Macroeconomic, sectoral and distributional effects of the Infrastructure Investment and Jobs Act in the United States

1. Introduction

The dramatic situation that the world has experienced with the Covid-19 pandemic has been later exacerbated with Russia's invasion of Ukraine, and many countries have taken different public policy measures to revitalize their economies. Most of these measures have something in common, namely, they have increased public spending to deal with the crisis. In November 2021, U.S. President Biden signed the *Infrastructure Investment and Jobs Act* (IIJA), a law that aims to "rebuild America's roads, bridges and rails, expand access to clean drinking water, ensure every American has access to high-speed internet, tackle the climate crisis, advance environmental justice, and invest in communities that have too often been left behind" (The White House, 2021a). The IIJA package includes $550 bn in new spending over 2022 through 2026 to improve the country's infrastructure (United States Congress, 2021), and 650$ bn coming from existing infrastructure funds and repurposed funds from other areas. The government plans to rebuild America's infrastructure, "creating good middle-class union jobs, supporting disadvantaged and underserved communities, advancing climate resilience and sustainability, and investing in American manufacturers." (The White House, 2021b).

This law represents the most ambitious infrastructure investment in the United States (U.S.) since President Eisenhower created in 1956 the Interstate Highway System, the greatest public works project in American history (Blas, 2010). According to the White House, it breaks records in terms of investment in public transit, passenger rail, single dedicated bridge and clean drinking water and wastewater infrastructure in American history. However, this ambitious plan was not approved without debate, even from Democratic senators. In fact, without the republican support (13 republican senators), it would have not been approved, as several Democratic Senators (6) did not support the law. They considered it lacks specific provisions to fight climate change (New York Times, 2021).

According to the 2019 Global Competitiveness Report (Schwab, 2019), the US ranks 13th in global infrastructure quality and 17th in road infrastructure quality. Over the past decades, government infrastructure has aged dramatically. The American Society of Civil Engineers (2021) classified America's Infrastructure as "poor" (C- score), and advocates for an increased, long-term investment to close the 2.6$ trillion investment gap. According to this professional organization, the deterioration of transportation infrastructures in the U.S. entails very significant direct and indirect costs for the country's economy. They estimate America's overdue infrastructure bill will cost the average household $3,300 a year.

To the best of our knowledge, there are not many analyses on the impact of the IIJA. Some exceptions are the studies by Bonakdarpour et al. (2021) and Yaros & Zandi (2021), which were undertaken prior to the publication of the IIJA. In this paper we offer new

short- and long-run estimations based on the information available on the IIJA and on ex-ante Computable General Equilibrium (CGE) simulations, using The Enormous Regional Model (TERM) for the U.S. Short-term effects are those occurring during the construction phase, in which the stimulus is based on a government demand increase for construction. By contrast, in the long-term infrastructures are fully functional and become part of a country's physical capital. Our methodology allows us to provide a very thorough analysis for macroeconomic variables, such as, GDP, aggregate private and public consumption, investment, exports, imports, wages and employment. We also derive the outcomes for production across the 26 sectors in which we have divided the U.S. economy and pay particular attention to the distributional impact across 10 types of occupations (six skilled and four unskilled). Our analysis takes into account different ways of financing the bill, namely, through foreign or national borrowing. In the real world, probably the funding will be a mix of foreign and national borrowing, however we want to illustrate their different implications.

Our main results are as follows. Let us begin with the short run. After one year of a $110 billion (i.e., one fifth of the overall) government spending increase in construction, U.S. GDP could rise by 0.22% or 0.19% if it is financed with foreign or national savings, respectively. Aggregate employment could go up by 0.43% or 0.38% (equivalent to 640,000 or 570,000 new jobs created per year, respectively). In the short run, when the increase in government spending is financed through national savings it slightly reduces private consumption and investment, which mildly limits the expansionary impact of the IIJA compared to foreign borrowing. We find that most workers' categories across skilled and skilled occupations would benefit, with those more involved in construction benefitting the most. These short run impacts would be repeated for five subsequent years since government spending would rise by the same amount per year in that period.

In the long run, we assume that unemployment returns to its long run equilibrium and increases in government investment have translated into a larger U.S. capital stock. As a result, U.S. GDP would increase by 1.18% with foreign borrowing or by 1.39% with national savings and wages would go up by 2.76% and 3.94%, respectively. If the U.S. economy has to pay back the foreign debt created by the IIJA, the long run expansionary impact is dampened compared to the case of national borrowing. In the latter case, there is no need to pay back any debt. The IIJA would benefit all occupations, with larger wage increases for unskilled occupations than for skilled ones. What is more, in general, sizeable wage increases tend to be more evenly distributed among all workers occupations with national borrowing than with foreign borrowing and unskilled workers benefit more from national borrowing than from foreign borrowing. Thus, we find that the way in which the IIJA is financed has relevant implications in terms of distributional effects.

This paper is organized as follows. The next section describes the Infrastructure Investment and Jobs Act (IIJA) and breaks down the various items corresponding to new investment. In section 3, we review the literature on the relationship between infrastructure and economic growth. In section 4, we describe the TERM model used for the simulations considering different ways of financing the deficit generated by the increase in public spending. Section 5 presents the simulations and macroeconomic

results, while sections 6 and 7 present the impact on production and occupations. Finally, the last section draws several conclusions.

2. Overview of the Infrastructure Investment and Jobs Act

Our impact analysis focuses on the $550 bn within the IIJA that correspond to new federal investment on "basic infrastructure", i.e., physical networks or assets such as roads, railroads, bridges, and rails over five years. When a $1.2 trillion is offered as the figure related to Biden's plan (e.g., U.S. Department of Transportation, 2022) it includes additional funding normally allocated each year for highways and other infrastructure (e.g., Federal-aid Highway Program, Federal Railroad programs or Research, Technology & Education). Thus, the funding beyond the $550 billion is already included in the figures of government spending in our model and does not imply any additional government spending. From 2022 to 2026, the IIJA increases federal infrastructure spending by $110 billion annually, which is an amount equivalent to 0.55% of GDP and 2.55% in terms of total government spending (Congressional Budget Office, 2020). Although considerably reduced from its first proposal ($2.3 bn), this plan changes the infrastructure investment over GDP declining trend in the US since the 1970's decade. If the $550 of new infrastructure investment were added to the US stock of nondefense infrastructure, its ratio over GDP would reach the levels of 2013 (Fair, 2021). With the IIJA, this ratio would still stay under the historical mean but counteracts the downward trend of the past decades.

Table 1 shows what the new investment funds will be devoted to. The law contemplates more than $110 billion to repair roads, bridges and highways, and $66 billion to promote passenger and freight rail. The latter investment represents the largest injection of funds into the country's rail network in the past five decades. By dedicating $65 billion for broadband infrastructures, it aims to supply every American with high-speed internet access. The bill also allocates $65 billion to modernize the electric grid and provides $63.3 for water infrastructure, e.g., lead pipe replacement. Related to transit it also breaks records by allocating more than $54 billion in transit modernization, replacement and acquisition of vehicles and for the expansion of the electric vehicle charging network. It also allocates billions of dollars to increase cybersecurity, reduce climate change effects, as well as to reform irrigation, ports and airports infrastructures, among others.

The infrastructures that are built in the short term imply a short run increase in the demand for construction. Once they are built, they can be grouped into three main sectors[1]: Utilities ($181 billion for energy distribution infrastructures, water, sewage services), Transport services ($298 billion for land transport, air transport, water transport, transit) and Information services ($65 billion for telecommunications, cable networks, information services, data processing services). Thus, the IIJA will increase the capital stock in these three sectors in the long run.

[1] Although some sub-items could be classified in other sectors, these correspond to comparatively much smaller amounts. Therefore, we do not model them explicitly, which implies we are conservative in our analysis.

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

New spending	$US Billion	Description
Roads and bridges	110	Repair roads and bridges and support major, transformational projects
Passenger and freight rail	66	Amtrak National Network backlog repairs, freight and rail and safety
Broadband	65	High speed internet through investment in broadband infrastructure
Clean energy and grid	65	Upgrade power infrastructure by building resilient transmission lines
Clean water, water infrastructures	63,5	Service line replacement, water storage, drought contingency plans
Transit	54	Transit modernization, replace deficient vehicles and improve access for elderly and people with disabilities, buy clean school buses & ferries, Electric Vehicle Chargers
Resiliency	50	Protection against impacts of climate change and cyber attacks
Airports	25	Modernize and construct runways, gates, terminals, air traffic control infrastructure
Environmental remediation	21	Remediate idled former industrial and energy infrastructure sites
Ports and waterways	17	Waterway and coastal infrastructures
Safety	11	Safety programs for highways and pedestrians
Total	547,5	

Source: authors' elaboration based on The White House (2021a).

Regarding the legislation pay for, 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 the half of it, as some of the reported offsets have already taken place (Committee for a Responsible Federal Budget, 2021).

3. Infrastructure expenditure and economic growth

Physical capital is intuitively an essential part of an economy, as it is a fundamental input for production, 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 nondefense 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, 2019).

The relationship between infrastructure investment and a country's economic growth has been subject of analysis for many decades, and it is now on the spotlight due to the challenges posed by the 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 sceptic about these results, arguing statistical problems related to the aggregated nature of data (Jorgenson, 1991) or spurious correlation between public capital and income due to the non-stationarity of the regressed variables critics (Tatom, 1991). The most recent economic literature does seem to agree on the positive relationship between infrastructure investment and economic growth. Rozas & Sánchez (2004) support that although the measurement of the impact of infrastructure investments on the development of a region or a country has yielded mixed results, much of the empirical evidence in the literature shows that infrastructure investments contribute to

output growth, cost reduction and improvements in profitability. In the same line, Stupak (2018) supports that increased infrastructure investment leads to higher GDP on the long term through increased productivity over time. According to Lawrence (forthcoming), 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 (Lawrence et al., 2009).

The Development Economics World Bank's research group remarks that there is a gap of empirical studies in the area of infrastructure investment and economic growth and that it is necessary to carry out additional studies (Timilsina et al., 2020).

4. Methodology and data

We use the United States version of The Enormous Regional Model (TERM-USA), a Computable General Equilibrium (CGE) model. CGEs are based on mathematical equations that capture the interactions between factor markets and goods markets and can integrate both the macro and microeconomic levels (Latorre 2012a, chapter 1; Latorre et al., 2020). They incorporate real data into a rigorous theoretical framework and present the relationships among economic agents as a system of equations derived from microeconomic optimization theory and cover the behavior of households, firms and government in the economy. 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. Moreover, they are flexible tools able to take into account many economic sectors considering the linkages among them and assess which of them benefit or would be negatively affected after a policy shock. This methodology is therefore appropriate to analyze the quantitative impact of the infrastructure bill at both the macro and the micro economic level.

The TERM framework was originally developed for the Australian economy (Horridge, 2012), and builds on the ORANI model (Dixon et al., 1982). Its database was developed using detailed official and regional statistics (Horridge, 2012). It follows a bottom-up strategy, meaning that regional results sum up to obtain the national results. Specific versions of the TERM model have been developed for a wide variety of impact analysis, such as Australian water shortage / water trading events (Wittwer & Dixon, 2013), or deforestation in Brazil (Souza Ferreira Filho et al., 2015). Regarding public infrastructure related studies, Giesecke et al. (2008) analyzed regional government infrastructure provision under different financing scenarios, and Horridge & Wittwer (2008) estimated the economic impacts of a construction project using SinoTERM, a TERM version for China.

The United States version of the TERM used in this study divides the US economy into 11 regions, 26 sectors and 10 occupations. This allows us to offer a rich set of estimates at the sectoral level and across different types of workers. This granular approach helps to identify whether Biden's act would help to counteract inequality issues that have been identified in the US economy and for which increases in investment could be

positive (Lawrence, forthcoming; Lawrence, 2015a; 2015b). Moreover, our study would provide a real-world test on whether new government programs that emphasize construction for infrastructure, renewable energy and climate change mitigation could serve to offset some of the non-inclusive impacts that have been found in R&D-intensive programs (Lawrence, forthcoming).

See Appendix X for a more detailed description of the version used in this study

5. Simulations and macroeconomic results

The economic effects of an infrastructure investment plan are usually approached in two phases: (1) short-terms effects during construction phase, in which the stimulus is based on a government demand increase for construction and (2) long-term effects are those during the operational phase, in which infrastructures are fully functional and increase physical capital in Utilities, Transport services and Information services sectors. In the long run the increase in government demand ceases but its effects work through a larger and better infrastructure. This study analyzes both phases, estimating the impact after the first year (short run) and in the long run. We define shocks on a percentage change basis (2019 as base year), using an estimated distribution of funds across states[2] (see Table in the Appendix). We have updated data on GDP and employment to 2019 levels[3] using the TERMSCAL program developed by the Center of Policy Studies (2019).

For the short run simulations, we show results after the first year. We run a government spending increase in the Construction sector, following the information available on the IIJA. Considering the $550 billion in new investments are distributed equally between 2022 and 2026, government spending increases in one year by 2.55% from baseline levels ($110 billion each year). This would represent the highest annual government spending increase in the last decades. In the short run, the economy's production response to an external shock is limited, and investment flows are not yet transformed into capital stocks. Therefore, we keep capital stocks fixed, while we allow the rental price of capital to vary. In the first year, wages are unable to vary, whereas employment adjusts to meet the demand increase.

The long run simulations contemplate the $550 billion devoted to new public spending and are based on three premises: investment stimulus raises capital stocks, output productivity increases and employment returns to its initial levels. Capital stocks in all industries are now determined endogenously, except for the Utilities, Transport services and Information services industries. We exogenously increase the capital stock in these three latter industries, based on allocation of funds shown in Table 1. Regarding output productivity, a meta study by Bom & Ligthart (2014) aggregated almost three decades of studies on measuring the private output elasticity of public capital. They found a long-run output elasticity of public capital supplied at the central government level of 0.122.

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

[3] Latest data available (from the U.S. Census Bureau) corresponds to 2020 (Census, 2022). The reader may check that government spending did not follow the previous trend due to the Covid-19 pandemic outbreak. Therefore, we consider 2019 to be a more realistic base year for our shock estimations, as data for full-year 2021 is unavailable at the moment of running the simulations (March, 2022).

Based on this finding, we apply that elasticity to increase productivity in Transportation, Utilities and Information considering capital stock increase in each industry. Differently from the short run closure rules, in the long run we assume employment returns to baseline levels, while national real wages adjust to labor market conditions.

When government spending leads to a larger federal budget deficit, it usually reduces the national savings rate and raises the trade deficit. A portion of the budget deficit is effectively financed through a rise in the total amount Americans borrow from abroad (McBride & Chatzky, 2019). Based on this, we define a scenario in which the initial stimulus is financed by the foreign sector (international borrowing) and a second scenario in which the increase in public spending is financed through reduced national savings (national borrowing). Because the labor market serves as primary driver of much of the activity in each region, in all scenarios we make regional consumption follow regional wage income. Table 2 shows the short and long run results for the main macroeconomic variables under each scenario. The real impact (in both the short- and long-run) would be somewhere in the middle of the national or foreign scenarios we analyze, since it will probably be a mix of national and foreign borrowing. All the macroeconomic variables in Table 2 are expressed in real terms and in percentage change with respect to the initial data.

Table 2. Impact on macroeconomic variables
(% change with respect to initial levels)

Macro variables	Foreign borrowing		National borrowing	
	Short run	Long run	Short run	Long run
Private consumption	0.00	0.00	-0.17	1.44
Investment	0.00	0.00	-0.35	0.56
Government consumption	2.55	0.01	2.55	1.46
Exports	-0.72	6.61	0.02	1.35
Imports	0.61	-2.45	0.12	0.70
Real GDP	0.22	1.18	0.19	1.39
Agg. Employment	0.43	0.00	0.38	0.00
Real wage	0.00	2.76	0.00	3.94
Agg. Capital Stock	0.00	2.10	0.00	2.52
GDP Price Index	0.65	-3.90	0.12	-0.64
Export Price Index	0.36	-3.15	-0.01	-0.67

Source: authors' estimations
Notes: results are expressed in real percentage changes from baseline levels

Under **(1) foreign borrowing** (see Table 2), the increase in government spending will be financed by the foreign sector, i.e., through a trade deficit increase. Thus, in addition to the short- and long- run assumptions already mentioned, we fix private consumption and investment. In the short run, the rise in demand for construction output increases demand for labor, and aggregate employment rises by 0.43% (equivalent to 640,000 workers). As a result, GDP goes up by 0.22%. The investment stimulus causes a rise in the domestic price of goods and services, and the GDP price index and export prices increase by 0.65% and 0.36%, respectively. This domestic appreciation causes a fall in exports (0.72%) and a rise in imports (0.61%), and the trade deficit rises by $35.1 billion

after the first year. A similar short run macroeconomic adjustment was experienced during the Global Financial Crisis, in which the domestic increase of construction investment generated a negative effect on the trade balance. This was reinforced by the increase in domestic construction prices which, in turn, drived a currency appreciation. However, dwelling investment is different than infrastructure investment, and the latter should boost production in the economy more heavily than the former. Improvements in basic infrastructure help to reduce firms' costs, and to boost productivity in the economy in the long run.

In fact, the competitiveness loss we have just described for the short run is reversed in the long run, when the initial deficit increase will have to be financed (i.e., the foreign debt has to be paid back) and infrastructure investments increase capital stocks. Thus, in the long run imports decrease by 2.45% and exports increase by 6.61%, leaving an overall trade deficit reduction of $41.7 billion from initial levels.

In the long run, the increase in capital stocks and in output productivity rises the productive capacity of the economy, and GDP rises by 1.18%. Workers experience an increase in the capital available for production and become, thus, more productive. As a result, their wages go up by 2.76%.

Under **(2) national borrowing** (see Table 2), we allow private consumption and investment to vary while we fix balance of trade as a share of GDP. Thus, we assume that the national deficit increase is financed internally through a redirection of savings or waiving current consumption levels. In the short run, the economy grows similarly to the international borrowing scenario, but the deficit increase caused by the initial stimulus is financed through reduced private consumption (0.17%) and reduced investment (0.35%). GDP rises by 0.19% and aggregate employment by 0.38%. The investment stimulus still causes a domestic appreciation in the economy, and the GDP price index rises by 0.12%. As in the foreign borrowing scenario, in the long run the increase in capital stocks and output productivity rises the productive capacity of the economy. GDP and national real wages increase by 1.39% and 3.94%, respectively. Do note, however that both the increase in GDP and wages are now somewhat larger than in the foreign borrowing case.

With national borrowing the increase in government spending is financed simultaneously in the short run through reduced private consumption and investment. This implies that in the long run, there is no debt (and no interests from the debt) to pay back, contrary to the case of foreign borrowing. As a result, in the long run under national borrowing the expansionary trend caused by a larger capital stock and productivity increases, boosts consumption and investment. Therefore, the expansionary trend is larger than with foreign borrowing. This contrasts with the impact in the short run, in which the sacrifices in consumption and investment necessary to nationally finance the increase in government spending slightly reduce the positive impact of foreign borrowing. Do note however, that even though we only present the results in the short run for one year, this shock represents one fifth of the overall Biden's stimulus package which will be implemented in five subsequent years. Thus, the results we present for one year could more or less be multiplied by five, to obtain an insight about their cumulative impact as the IIJA unfolds in a 5-year period.

Under national borrowing no foreign borrowing occurs. Therefore, we consider a constant balance of trade over GDP ratio, and thus exports and imports adjust to meet this constraint (exports grow by 1.35% and imports grow by 0.70%). The counterpart of this increase in competitiveness is a decrease in the general price of goods and services, i.e., the economy experiments a deflationary process (GDP price index decreases by 0.64%).

We compare our results with two relevant analyses that have been conducted on the IIJA, namely, Bonakdarpour et al. (2021) and Yaros & Zandi (2021). Both were published prior to the approval of the law and use an econometric approach. To our knowledge, our impact analysis is the first study of the IIJA that uses a CGE model. Moreover, our results are more comprehensive, as we provide results for several macro variables which the rest of analyses (to date) do not offer. In particular, their studies do not cover the impact on exports, imports and prices.

Although macro-econometric models and CGEs are both based on a core input-output structure and on a national accounting framework, they offer a different approach to phenomena. Macro-econometric models do not include optimizing behavior as they are based on uncertainty conditions (Pollitt et al., 2019; Latorre et al., 2020). Unlike econometric models, in which parameters are based on time-series data, CGE's are based on microeconomic behavioral equations that capture the links between the different agents in an economy.

The study carried out by Yaros & Zandi (2021) is mentioned in The Annual Report of the Council of Economic Advisers (United States President & Council of Economic Advisers, 2022). It compares a business as usual scenario with several possible scenarios, including the impact of the America Rescue Plan[4] (ARP) (The White House, 2021c), the IIJA corresponding to additional infrastructure investment ($550 billion) and the Build Back Better framework. Differently from our analysis, they do not isolate the effect of the IIJA, and make their estimates based on an increasing distribution of investment between 2022 and 2031. Results are shown as an add-on to the ARP, comparing a scenario in which only ARP is contemplated with a scenario in which ARP and IIJA are combined. Therefore, comparations should be taken cautiously. The IIJA could rise US GDP by 0.6% in 2023, if we consider the difference between the impact of ARP + IIJA (2.9%) and the impact of the ARP alone (2.3%). However, in the following years the impact of the IIJA seems to be close to zero (since it coincides with the impact of ARP + IIJA) or even negative, with a tenth of a percentage point difference (i.e., 1.7% with IIJA vs 1.8% without IIJA). As for employment, they estimate an increase of 320,000 workers[5] for the same year, reaching 800,000 by 2025. In terms of jobs created, their results point to fewer jobs than we estimate. Larger GDP with smaller job creation than we find may occur for example due to the sectors in which jobs are created and for which they offer no detail. This study uses The Moody's Analytics macro-econometric model for the simulations over the decade through 2031.

Bonakdarpour et al. (2021) study was commissioned by the American Road and Transportation Builders Association and analyzes the additional highway, bridge and

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

[5] They show level-form results for the number of jobs created, while our results are expressed in percentage change. Therefore, comparisons should be made with caution.

public transit spending in the IIJA (around $150 billion). It uses a combination of two models, the IHS Markit model and the IMPLAN model. Considering that these results show the dynamic impact of $150 billion on the U.S. economy[6] (i.e., about a third of the shock we run) their GDP estimates are of a total accumulation of $488 billion between 2022 and 2027, as well as an employment increase of 200,000 workers per year in the same period. Thus, as happened with Yaros & Zandi (2021), Bonakdarpour et al. (2021) also obtain larger GDP estimations but lower job creation than we find.

Other major public investment projects have been analyzed under a CGE framework (Euijune et al., 2004; Zhai, 2018; Christensen et al., 2019). The RHOMOLO is the spatial computable general equilibrium model of the European Commission used to analyze the impact of the Investment Plan for Europe, also called the Juncker Plan (European Commission, 2014). Christensen et al. (2019) uses the RHOMOLO-EIB[7] model, which analyses the effect of the EU structural investment funds provided through lending. According to their study the total expected investments from the European Fund for Strategic Investments (under the Juncker Plan) totaled €408 billion over the 2015-2019 period. Their results showed that these investments would cause a 1.76% increase on GDP by 2022, as well as an increase of 1.68 million workers by the same year. A smaller amount of investment, accumulated through a similar period of time (5 years) yield a somewhat larger GDP impact and smaller job creation than we find. However, comparations should be taken cautiously, as these results are referred to a different region (EU).

6. Impact on production

Results for GDP and employment are expressed as an annual average between the years 2022-27 and show a very positive impact of the funding dedicated to highways and bridges. Differently from our study, they show yearly wage increases from start. This analysis also deepens into the labor impacts and state-level results. Regarding labor, the study highlights that the increases in employment levels go beyond the construction sector. On average, health care and social assistance, retail trade, and manufacturing alone would make up 6% of the employment impact.

Table 3 presents the impact on output at a sectoral level for each scenario in the short- and long-run. Short run estimations are based on an increase in public demand for construction output, and therefore this sector experiments the highest increases. A high share of the goods produced by some industries such as Non-metallic mineral products (37%), Other mining (21.8%) or Metal products (11.4%) is used as intermediates by the Construction sector, and therefore these industries experiment important output increases. The Construction sector performs slightly better in the short run when the investment stimulus is financed through an increase in trade deficit (foreign borrowing). This is because under national borrowing investment goes down, thus, reducing slightly

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

[7] The RHOMOLO-EIB framework capitalizes on the well-established RHOMOLO model, initially developed by the Joint Research Centre to evaluate the performance of EU policies and extends it to cover the business model of the European Investment Bank (EIB) Group. The main difference between the two versions of the model lies in the modelling of the EIB-Group operations as loans financed by the Bank which differ from grants financed by taxes levied by the EU governments. The latter are the ones normally analyzed with the RHOMOLO model.

private demand for construction. The production in the rest of sectors remain nearly unaffected in the short run.

In the long run the sectors targeted by the IIJA experience larger increases in the capital stock than the rest. This explains why Utilities, in particular, and to a lesser extent Transport services and Information services exhibit quite remarkable increases in production. Although the Transport services sector receives most of the investment, it also experiences smaller output increases than the other two. This is due to the fact that this sector is the one that increases comparatively less its capital stock (in percentage terms). The increase in demand for Utilities pulls demand for Energy minerals products, which also experiments a very important increase in production. More than 37% of the Energy and Minerals sectors' output is used as intermediate by the Utilities sector, and almost 45% of the intermediates used by the Utilities industry comes from the Energy minerals industry. In addition, because there is a general increase in the U.S. capital stock in the long run there is an overall expansionary trend in most of the sectors of the economy. This contrasts with their sluggishness in the short run, with the exception of construction and its suppliers, which grow in the short run.

7. Distributional impact

Job creation, and specifically jobs in the manufacturing sectors, is an important target of this package, and it is mentioned several times by the White House (2021a). Table 4 shows the distributional impact of the IIJA among skilled and unskilled occupations. The first column shows the share that each occupation has on aggregate employment.

In the short run, those occupations especially related to the Construction industry experience the highest job increases, with similar results for both scenarios (foreign borrowing and national borrowing). Construction workers account for the 63.6% of the total labor in this industry, and therefore it is the occupation that benefits the most from the increase of government spending in Construction. Craft and related trade workers (skilled) experiment the second highest increases (over 0.7%) as this occupation allocates a high share of its total labor force in the Construction industry. Farm, fishery & forestry workers are mostly allocated in Crops and Forestry and Fishery sectors. These sectors export an important share of their production. Thus, the export decrease experimented under foreign borrowing reduces demand for Farm, fishery & forestry workers. On the other hand, almost 90%[11] of Service workers allocate within Health and Social services and Government and Defense services sectors. These industries experiment an output decrease under national borrowing, thus lowering demand for service workers (0.06%).

In the long run employment returns to its initial level and adjustments in the labor market occur through wages. The IIJA would benefit all occupations in the long run, with larger wage increases for unskilled occupations than for skilled ones. What is more, unskilled workers benefit more with national borrowing than with foreign borrowing. Further, in general, wage increases tend to be more evenly distributed among all workers occupations with national borrowing than with foreign borrowing. This is related to the production increase we have just analyzed. In the long run, with national borrowing there was an overall expansion in production, with all sectors expanding. With foreign borrowing though, we have seen that the construction sector and a few

services sectors would contract and these translates in uneven increases in wages across worker occupations. Thus, the way in which the IIJA is financed has relevant implications in terms of distributional effects.

8. Conclusions

In this paper we analyze the impact that an increase in public infrastructure spending has on the U.S. economy. It is the strongest public infrastructure investment stimulus that has been approved in the US in the last decades. To the best of our knowledge, we offer the first analysis of the Infrastructure Investment and Jobs Act (IIJA) using a Computable General Equilibrium approach. Moreover, we present our work after the recent approval of the plan in November 2021, while the previous analyses made on the IIJA were carried out before it was signed into law (Bonakdarpour et al., 2021; Yaros & Zandi, 2021). We use The Enormous Regional Model for the U.S. economy, which allows us to introduce regional-level shocks and offers macroeconomic results, as well as industry level results. Furthermore, its disaggregation of employment allows us to compare results for ten different occupations covering both skilled and unskilled workers.

We evaluate the short run effects of the increase in government demand for Construction ($110 billion after the first year), and the long run effects of the stimulus ($550 billion), once the investments rise capital stock in the Utilities, Transport services and Information service industries. Intuitively, it is assumed that physical infrastructure plays a key role in any economy, but at the same time we know it requires significant upfront investment, which inquires a debt increase. This debt can be financed through foreign debt (i.e., a trade deficit) or through reduced national savings. We evaluate the impact under both scenarios, considering that the real impact falls in between these two.

When the deficit is financed through foreign borrowing in the short run, the initial stimulus rises GDP by 0.22% and employment by 0.43% but causes a domestic appreciation (GDP price index rises by 0.65%). As a result, exports decrease by 0.72% and imports rise by 0.61%, thus, increasing the trade deficit. As government demand for construction grows, there is a surge in demand for construction workers (4.19%) and for those occupations with a high share of workers in Construction, such as Craft and related trade workers (0.74%). Do note that the IIJA will increase government spending throughout five subsequent years. So similar outcomes would be repeated in each of those years. The trade deficit increase rises national debt, which is paid in the long run by a lack of growth in private consumption and investment. The economy grows through increased exports (6.61%) and reduced imports (2.45%), creating a trade surplus to pay off its debt.

If the domestic economy finances the debt increase in the short run, results show a mild reduction in consumption (0.17%) and investment (0.35%). These short run results could be interpreted as paradoxical since the objective of increased public spending is to improve the economy of the country and its citizens. However, we do derive that national borrowing results in a 0.19% increase in GDP and a 0.38% rise in employment in the short run, following the government demand stimulus. What is more, it is under this scenario in which the most positive long-run results are obtained. GDP rises by

1.39% and wages rise by more than 3.9% compared to 1.18% and 2.76% increases in GDP and wages under foreign borrowing. We consider it of special importance to share these results, as currently rising inflation levels and the rise in interest rates in the near future may cause the payout of this plan to increase in a contest of weak GDP growth after Russian's invasion of Ukraine. Moreover, national borrowing results tackle better the wages inequalities between skilled and unskilled occupations, and results in higher increases in wages than foreign borrowing.

Regarding production, the short run demand increase for Construction mainly benefits this industry, which levels up its production over 3.3% under both scenarios. In the long run the economy experiences a general upward trend in production. However, we do find a somewhat contrasting trend between national and foreign borrowing. Because in the long run the foreign debt has to be paid back, there is a small push for production with a few sectors reducing output. This does not happen with national borrowing. In this latter case, the impetus of a larger capital stock is not dampened by the need to service the debt. As a result, the increase in production occurs across the board, and these results in better results for wages across all labor categories, with unskilled workers benefitting the most.

We believe that this contrast between national borrowing and foreign borrowing can also be interpreted as a differential impact between short term and long-term debt maturity periods. Somehow, the main message is that the accumulation of an important debt, which has to be paid back in a given point of time in the future tends to translate into abrupt production adjustments and even output contraction in some sectors. By contrast, a more regular and evenly distributed debt service tends to facilitate a strong boost for production across all sectors and workers categories.

In sum, our results suggest that the IIJA will increase GDP, employment and wages in the US economy, no matter how it is financed. In the short run foreign borrowing (or short run debt maturity) results in slightly larger increases than national borrowing (or important debt accumulation for the long run). However, in the long run the need to pay back the debt dampens the stimulus compared to national borrowing. National borrowing (or a more evenly distributed debt) brings about a more general push across sectors and benefits all workers, with unskilled over benefiting the most.

Appendix 1. Tables

Table A1. Model regions and regional fund allocation

Region	States	Estimated fund allocation ($US billion)
NorthWest	Washington, Oregon, Montana, Idaho, Wyoming, Nevada, Utah	40.58
California	California	57.55
SouthWest	Colorado, Arizona, New Mexico	22.23
SSP	Nebraska, Kansas, Oklahoma	16.34
Texas	Texas	45.77
MISO	North Dakota, South Dakota, Minnesota, Wisconsin, Iowa, Illinois, Missouri, Arkansas, Louisiana, Mississippi, Michigan, Indiana	113.33
PJM	Ohio, Kentucky, Pennsylvania, West Virginia, Virginia, Maryland, Delaware, New Jersey	96.74
SouthEast	Tennessee, North Carolina, South Carolina, Alabama, Georgia, Florida	81.21
NewYork	New York	34.77
NewEngland	Maine, Connecticut, Massachusetts, New Hampshire, Rhode Island, Vermont	31.74
AlasHawaii	Alaska, Hawaii	9.75
Total		**550.00**

Source: authors' elaboration based on CNBC (2021); US Census Bureau (2021)