Int Adv Econ Res (2023) 29:165–176
https://doi.org/10.1007/s11294-023-09875-w

Modeling the Impact of Public Infrastructure investments in the U.S.: A CGE Analysis

David Suárez-Cuesta[1] · Maria C. Latorre[2]

Accepted: 12 July 2023 / Published online: 8 August 2023

Abstract This study offers a computable general equilibrium analysis of the $550 billion devoted to new infrastructure investment (new and remodeled physical infrastructure for transportation, information and public services) in the United States under the Infrastructure Investment and Jobs Act, a federal law signed by President Joseph Biden in November 2021. The simulations are based on the state-level distribution of funds and distinguish between the construction phase (short run) and the operational phase (long run). Gross domestic product (GDP) and labor demand react to the government spending stimulus after the first year by growing 0.24% and 0.44%, respectively. The gains derived from this investment plan are higher in the long term once investments increase the country's capital stock; GDP increases by 1.39% and wages by 3.94%. This paper analyzes the efficiency of the current distribution of funds across sectors, and finds that the current distribution benefits the United States economy more. Even though a slightly higher GDP impact could have been reached (1.42%) if all the funds were devoted to transport services, the price increases would result in lower real wage increases.

JEL Codes C68 · H54 · R42

Keywords Public Infrastructure Investment · Government Spending · Capital Stocks · Output Productivity · United States

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11294-023-09875-w.

✉ David Suárez-Cuesta
dsuare04@ucm.es

[1] Universidad Complutense de Madrid, Department of Applied and Structural Economics & History, Faculty of Statistical Studies, Ciudad Universitaria, Avenida Puerta de Hierro, s/n, 28040 Madrid, Spain

[2] Universidad Complutense de Madrid and European Commission (DG Trade), Department of Applied and Structural Economics & History, Faculty of Statistical Studies, Ciudad Universitaria, Avenida Puerta de Hierro, s/n, 28040 Madrid, Spain

Introduction

The *Infrastructure Investment and Jobs Act* (IIJA) signed by United States (U.S.) President Biden in November 2021 was aimed at modernizing the country's roads, bridges, rail, ports, airports, broadband and drinking water (The White House, 2021a). From the $1.2 trillion bill, $550 billion was spending over the initial levels, i.e., on new infrastructure over five years (2022-2026).

According to the 2019 Global Competitiveness Report (Schwab, 2019) the U.S. ranks 13th in global infrastructure quality and 17th in road infrastructure quality. Total (real) public infrastructure spending[1] has decreased since 2003 when it peaked at $480 billion, falling to $440 billion in 2017 (Congressional Budget Office, 2016). The American Society of Civil Engineers (2021) estimated a $2.6 trillion infrastructure investment gap during the period 2020 to 2029. Thus, even though this plan does not fully cover the investment gap, it counteracts the declining trend of the past decades.

The purpose of this study is to ascertain whether this investment stimulus will benefit the U.S. economy and if so, to what extent, providing results based on a robust methodology and simulations based on official figures.

Infrastructure Expenditure and Economic Growth

Physical capital is intuitively an essential part of an economy, as it connects supply chains, enables the movement of goods and services, and ultimately facilitates greater opportunities for economic growth. However, major infrastructure projects are large-scale and capital-intensive, implying high initial costs, while profits are spread out over time and thus their benefit is harder to estimate. Most federal investment for non-defense purposes contributes to the economy on an ongoing basis by improving the private sector's ability to invent, produce, and distribute goods and services (Congressional Budget Office, 2016).

The relationship between infrastructure investment and a country's economic growth has been the subject of analysis for many decades, and is now in the spotlight due to the challenges posed by the coronavirus (COVID-19) crisis. Early studies that analyzed this relationship yielded mixed results. Aschauer (1989) found that much of the decline in the U.S. productivity had a close relationship with the descending rates of public capital investment. His findings were later reaffirmed by Munnell (1992). Other studies were skeptical about these results, arguing statistical problems related to the aggregated nature of the data (Jorgenson, 1991) or a spurious correlation between public capital and income due to the non-stationarity of the regressed variables (Tatom, 1991).

The most recent economic literature does seem to agree on the positive relationship between infrastructure investment and economic growth. Rozas and Sánchez (2004) found that although the measurement of the impact of infrastructure investments on the development of a region or a country has yielded mixed

[1] Includes spending on capital and maintenance of transportation and water infrastructures.

results, much of the empirical evidence in the literature shows that infrastructure investments contribute to output growth, cost reduction and improvements in profitability. According to Lawrence (2023), the high share of investment, and hence manufacturing, in Asian economies is closely related to their rapid growth. Infrastructure investment has also been part of the trade facilitation strategy of developing countries over the past decades, making the flow of trade cheaper, faster and more reliable.

In terms of physical infrastructure investments, recent literature points to a positive relationship between physical infrastructure investment and economic growth, but this relationship is relatively complex and can be studied from different perspectives. Stupak (2018) examined the trends surrounding infrastructure investment in the U.S. and carried out a qualitative analysis on how different financing mechanisms may affect gross domestic product (GDP) and employment, and the effect on the private sector. Some studies go beyond this effect and analyze the crowding effect that public investments may have on private capital productivity (Congressional Budget Office, 2016; Abiad et al., 2016).

Another part of the literature focuses on one type of infrastructure and provides empirical results for broadband investments (Czernich et al., 2011), transport investments (Melo et al., 2013) and energy investments (Li & Li, 2020). From other perspectives, Chakamera and Alagidede (2018) analyzed the relationship between infrastructure investments and economic growth focusing on the quantity and quality of the infrastructures, while Blimpo and Cosgrove-Davies (2019) studied how access to those infrastructures can influence the expected economic outcomes of such investments. Finally, the literature contains some studies with a closer focus on this analysis, such as Canning and Pedroni (2004). They investigated the long-run consequences of the provision of different types of infrastructure, but focused on per capita income.

The current computable general equilibrium (CGE) analysis not only provides reliable macroeconomic estimates of impact of the IIJA, but also contributes to the existing literature by providing insight into how an increase in public infrastructure investments affects development over the longer term. According to Timilsina et al. (2020), the current literature lacks empirical analyses on how physical infrastructure investments provide economic growth in the longer term across the economy. Timilsina et al. (2020) claimed that studies such as Lenz et al. (2017) provide short-term effects on specific users but do not provide longer-term effects across the economy. This is precisely one of the strengths of the CGE approach. Additionally, another advantage of CGEs compared to other techniques is that they do not focus on one market or user but consider a broad set of sectors and all agents in the economy.

Therefore, the current analysis provides the impact of the IIJA across all sectors of the U.S. economy and for different agents such as different types of workers and the government. Finally, compared to other less detailed techniques, this study takes into account the input-output linkages and macroeconomic identities in the economy, considering the transmission mechanisms across sectors including forward and backward linkages of the IIJA and other knock-on effects triggered by this policy.

Overview of the IIJA

Within the $1.2 trillion appropriation, more than half ($650 billion) was earmarked to extend ongoing programs such as the Highway Trust Fund, the Waterways Trust Fund and other comparable funding sources that are already included in the government's budget. This allocation does not indicate any extra government spending (The White House, 2021a). The current study only considers the remaining $550 billion that correspond to public spending above baseline levels.

Table 1 shows how the new investment funds will be allocated. The infrastructures that are built in the short term imply a short-run increase in the demand for construction. Once built, they mainly increase the capital stock of three sectors[2] in the long run: transport services ($283 billion for land transport, air transport, water transport, and transit), utilities ($202 billion for energy distribution infrastructures, water, and sewage services) and information services ($65 billion for telecommunications, cable networks, information services, and data processing services).

In terms of financing these new investments, the plan initially proposed offsets that would cover the $550 billion of new spending (Cantwell, 2021). However, recent estimates find that total savings will cover less than half, as some of the reported offsets have already taken place (Committee for a Responsible Federal Budget, 2021).

Methodology and Data

CGE models are a class of economic models that estimate how an economy might be affected due to a change in a specific policy, technology or other kind of external factors. They are based on mathematical equations that capture interactions between factor markets and goods markets and can integrate both the macro and microeconomic levels (Latorre 2010; Latorre et al., 2020). They use real data in a rigorous theoretical framework and present the relationships among economic agents as a system of equations derived from microeconomic optimization theory. Resting on the usual progression of the circular flow of the economy (production, income distribution and domestic and foreign demand), CGEs describe the equilibrium conditions in goods, factor markets and in the foreign sector. They cover the behavior of households, firms and government in the economy.

The model used in this study is the U.S. version of The Enormous Regional Model (TERM-USA) aggregated for 11 regions and 26 sectors. The TERM model follows a bottom-up strategy, meaning that regional results sum up to obtain national results (Horridge, 2012). Data sources for this study include various U.S. official databases such as the Bureau of Economic Analysis (2022) and the U.S. Census Bureau (2021).

[2] Although some sub-items could be classified in other sectors, they correspond to comparatively much smaller amounts. Therefore, they are not modeled explicitly, which implies this analysis is still conservative.

Table 1 New investment allocation of funds (in $U.S. billion)

Modelsector	Category	Total spending 2017($US billion)	Total spending increase2022-2026($US billion)	Annual spending increase2022-2026($US billion)
Transport	Roads and bridges Passenger and freight rail transit Airports Ports and waterways safety	136	283	57
Utilities	Clean energy and grid Water infrastructures Resiliency Environmental remediation	53	202	40
Information	Broadband	6	65	13
	Total	195	550	110

Source: Created by author based on The White House (2021a, 2021b), U.S. Census Bureau (2021).

By using a program developed by the Centre of Policy Studies (2019), the original database (Centre of Policy Studies, 2013) was updated to 2019 levels.

The simulations conducted using a CGE consist of a comparison between two scenarios, before and after the policy shock. The pre-policy scenario assumes that the economy is in equilibrium, i.e., all the model equations are solved at a set of prices in which quantities supplied and demanded are equal in all markets. After changing one or several exogenous variables, this equilibrium is broken and the equations are solved to find the new equilibrium. The percentage change in the endogenous variables (modeler defines the endogenous and exogenous variables in the closure of the model) correspond to the impacts caused by the distortion.

The general feature of the model implies that, unlike the partial equilibrium models, a change in the demand or supply for a good of one market can lead to changes throughout the entire economy. A shock (e.g., in the price or quantity of a good) introduced in one market will lead to changes in the demand or supply for goods from other markets.

Simulations and Results

The results shown herein cover the (1) effects after the first year (once the construction phase is initiated (Simulation 1), in which the stimulus is based on an increase in government demand for construction and the (2) long-term effects during the operational phase (Simulation 2), in which infrastructures increase the country's physical capital stock. The results reveal variations in the main macroeconomic variables expressed as percentage changes from the initial data.

Table 2 shows the macroeconomic results from the two simulations. The first column shows the results after the first year of the plan (i.e., very short run), assuming

Table 2 Macroeconomic results

Variable	Simulation 1 $110 billion (first year)	Simulation 2 $550 billion (long run)
Real consumption	0.69	1.44
Real investment	0.00	0.56
Government spending	2.55	1.46
Exports	-2.93	1.35
Imports	1.89	0.70
Real GDP	0.24	1.39
Aggregate Employment	0.44	0.00
Real Wage	0.00	3.94
Aggregate Capital Stock	0.00	2.52
GDP Price Index	2.33	-0.64
Consumer Price Index	1.88	-0.93

Source: Authors' estimations based on Centre of Policy Studies (2013, 2019). See Methodology and Simulations for additional information on the data used.

one fifth of the funds are already allocated and the increase in outlays occurs after the first year (second column). Considering that the $550 billion in new investments are distributed equally between 2022 and 2026, government spending increases in one year by 2.55% from the initial level ($110 billion each year). This would represent the highest annual government spending increase in recent decades.

After the first year (Simulation 1), it is assumed that wages are unable to vary and employment adjusts to meet the increase in demand. There is not enough time for capital adjustment. Therefore, capital stocks remain fixed. The shock after the first year reflects the immediate response to the stimulus, i.e., increase in government demand for construction output (indeed Table 2 shows that government spending increases by 2.55%). During the construction phase, the increase in construction expenditure stimulates a direct increase in both the output and the price levels as shown in Table 2.

The labor market responds to the initial stimulus by increasing the demand for labor (real wages remain fixed). Shocks are defined on a percentage change basis (2019 as base year), using an estimated distribution of funds across states[3] (Online Supplemental Appendix Table 1).

Driven by the increase in demand for construction output, results after the first year showed that GDP would grow by 0.24% ($55 billion) and national employment by 0.44% (equivalent to 650,000 workers). With fixed capital and no variation after the first year, the increase in demand for non-traded construction goods leads to a real domestic appreciation (the GDP price index and the Consumer Price Index (CPI) increase by 2.33% and 1.88%, respectively) and cause the economy to

[3] Calculations are set by statute and can vary over time. Estimates are based on prior legislation that could vary over time.

move towards an increase in the trade deficit (exports fall by 2.93% and imports increase 1.89%).

There are two main assumptions for the long-run simulation: an investment stimulus increases capital stocks and output productivity. Capital stocks are determined endogenously in the long run following a fixed growth rate of capital (fixed investment/capital ratio) in all industries except for the transport[4], utilities and information industries. In this simulation the shock introduced corresponds to a capital stock increase in these three industries[5] based on the allocation of funds shown in Table 1. In the long term, it is also assumed that the U.S. national real balance of trade as a share of real GDP remains constant and that, regarding the labor market, employment returns to initial equilibrium, while real wages are defined as endogenous.

In terms of the productivity increase, a meta-analysis by Bom and Ligthart (2014) aggregated almost three decades of studies measuring the output elasticity of public capital. They found a long-run output elasticity of public capital supplied at the central government level of 0.122. This is the elasticity used to increase the output productivity of transportation, Utilities and information industries in Simulation 2, considering the capital stock increase for each of them.

As a result of the increase in capital stock and output productivity, GDP would rise by 1.39% ($292 billion) and real wages by 3.94%. The competitiveness loss described in the short run is reversed in the long run, once the investments increase, the capital stock and the foreign debt must be paid back. Prices fall (the GDP price index and CPI decrease 0.64% and 0.93%, respectively) and domestic consumption increases (private and public consumption increasing more than investment).

An additional question addressed in this article concerns the efficiency of the actual distribution of investments in the long term. For this purpose, three simulations were compared, in which the total IIJA new spending ($550 billion) was devoted exclusively to the transport, utilities and information sectors. As in the original long-run scenario, the simulations include two types of shocks: (1) sectoral capital stock increase and (2) sectoral output productivity increase using the long-run productivity elasticity estimated by Bom and Ligthart (2014).

Results show that the most efficient sector in terms of economic growth is the one to which most of the funds have been dedicated; the transport sector. Investment in transport has the highest GDP increase (1.42%), followed by information (1.23%) and utilities (0.88%). In addition, investment in transport is the only sector that obtains a higher GDP increase than in the original simulation (1.39%). However, it is also the one that obtains the least sizeable real wage increase (2.98%). If the full investments ($500 billion) were devoted exclusively to the information or the utilities industries, the aggregate real wage increase in those scenarios would be 3.15% or 3.11%, respectively.

The main reasons behind these results are that (1) the transport sector has the lowest capital stocks, i.e., the capital stock increase is proportionately higher than

[4] Transportation capital stock is the value of transportation infrastructure (e.g., roadways, bridges, and stations) and equipment (e.g., automobiles, aircraft, and ships)

[5] Total capital stock increases by 2.52% (see Table 2, second column).

in the other sectors and (2) it is the least capital-intensive sector among the three considered. In fact, transport is the only sector that has a capital over labor (K/L) ratio below 1 (i.e., is a labor-intensive sector), Information and utilities have a K/L ratio over 1 (i.e., are capital-intensive sectors). These two findings imply that the same amount of additional capital in transport is the most productive comparatively speaking and leads to the highest GDP outcome for the whole economy. In contrast, information and utilities experience diminishing returns to capital that arise due to more intensive capital accumulation (because of their larger initial K/L ratios) than experienced by transport, therefore resulting in lower increases in GDP.

On the other hand, the accumulation of capital in one particular sector tends to reduce its rate of return in that sector, relative to labor, since capital becomes relatively more abundant than labor in that sector. This reflects the fact that capital becomes relatively less productive when it is more abundant and labor becomes relatively more productive when it is scarcer. As mentioned earlier, diminishing returns to capital tend to be more sizeable in the more capital-abundant sectors (implying that labor becomes relatively more productive than capital therein). Consequently, transport capital remains much more productive (and labor remains less productive) than in the other two sectors. This explains why wage increases are of smaller magnitude after the investment in transport than after the investment in the other two sectors. A similar analysis of the microeconomic mechanisms underlying these adjustments can be found in Latorre (2013).

Note that the mechanisms of adjustment that take place in the sector receiving the IIJA shock prevail over other adjustments and drive the macroeconomic evolution of GDP and aggregate real wages. This is because the initial shock is the largest occurring in the economy even though it triggers other knock-on effects across the rest of sectors.

All in all, the results of these additional simulations show that even though the current distribution of funds benefits workers the most, if the funds were fully allocated to the transport sector, the benefits in terms of economic growth would be slightly higher in terms of GDP.

Comparison with other IIJA Studies

Two relevant analyses[6] were conducted on the IIJA, namely, Bonakdarpour et al. (2021) and Zandi and Yaros (2021), both using an econometric approach. The results shared in the current study are the first in the English language literature obtained using a CGE approach, to the best of our knowledge. Moreover, this paper provides results for some macro variables which the rest of the analyses (to date) do not offer, such as the impact on exports, imports or price increases.

Zandi and Yaros (2021) used Moody's Analytics macro-econometric model for the decade through 2031 and forecast the impact considering the estimated changes in direct spending on a yearly basis using estimates from the Congressional Budget Office (2021). They compared a baseline scenario with several possible scenarios, including the impact of the America Rescue Plan[7] (ARP) (The

[6] Both analyses were published prior to the approval of the law.

[7] Signed into law by President Biden in March 2021.

White House, 2021c), the IIJA and the Build Back Better framework. As for the IIJA, its impact was shown as an add-on to the ARP, comparing a scenario in which only ARP was contemplated with a scenario in which ARP and IIJA were combined. The results obtained are in line with those from the current analysis, with some differences that make these estimates a bit larger. After the first year of investments (i.e., by 2022) they estimated GDP and employment reductions due to lags in starting the infrastructure projects. Once infrastructure projects have started after the second year (i.e., by 2023) they estimated a GDP increase of 0.65% and an employment increase of 0.21% (around 320,000 workers). Results for subsequent years were more reduced (or even negative). The results from the present paper are in line with these estimates, as funds are equally distributed through five subsequent years. Additionally, Zandi and Yaros (2021) considered the changes in revenues estimated by the Congressional Budget Office through various means ranging from the of COVID-19 appropriations to spectrum auctions, thus obtaining larger GDP impacts than the present analysis, which does not consider those and is more conservative.

The Bonakdarpour et al. (2021) study, commissioned by the American Road and Transportation Builders Association, analyzed the additional highway, bridge and public transit spending in the IIJA ($150 billion). It used a combination of two models, the IHS Markit model and the IMPLAN model. Results are expressed as an annual average between the years 2022-2027 and showed a very positive impact of funding dedicated to highways and bridges. The study estimated an annual GDP increase of $82 billion (0.3%), and an increase in employment of 200,000 workers per year 2022-2027. Considering that these results showed the impact of $150 billion on the U.S. economy, they are clearly above the impact estimated in this study. For example, the study claimed that the $150 billion investment increase[8] would raise GDP by $488 billion (1.8%).

The IHS's Markit's U.S. macroeconomic model used by Bonakdarpour et al. (2021) is an econometric dynamic equilibrium growth model, i.e., solved period-by-period and considering capital accumulation. This is one of the main causes of the higher impact estimated by Bonakpardour et al. (2021). Macro-econometric models are based on time-series data, are statistically rigorous and have predictive skills, but can only provide aggregated (macro) impacts. They capture the dynamic benefits of infrastructure investments, but do not incorporate shocks at a sectoral level as CGEs do.

Additionally, econometric models assume stronger impacts from increasing uncertainty (Latorre et al, 2020), whereas in CGEs the economic agents react to a shock by maximizing profits (firms) and utility (households). Differently from econometric forecasting models, CGE models link the economic theory to data from regions and countries. To obtain sectoral impacts, Bonakdarpour et al. (2021) run an input-output model, which differs from a CGE model in that it does not assume resource constraints and captures only the demand side of an economy.

[8] Sum of investment on highways & bridges ($110 billion) and public transit ($39.4 billion).

Conclusions

This study analyzed the impact that the IIJA signed into law by President Biden in November 2021 would have on the U.S. economy. This law contemplates $650 billion of normal allocated funds, plus $550 billion in new investment for core infrastructure projects (e.g., highways, bridges, waterway), the latter being the ones simulated in this paper. The results show the impact one year after the construction works start, once the funds are fully allocated across states (short run) and in the long run, i.e., the new or renewed infrastructures increase the country's physical capital stock.

The model used is a regional CGE model, namely The Enormous Regional Model (TERM) for the U.S., aggregated into 11 regions and 26 sectors. Therefore, it allows shocks to be introduced at regional and industry levels. The original database was updated to 2019 values using a program developed by the Centre of Policy Studies (2019).

In the first year, after the government demand shock for construction, the first reaction was from the demand for construction output. Since the capital stock and productivity do not change, this increase in demand raises labor demand mainly in the construction sector, and other related sectors. On the other hand, the country's competitiveness is eroded by rising prices, increased imports and declining exports. These results are more pronounced after the fifth year of the stimulus plan, right after the construction phase. GDP and employment increase and there is a boost in private consumption, but at the same time there is an important price increase that reduces external competitiveness (increase in the trade deficit). Once the investments increase the capital stock in the long run (operational phase), employment returns to initial levels and there is an important increase in the national real wage.

Regarding the efficiency of the investments, the estimates from this study suggest that the current distribution of funds is the most beneficial across the main macroeconomic indicators. However, if all funds were devoted to the transport industry, a slightly higher GDP and a lower real wage increase would have been reached. All in all, the results obtained in this analysis indicate a positive outcome for the U.S. economy both in the short and long run as a consequence of the IIJA, since it generates GDP growth, new jobs and increases real wages.

Acknowledgements The paper was presented at the 94th International Atlantic Economic Conference, in-person in Washington, D.C. 6-9 October 2022.

Funding Open Access funding provided thanks to the CRUE-CSIC agreement with Springer Nature.

Declarations

Conflict of interest The authors of this research article declare that they have no financial or personal conflicts of interest that could influence the objectivity, integrity, or impartiality of the findings presented in this paper.

References

Abiad, A., Furceri, D., & Topalova, T. (2016). The macroeconomic effects of public investment: Evidence from advanced economies. *Journal of Macroeconomics, 50*(December), 224–240. https://doi.org/10.1016/j.jmacro.2016.07.005

American Society of Civil Engineers (2021). 2021 Report Card for America's Infrastructure. Available at: https://infrastructurereportcard.org/wp-content/uploads/2020/12/National_IRC_2021-report.pdf. Accessed 2 March 2022.

Aschauer, D. A. (1989). Is public expenditure productive? *Journal of Monetary Economics, 23*(2), 177–200. https://doi.org/10.1016/0304-3932(89)90047-0

Blimpo, M. P. & Cosgrove-Davies, M. (2019). Electricity Access in Sub-Saharan Africa: Uptake, Reliability, and Complementary Factors for Economic Impact. Africa Development Forum series. Washington, DC: World Bank. https://doi.org/10.1596/978-1-4648-1361-0

Bom, P. R. D., & Ligthart, J. E. (2014). What have we learned from three decades of research on the productivity of public capital? *Journal of Economic Surveys, Wiley Blackwell, 28*(5), 889–916.

Bonakdarpour, M., Campbell, K.A., Newport, P. & Eiseman, N. (2021). Economic impacts of transportation infrastructure. Macroeconomic, industry and state-level impact analysis of the additional highway, bridge and public transit spending in the Infrastructure Investment and Jobs Act. Prepared for: American Road and Transportation Builders Association. Available at: https://www.artba.org/wp-content/uploads/federal-investment/iija/ARTBA_EIA_IIJA_Report_Sept2021.pdf. Accessed 2 March 2022.

Bureau of Economic Analysis. Regional Economic Accounts. U.S. Department of Commerce. https://www.bea.gov/data/economic-accounts/regional. Accessed March 13, 2022.

Canning, D. & Pedroni, P. (2004). The Effect of Infrastructure on Long Run Economic Growth. Department of Economics Working Papers, 2004-04, Department of Economics, Williams College. https://web.williams.edu/Economics/wp/pedroniinfrastructure.pdf

Cantwell, M. (2021, October 8). Infrastructure Investment and Jobs Act will deliver on Senator Cantwell's Priorities. María Cantwell, United States Senator for Washington. https://www.cantwell.senate.gov/news/press-releases/cantwell-outlines-big-wins-for-washington-states-infrastructure-salmon-economy-. Accessed 20 Feb 2022.

Centre of Policy Studies (2013). TERM-USA model. https://www.vu.edu.au/centre-of-policy-studies-cops/contract-research-cge-model-sales/cge-model-sales/term-usa-model

Centre of Policy Studies (2019). TPMH0182. Centre of Policy Studies. Available at: https://www.copsmodels.com/archivep.htm

Chakamera, C., & Alagidede, P. (2018). The nexus between infrastructure (quantity and quality) and economic growth in Sub Saharan Africa. *International Review of Applied Economics, 32*(5), 641–672. https://doi.org/10.1080/02692171.2017.1355356

Committee for a Responsible Federal Budget (2021) What's in the Bipartisan Infrastructure Investment and Jobs Act? United States. https://www.crfb.org/blogs/whats-bipartisan-infrastructure-investment-and-jobs-act. Accessed 20 Feb 2022.

Congressional Budget Office (2016). The Macroeconomic and Budgetary Effects of Federal Investment, June 2016, https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/51628-Federal_Investment-OneCol.pdf. Accessed 20 Feb 2022.

Congressional Budget Office (2021). Cost estimate for Senate Amendment 2137 to H.R. 3684, the Infrastructure Investment and Jobs Act. https://www.cbo.gov/system/files/2021-08/hr3684_infrastructure.pdf. Accessed 20 Feb 2022.

Czernich, N., Falck, O., Kretschmer, T., & Woessmann, L. (2011). Broadband infrastructure and economic growth. *The Economic Journal, 121*(552), 505–532.

Horridge, J. M. (2012). The TERM model and its database. In G. Wittwer (Ed.), Practical policy analysis using TERM (1st ed., pp. 13 - 35). Springer. https://doi.org/10.1007/978-94-007-2876-9_2

Jorgenson, D. (1991). Productivity and Economic Growth. In G. Fromm and D. Simpson (Eds.), Fifty Years of Economic Measurement: The Jubilee of the Conference on Research in Income and Wealth (pp. 19-118). National Bureau of Economic Research, Inc.

Latorre, M. C. (2010). Chapter 1: Introduction to the impact of foreign-owned companies on host economies using a computable general equilibrium approach. In M. C. Latorre (Ed.), *The impact of foreign-owned companies on host economies: A computable general equilibrium approach* (pp. 1–13). Nova Science Publishers.

Latorre, M. C. (2013). On the differential behaviour of national and multinational firms: A within- and across-sectors approach. *The World Economy, 36*(10), 1294–1317. https://doi.org/10.1111/twec.12100

Lawrence, R. Z. (2023). Behind the Curve: Can Manufacturing Still Provide Inclusive Growth? Peterson Institute for International Economics.

Lenz, L., Munyehirwe, A., Peters, J., & Sievert, M. (2017). Does Large-Scale Infrastructure Investment Alleviate Poverty? Impacts of Rwanda's Electricity Access Roll-Out Program. *World Development, 89*(January), 88–110. https://doi.org/10.1016/j.worlddev.2016.08.003

Li, J., & Li, S. (2020). Energy investment, economic growth and carbon emissions in China—Empirical analysis based on spatial Durbin model. *Energy Policy, 140*(May), 111425. https://doi.org/10.1016/j.enpol.2020.111425

Melo, P. C., Graham, D. J., & Brage-Ardao, R. (2013). The Productivity of Transport Infrastructure Investment: A Meta-Analysis of Empirical Evidence. *Regional Science and Urban Economics, 43*(5), 695–706. https://doi.org/10.1016/j.regsciurbeco.2013.05.002

Munnell, A. H. (1992). Policy watch: Infrastructure investment and economic growth. *Journal of Economic Perspectives, 6*(4), 189–198. https://doi.org/10.1257/jep.6.4.189

Rozas, P., Sánchez, R. (2004). Desarrollo de infraestructura y crecimiento económico: revisión conceptual [Infrastructure development and economic growth: conceptual review]. Serie Recursos Naturales e Infraestructura. ECLAC, United Nations. https://repositorio.cepal.org/bitstream/handle/11362/6441/1/S048642_es.pdf Accessed May 3 2022.

Schwab K. (2019). The Global Competitiveness Report 2019. Geneva: World Economic Forum. p. 666. Available at: https://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf. Accessed 3 May 2022.

Stupak, J. M. (2018). Economic Impact of Infrastructure Investment. Congressional Research Service, 2018. Available at: https://sgp.fas.org/crs/misc/R44896.pdf. Accessed 15 April 2022.

Tatom, J. A. (1991). Public Capital and Private Sector Performance. Federal Reserve Bank of St. Louis Review, May/June 1991, pp. 3-15. https://doi.org/10.20955/r.73.3-15

The White House (2021a). Fact Sheet: The Bipartisan Infrastructure Deal. Office of the Press Secretary of the United States. 06 Nov. 2021, Available at: https://www.whitehouse.gov/briefing-room/statements-releases/2021/11/06/fact-sheet-the-bipartisan-infrastructure-deal/. Accessed 10 April 2022.

The White House (2021b). Bipartisan Infrastructure Law State Fact Sheets. The United States Government, Nov. 2021. Available at: https://www.whitehouse.gov/build/state-fact-sheets/. Accessed 10 April 2022.

The White House (2021c). Fact Sheet: American Rescue Plan. Available at: https://www.whitehouse.gov/american-rescue-plan/ Accessed . 10 April 2022.

Timilsina, G., Hochman, G. & Song, Z. (2020). Infrastructure, Economic Growth, and Poverty: A Review, World Bank Policy Research Working Paper Series No. 9258, https://ssrn.com/abstract=3612420

U.S. Census Bureau (2021). Construction Spending. Available at: https://www.census.gov/construction/c30/historical_data.html. Accessed 20 May 2022.

Zandi, M., & Yaros, B. Jr. (2021). Macroeconomic Consequences of the Infrastructure Investment and Jobs Act & Build Back Better Framework. Moody's Analytics. Available at: https://www.moodysanalytics.com/-/media/article/2021/macroeconomic-consequences-infrastructure.pdf. Accessed 13 April 2022.