a computable general equilibrium model of trade, we quantify the potential economic gains in Alberta from reductions in trade costs and identify the importance of improved access to lower cost transportation options like rail for select commodities. We find that lowering trade costs substantially increases Alberta's real GDP through its effect on international and interprovincial trade flows. Infrastructure capacity is particularly valuable, as we find that increasing the share of exports shipped by rail by 10 percentage points may increase Alberta's GDP by nearly 1.5 per cent in the short run and over 2.5 per cent in the long run — equivalent to over $9 billion per year in economic activity.

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6 A Hicksian Welfare index of 1.033 resulting from a 10 per cent increase in rail's share of transportation vs. a value of one in the benchmark. As indicated above, the median family income in Alberta in 2018 was $103,600 (Statistics Canada Table: 11-10-0190-01). It follows that 3.3 per cent of $103,600 is $3,419.

Our analysis is only a first step and explores only one potential effect of expanding infrastructure capacity. More research is needed, and governments can play a role by supporting expanded research activities into the feasibility and potential benefits of dedicated multimodal infrastructure corridors in Canada. In addition, though we made progress using detailed shipment-level data, there are shortcomings in coverage and detail that constrain the scope for potential research. Governments should therefore increase the collection and reporting of relevant data on internal trade to facilitate research into the costs producers and consumers face, and the potential gains from internal trade liberalization. Despite the value of expanding research capacity, our analysis points clearly towards the potential gains from internal trade liberalization. Expanded transportation infrastructure capacity can lower trade costs, and therefore governments hoping to expand internal trade should explore means of increasing such capacity, especially the possibility of increased rail shipment capacity. Finally, given the high degree of trade concentration (and therefore low level of export market diversification), regions like Alberta should potentially give priority to infrastructure capacity and policy changes that promote increased trade to underserved markets within the United States and to other international markets. Overall, the potential for positive economic effects from multimodal infrastructure corridors is compelling and warrants additional investigation.

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