

What Have We Learned about the Effectiveness of Infrastructure Investment as a Fiscal Stimulus?

A Literature Review

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Abstract

Since the Great Depression of the 1930s, and through the more recent Asian Crisis of 1997 and Great Recession of 2008/09, governments have experimented with Keynesian style fiscal stimulus to support employment and accelerate economic recovery. The effectiveness of these policies depends on the size of fiscal multipliers. A large body of economic literature has estimated such multipliers, with gradually increasing precision, due to econometric improvements and better ways to identify fiscal impulses. Overall, the largest multipliers are found to be associated with public investment, as opposed to other types of spending. Such public investment multipliers are typically below one in the short run, but studies with multi-year horizons suggest that values higher than unity can be attained over time. The size of multipliers is sensitive to economic conditions. During recessions, and periods of high unemployment, transfer payments appear sometimes to offer higher multipliers

than public investment. An important exception is when fiscal and monetary policies are closely coordinated and interest rates approach zero, conditions that provide the strongest evidence for the efficacy of public investment multipliers. Other institutional factors also play a crucial role in determining the size of the public investment multiplier, in particular the country's absorptive capacity, and the selection of high-quality shovel ready projects. However, there is limited empirical evidence available on the magnitude of fiscal multipliers in developing country settings, or for infrastructure sectors or subsectors specifically. The few studies available suggest that certain types of green infrastructure (energy efficiency, solar energy, and so forth) may bring employment benefits in the short run, while innovative digital infrastructure may yield longer-run benefits for economic growth. The relevance of these findings to the current COVID-19 crisis is explored.

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**What Have We Learned about the Effectiveness of Infrastructure Investment
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1. Introduction

According to the Keynesian approach, government spending can be used as a powerful stimulus, particularly during times of high unemployment. A large body of economic literature, starting from the Great Recession, has estimated fiscal multipliers first focusing on overall government spending, and then disentangling some subcomponents, such as public investments, and in few cases public infrastructure investment. The effectiveness of fiscal stimulus packages features prominently in public debates surrounding the current COVID-19 crisis, as policy makers seek to understand whether encouraging public investment/infrastructure would help to raise economic growth, increase productivity, and crowding in the private sector.

The objective of this paper is to review the academic literature on fiscal multipliers in general, as well as the efficacy of the fiscal response to previous crises in particular, so as to draw the key lessons that can be applied to the current COVID-19 crisis. Despite our focus being on investment in infrastructure for developing countries, this nonetheless leads us to a broader examination on the fiscal multiplier literature across all types of spending, much of which centers on developed countries due to limitations in data and available research.

Ramey's (2011) pioneering contribution, surveying the literature after the 2009 financial crisis, finds fiscal spending multipliers for developed economies within the 0.5 to 2 range. Subsequent contributions -- including Ramey (2019) -- refine such estimates, coming up with a narrower 0.6 to 1 range. The narrowing range of estimates are partly due to new techniques used to compute fiscal spending multipliers. In a nutshell, the encouraging news is that their value is positive but less than or equal to unity, meaning that spending raises gross domestic product (GDP), but does not stimulate additional private activity and may crowd it out.

The remainder of the paper is structured as follows. Section 2 reviews the key findings on the size of fiscal multipliers. Section 3 provides a historical perspective on the effectiveness of fiscal stimulus during crises. Section 4 provides early evidence of stimulus packages announced during the COVID-19 pandemic. Section 5 draws preliminary policy recommendations.

2. Evidence on the Magnitude of Fiscal Multipliers

Fiscal multipliers are generally derived from the calibration of New Keynesian DSGE models, from structural macro-econometric models, and the so-called narrative method. Since the work of Fatás and Mihov (2001) and the seminal contribution by Blanchard and Perotti (2002), empirical estimates of fiscal multipliers tend to rely on vector autoregressive (VAR) models, with new contributions increasingly making use of sophisticated identification techniques to address the possible endogeneity of fiscal shocks. While the long time series available for countries such as the US allows for the use of narrative methods to identify exogenous shocks (Ramey, 2011), estimates based on shorter time series for European and developing countries still rely on less refined methods. As noted in Kraay (2012), whereas different types of government spending may have different short-run effects on output identify disaggregated multipliers is limited by imperfect data on the composition of spending. Identifying a plausible identification strategy for total spending is hard enough. Once different subcomponents of government spending are considered, separate instruments for the different types of spending would need to be considered, which makes the problem extremely challenging.

The narrative approach constitutes a methodological improvement upon the traditional measurement of fiscal shocks. The structural VAR methodology, which employs output elasticities of expenditure to filter out automatic stabilizers, may fail to capture exogenous policy changes correctly, because changes in expenditure are not only due to output developments and discretionary policy, but may also be attributable to asset and commodity price movements. The narrative approach instead seeks to identify exogenous fiscal shocks directly. In addition, SVAR models by providing “average” multiplier may not be able measure accurately fiscal multipliers in the case countries have been implementing major structural changes. Finally, they may not be able capture state-contingent multiplier unless they employ non linear estimations. One advantage of DSGE models is that they describe the behavior of the economy as a whole by analyzing the interaction of many microeconomic decisions. However, results of simulations tend to be sensitive to the choice of certain parameters (e.g., degree of price and wage rigidities, investment adjustment cost, and proportion of liquidity-constrained agents) and to the specific modeling assumptions, especially if the models are calibrated rather than estimated.

To illustrate how different definitions of the multiplier can lead to strikingly different estimates, Ramey (2019) computes the effects of fiscal spending shocks, with three different methods. The first one follows the approach of Blanchard and Perotti (2002), focusing on the ratio between the peak of the response of output and the impact response of fiscal spending. This method leads to a ‘quasi-multiplier’ because it overlooks the role played by fiscal spending persistence. The second one follows Mountford and Uhlig (2009) proposing computing cumulative fiscal multipliers discounting the future realization of output and fiscal spending as predicted by the VAR impulse responses. The third one based on the analysis of Hall (2009) and Barro and Redlick (2011) avoids the use of the ratio between output over public spending conversion ratio to convert the estimated elasticities to dollar terms (by transforming the variables employed in the analysis to the same units before the estimation of the econometric model). This is achieved by dividing them either by past real GDP or by past real potential GDP.¹

The key conclusion from Ramey’s (2019) comparison is that the calculation of multipliers à la Blanchard and Perotti (2002) can induce a substantial upward bias in the figures related to this spending multiplier. Once the persistence of spending is taken into account, the multiplier becomes less than one. Getting rid of the conversion factor reduces even further the multiplier, at least conditional on the data set employed by Ramey (2019).

In sum, the more plausible lower-end estimates of the fiscal multipliers come from more data-driven time series and narrative methods, while the upper bounds are the outputs of more sophisticated calibrated models, based on new Keynesian types of model and the use of vector autoregressive (VAR) models. However, the calibration sometimes relies on strong assumptions either in the theoretical models or in the econometric analyses to identify the fiscal policy effect.

In the following sub-sections, we explore the range of multipliers, depending on the fiscal instrument used, on the “state” of the economy as well as the composition of government spending, focusing on infrastructure investments.

Within sections 2.1 and 2.2, the concept of “multiplier” used to capture the impact of fiscal stimulus packages is simply the ratio of the expected change in output (GDP) over the proposed government outlay.

¹ The use of this conversion factor is problematic for two reasons. First, it is unstable over long sample periods. Second, as noted by Sims and Wolff (2018), the numerator is acyclical while the denominator is procyclical. Hence, the ratio is procyclical too, which implies that the use of a constant ratio overestimates the spending multiplier in recessions (and underestimates it in expansions).

2.1 Size of Multipliers across Fiscal Instruments

Gechert and Rannenberg's (2018) meta-regression analysis sheds additional light on how the range of multipliers varies, depending also on the fiscal instrument used. The summary statistics (displaying the minimum, maximum, as well as the mean) are summarized in Figure 1 below, based on their designed data set of 98 empirical studies with more than 1,800 observations on multiplier effects and control for regime dependence of the multipliers.

A few salient features of Figure 1 are worth noting. First, the means of reported multipliers from investments and public spending impulses are approximately twice as high as those from tax cuts and transfers. Among the public spending categories, multipliers related to public investment display the highest value. Second, the minimum value for all fiscal instruments is negative, meaning that the range of estimation does not exclude a fiscal stimulus resulting in an undesirable adverse impact on output.

Figure 1 Range of fiscal multipliers depending on fiscal instrument used



Source: Authors' elaboration based on Gechert and Rannenberg (2018)

Data, modeling, and methodological choices can affect the estimates of fiscal multipliers obtained from Structural VAR (SVAR) models. Both spending and tax cut multipliers are sensitive to specific choices regarding the composition of government spending and revenues. The specific definition of government revenues or spending, as well as specific ways of treating the data prior to estimation, can be very influential for both spending and tax cut multipliers. Capek and Crespo Cuaresma (2020) show how the spending multiplier is sensitive to different modeling and methodological choices, such as different ways to deflate nominal variables and the use of different time horizons. The identification strategy used to isolate structural shocks also matters in some cases.² Table 1 summarizes the estimations of public spending and investment multipliers and methodologies in several country-specific studies, including the identification strategy. It is important to note that estimates are based on averages for a particular country over a particular period of time. This makes it difficult to compare even the studies that calculate the multiplier for the same country.

² In cases where a causal ordering based on Cholesky decompositions is used to identify fiscal shocks in VAR models that contain inflation and the interest rate, the value of the spending multiplier tends to be larger (by 0.113 and 0.320, respectively). This qualitative result holds also for the tax cut multiplier in the case of Cholesky-based identification, which is also strongly affected by the particular values of the elasticities used when implementing the Blanchard and Perotti (2002) approach.

Table 1: Survey of Public Investment and Spending Multipliers

Country & Region	World Bank Income Group (2020)	Author(s)	Study Period	Methodology, including identification strategy	Multiplier range	Type
Peru	Upper Middle Income	Central Reserve Bank of Peru (2012)	1992-2012	VAR (output elasticities of expenditure to filter out automatic stabilizers)	0.24; 0.92 (short-term) 0.49; 1.42 (medium-term)	Current; Capital spending
Peru	Upper Middle Income	Rossini <i>et al.</i> (2012)	2005-2011	SVAR (a multivariate, linear representation of a vector of observables on its own lags)	0.78; 1.36 (short-term) 0.52; 2.63 (medium-term)	Current; Capital spending
Australia	High Income	Hunt <i>et al.</i> (2009)		DSGE model (simulated impacts on the output)	1.22 1.12	Public Investment Public Consumption
Czech Republic	High Income	Ambrisko <i>et al.</i> (2015)	1996 - 2011	DSGE model (simulated impacts on the output)	0.5 (in the first year) 0.6 (in the first year)	Government investment Government Consumption
Germany	High Income	Veld (2016)		European Commission's macro Quest model simulations (simulations under different scenarios)	0.6	Public Investment
Italy	High Income	Acconcia <i>et al.</i> (2014)	1990 - 1999	OLS with IV to address endogeneity	1.5	Public spending
Japan	High Income	Bruckner and Tuladhar (2014)	1990 - 2010	Panel VAR at prefecture level	0.26	Government Spending
Japan	High Income	Kanazawa (2018)	1980 - 2014	Local projection – IV method (using the extracted measure of the excess return shocks as an instrument variable)	1.64 (after one year)	Public Investment
Japan	High Income	Kuttner and Posen (2002)	1990 - 1999	VAR (output elasticities of expenditure to filter out automatic stabilizers)	2 (cumulative four-year multiplier)	Public Spending

Country & Region	World Bank Income Group (2020)	Author(s)	Study Period	Methodology, including identification strategy	Multiplier range	Type
Japan	High Income	Miyamoto <i>et al.</i> (2017)	1980 – 1995 1996 – 2014 (Zero lower bound)	Local projection method (estimates impulse response functions on shocks as well as lags of variables usually entering a vector autoregression)	0.6 1.5	Government Spending
Korea, Rep	High Income	Eskesen and Lueth (2009)		DSGE (simulated impacts on the output)	0.8	Government Investment and Consumption
Netherlands	High Income	Veld (2016)		European Commission's macro Quest model simulations	0.5	Public Investment
Gulf Cooperation Council Countries	High Income	Espinoza and Senhadji (2011)	1975-2009	VAR linking real GDP, real government expenditure and non-oil real GDP. The VAR estimated in growth rates using three lags	0.3 - 0.7 0.6 - 1.1	Current Expenditure Capital Spending
Spain	High Income	Pereira and de Frutos (1999)	1970-1989	VAR (this approach does not impose a priori restrictions on the dynamic relations among the different variables)	0.65 (after two years)	Public capital accumulation
United States	High Income	Coenen <i>et al.</i> (2012)		DSGE (simulated impacts on the output)	1	Government Spending
United States	High Income	Erickson <i>et al.</i> (2015)	2001-2012	OLS with IV to address endogeneity	1.5	Federal Government Spending
United States	High Income	Ramey & Zubairy (2018)	1889-2015	Local projection method (based on sequential regressions of the endogenous variable shifted several steps ahead)	0.66 (after two years) 0.71 (after four years)	Government Spending
United States	High Income	Zandi (2008)		Moody's Economy.com macro model	1.59 (after one year)	Government Spending

Country & Region	World Bank Income Group (2020)	Author(s)	Study Period	Methodology, including identification strategy	Multiplier range	Type
102 Developing Countries		Kraay (2014)	1970-2010	IV to address endogeneity (the lags between commitments and eventual disbursements on loans by official creditors to developing country governments)	0.4	Spending
11 European Countries	High Income	Deleidi <i>et al.</i> (2020)	1970-2016	Local Projections approach on a panel dataset and considering different model specifications	0.96	Public Investment
17 OECD economies	High Income	Abiad <i>et al.</i> (2015)	1985-2013	Local projections method (estimates impulse response functions by directly projecting a variable of interest on shocks as well as lags of variables usually entering a vector autoregression)	1.4 (medium-term)	Public Investment

Source: Compiled by authors

As shown by the table, fiscal multiplier estimates (even using the same broad methodology, country, and time period) are heterogeneous. Some reasons for the differences across estimates are due to the role of institutional settings or the asymmetry of fiscal multipliers in different business cycle phases. Data choices and identification strategies are also found to have important effects on the precision of multiplier estimates.

Overall estimates for public spending and investment multipliers are modest and generally less than one. However, what is most striking about the findings is that public investment multipliers grow and have more lasting effects over time. Studies estimating the impact for the long run or over a multi-year horizon find larger multipliers than the studies measuring the impact on the same year or after one year. As illustrated by Leeper *et al.* (2010) implementation delays can produce small or even negative labor and output responses in the short run.

In sum, the key lessons underscore that the spending multiplier is highly sensitive to different modeling and methodological choices, as well as even more innocuous choices of time period considered in the analysis. Overall, one of the strongest findings is that investment and spending are more effective than tax cuts and transfer payments. In the next section, we will consider whether such a finding will be robust to the different specifications of the “state” of the economy and other institutional factors.

2.2 Multipliers across Macroeconomic Conditions

While empirical estimates of the size of fiscal multipliers vary widely, there is a somewhat broader consensus that the effectiveness of fiscal policies depend crucially on macroeconomic conditions, such as *inter alia* the interaction between fiscal and monetary policies, and financing mechanisms. It also depends crucially on a broader set of factors such as the selection and timeliness of projects, and the underpinning characteristics.

Macroeconomic “state dependent multipliers”

Some of the challenges of the “state” dependent estimation of multipliers comes from the fact that the identified changes in government spending must be exogenous and big enough to be able to disentangle their effects from other economic shocks. Informative estimates require that the states span over a sufficient portion of the sample and that the exogenous changes in government spending spread across the states. Because there is no scope for controlled, randomized trials on countries, all estimates of aggregate government multipliers are necessarily relying on historical episodes. Unfortunately, the data do not allow to build clean natural experiments and is often subject to simultaneous equations bias (Ramey and Zubairy, 2018).

Table 2 summarizes the macroeconomic conditions that contribute to the higher effectiveness of fiscal stimulus. We will focus the discussion on those for which the economic literature provides stronger evidence.

Table 2: Conditions affecting the effectiveness of fiscal stimulus

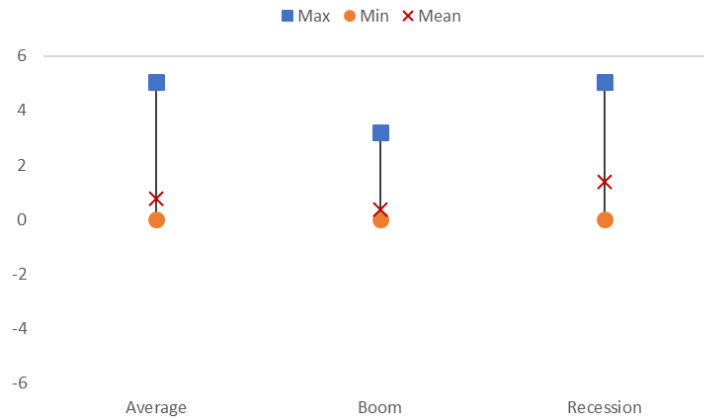
State variables	Conditions for higher multipliers	Reference
Exchange rate regime	Fixed (as opposed to floating) exchange rate	Ilzetzki <i>et al.</i> (2013)
Openness to trade	Less open economy	Ilzetzki <i>et al.</i> , 2013; Gonzalez-Garcia, Lemus, and Mrkaic (2013)
Public indebtedness	Lower levels of public debt	Batini <i>et al.</i> (2014); Corsetti <i>et al.</i> , (2012); Ilzetzki <i>et al.</i> , (2013); Nickel and Tudyka, (2014); Huidrom <i>et al.</i> (2019)
State of economy	Recessions (as opposed to booms or average periods)	Broda and Parker (2014); Bachmann and Sims, 2012; Owyang <i>et al.</i> (2013); Ramey and Zubairy (2018)
Stage of development	Inconclusive evidence	Sheremirov and Spirovska (2019); Arizala <i>et al.</i> (2017); Kraay, 2010; Ilzetzki <i>et al.</i> (2013). Izquierdo <i>et al.</i> (2019). Egger <i>et al.</i> (2019)
Coordination with monetary policy	Accommodative monetary policy, particularly under zero lower bounds	Cogan <i>et al.</i> (2010); Coenen, Straub, and Trabandt (2013); Eggertsson and Woodford (2003); Eggertsson (2010), Christiano <i>et al.</i> , (2011); Woodford, (2011); Fernandez-Villaverde <i>et al.</i> (2015); Leeper <i>et al.</i> (2017)

Source: Authors’ elaboration

As Figure 2 illustrates, for most fiscal impulses, the magnitude of the multiplier substantially increases as the economy moves into a recession, the only exception being the tax multipliers. For all impulses other than tax changes, the point estimate of the multiplier strongly exceeds one in recessions, and for all expenditure types other than government consumption significantly so at the 5 percent level. The spending multiplier is significantly higher during downturns than during average periods or booms, both in statistical

and economic terms. The multiplier ranges from 0.8 to 0.9 across the various specifications, while the one in the boom is estimated to be negative in most specifications and is never significantly positive in economic or statistical terms. In contrast to the government expenditure multiplier, the effect of tax changes on GDP seems to be roughly the same in booms, recessions, and average economic regimes.

Figure 2 Range of fiscal multipliers depending on the state of the economy



Source: Authors' elaboration based on Gechert and Rannenberg (2018)

The range of variation during a downturn is much larger across the different fiscal instruments used (see Figure 3). Transfers have the highest regime multiplier, followed by military spending, investment, consumption, and general spending. Part of the explanation might be that the share of liquidity-constrained or credit-constrained consumers rises strongly during downturns and the transfer increases occurring during downturns tend to be especially well targeted. The high marginal propensity to spend out of government transfers increases during downturns as suggested by the findings of Broda and Parker (2014), who investigate the effect of the 2008 stimulus payments of the US government on household consumption. Furthermore, transfer increases might also lift consumer sentiment, thus increasing the propensity to consume out of any given increase in disposable income (Bachmann and Sims, 2012).

Figure 3 Range of fiscal multipliers depending on the fiscal instruments during a downturn



Source: Authors' elaboration based on Gechert and Rannenberg (2018)

Evidence for higher spending multipliers during recessions or times of high unemployment is fragile, and most robust results suggest multipliers of one or below during these periods. Most of the state-dependent analyses are mainly conducted using nonlinear VARs, with shocks often identified by a Blanchard-Perotti (2002) type of recursive strategy without taking external information on tax elasticities into account. Differently, Owyang et al. (2013) and Ramey and Zubairy (2018) employ local projections à la Jordá (2005) and exploit fiscal spending news shocks identified with a narrative approach to compute asymmetric multipliers in expansions and in recessions. Using the narrative approach, they find no evidence in favor of larger multipliers in bad times for the United States. This evidence, however, is found for Canada. Caggiano et al.'s (2015) result on the acyclicity of fiscal spending multipliers is similar to the one in Ramey and Zubairy (2018). However, when extreme events (in particular, the Great Recession) are considered, the smooth-transition VAR used by Caggiano et al. (2015) points to a large fiscal spending multiplier (about 2.5) which is much higher than the one normally associated with sustained booms. One of the key takeaways is that not all recessions are the same, and during deeper ones, higher returns may result from increasing public investment or consumption.

It is important to note that, while most of the literature has focused on the effects of positive fiscal spending shocks in booms and busts, recent evidence points to significant differences between the effects of positive and negative changes in fiscal spending. Barnichon and Matthes (2017) show that the contractionary multiplier – the multiplier associated with a negative shock to government spending--is above 1, and it is even larger in times of economic slack. In contrast, the expansionary multiplier --the multiplier associated with a positive shock – is substantially below 1 regardless of the state of the business cycle.

The evidence for higher government spending multipliers during periods in which monetary policy is very accommodative, such as zero lower bound periods, is somewhat stronger. Given the inability of most central banks to implement conventional policy easing (a costly inability, as empirically proven by, for example, Caggiano et al. 2017; Kulish et al. 2017; Liu et al. 2017), policy makers have experimented with expansionary policies such as unconventional monetary policy interventions or fiscal plans to stimulate their economies out of recession.

Let us consider Christiano et al. (2011) who study the effects of a binding zero lower bound on the fiscal spending multiplier in a medium-scale New Keynesian framework (for other references, see Eggertsson and Woodford, 2003; Eggertsson, 2010; Christiano et al., 2011; Woodford, 2011, Fernandez-Villaverde et al., 2015; and Leeper et al., 2017). They show that the multiplier can be much larger than one. The reason is the following. An increase in spending leads to an increase in output, marginal cost of production, and expected inflation. The increase in expected inflation, given the zero level of the policy rate, drives the real ex-ante interest rate down, which then boosts the multiplier. The value of the multiplier depends on many factors. Interestingly, the larger the output cost an economy experiences due to the presence of the zero lower bound (which limits the central bank's ability to tackle recessionary shocks in the first place), the larger the value of the multiplier.

While fiscal policy has often been studied in isolation, it is important to stress that its interaction with monetary policy is crucial for the determination of the size of the fiscal multipliers. Bianchi and Melosi (2017) model the interaction between monetary and fiscal policy with a micro-founded regime-switching DSGE framework featuring different possible monetary–fiscal policy mixes. Bianchi and Melosi (2019) show that a coordinated commitment to inflate away part of the debt can lead to welfare improvements and lower uncertainty because it separates the issue of long-run debt sustainability from the need for a short-run fiscal stimulus.

Other relevant papers on the policy mix are the ones by Eusepi and Preston (2018a, 2018b). Using a DSGE model the authors find that stability (defined as the set of policies that ensures agents correctly learn the

long-run objectives of the policy) is threatened when debt is high and of moderate maturity (between 2 and 7 years), which is indeed the maturity for most European countries.³ This is a crucial policy message because most European countries (with the notable exception of the United Kingdom) feature high debt levels and average debt maturities falling within this range. Eusepi and Preston (2018b) show that, even under an aggressive monetary policy, debt levels and maturities comparable to the European ones would have prevented the US economy from the Great Moderation. Turning to the VAR empirical side, Rossi and Zubairy (2011) and Canova and Pappa (2011) show that fiscal multipliers tend to be larger when positive spending shocks are accompanied by a decline in the real interest rate.

A number of studies have looked at the size of multipliers under different macroeconomic conditions. After analyzing a quarterly data set on government expenditures for 44 countries (20 high-income and 24 developing) from 1960 to 2007, Ilzetki *et al.* (2013) conclude that the fiscal multiplier is relatively large in economies operating under a predetermined exchange rate, but it is zero in economies operating under flexible exchange rates. They also find that fiscal multipliers are smaller in open economies than in closed economies and are zero in high-debt countries. The evidence, despite being intuitive, as a fixed exchange rate and the limited openness to trade may reduce potential crowding out effects, is however based on comparison between countries with different regimes rather than implying evidence *ceteris paribus* on the shift from one regime to another for the same country.

Unfortunately, there is a substantially smaller number of studies that have focused on the determinants of the size of the public investment multipliers, particularly when it comes to developing countries, for which lack of long time series poses formidable challenges. Accordingly, crucial questions such as whether multipliers in lower-income countries should be expected to be higher or lower than in high-income ones remain still unaddressed (Batini *et al.*, 2014). Some studies suggest that multipliers are lower. These include studies finding that multipliers in lower-income countries are half the size of those in advanced economies (Sheremirov and Spirovska, 2019); are smaller in Sub-Saharan Africa than in advanced and emerging market economies (Arizala *et al.*, 2017); or are effectively zero (Kraay, 2010; Ilzetki *et al.*, 2013). Other results are more optimistic, suggesting that public investment in developing countries would carry high returns. Namely, the theoretical notion according to which public investment multipliers should be higher or lower according to the size of the initial stock of public capital seem to be confirmed by Izquierdo *et al.* (2019). Finally, other studies suggest that one-time cash transfers in Kenya have been shown to have large impacts on consumption for recipients and large positive spillovers for non-recipient households and firms (Egger *et al.*, 2019).

The quality, quantity, and accessibility of economic infrastructure in low-income developing countries lags considerably behind those in advanced and emerging market economies (Gurara *et al.*, 2017). At the same time, public investment overall accounts for a larger share of the economy: 7.5 percent of GDP in the median low income countries, compared to 4.8 percent in emerging markets and 3.2 percent in advanced economies (Tandberg and Allen, 2020). Ganelli and Tervala (2016), modeling a public infrastructure investment shock with a temporary demand effect and a supply-side effect, the latter due to the fact that the productive capacity of firms increases with a higher infrastructure stock, find that the welfare gains of public infrastructure investment may be substantial. Notably, a dollar spent by the government for investment raises domestic welfare by the equivalent of 0.8 dollar of additional private consumption.

³ Typically, rational expectation-DSGE models of inflation assign a dominant role to monetary policy and confine fiscal policy to the background. In the language of Leeper (1991), fiscal policy is ‘passive’, that is, it just determines the value of debt.

Other institutional factors affecting fiscal multipliers

There has been great interest in better understanding the effect of lack of efficiency on the size of the public investment multiplier, due to cost overruns, implementation delays (making the costs of the project higher or ‘wasteful’), poor project selection or allocation across sectors or simply due to the presence of corruption. A recent paper by Gurara *et al.* (2020) looking at the association between cost inflation and public investment in a large sample of road construction projects in developing countries shows a non-linear U-shaped relationship between public investment and project costs. Unit costs increase once public investment is close to 10 percent of GDP. This threshold is lower (about 7 percent of GDP) in countries with low investment efficiency and, in general, the effect of investment scaling up on costs is especially strong during investment booms.

Another strand of the literature identifies among the reasons that may explain the weak association between public investment accelerations and output growth the limited absorptive capacity (Horvat, 1958; Rosenstein-Rodan, 1961). A first way to conceptualize absorptive capacity is in terms of declining marginal returns to public investment. In that sense, one could think that the output gains of additional public investment diminish as long as public capital is accumulated, so that the expected rate of return is declining with capital investment. A slightly different way to think about absorptive capacity is to relate supply bottlenecks with public investment dynamics. It has been argued that once the pace of investment (rather than the level) is above a certain threshold, countries do not have the capacity – in terms of skills, institutions, and management – to reap the benefit of additional public investment.

Last but not least, for infrastructure spending to be an effective economic stimulus requires the money to be deployed and create jobs while the economy is struggling. Large infrastructure investments have been often slow-moving projects requiring years to plan and execute. In a review of the 2009 stimulus in the US, Mallett (2020) notes that infrastructure projects were moving at a much slower pace than other types of stimulus leading to a lag in the economic impact. This last strand of literature emphasizes the need for “shovel ready” projects for guaranteeing an effective economic stimulus.

Large new infrastructure projects require design, engineering, permitting, and environmental reviews before construction can begin. Few projects are ready to break ground and start the labor-intensive construction phase quickly. Those that are ready can be delayed by federal involvement. In the US, “shovel ready” projects were delayed by a further year following the receipt of federal grants due to the need to pass through federal environmental and historical regulatory reviews, which forced layoffs as the contract was rebid and construction waited for federal approval (Michel, 2021).

Most jobs, especially infrastructure construction jobs, require skills specialization and training to be effective, safe, and efficient. Training unemployed workers without prior construction experience to expand payrolls temporarily is often not worth the time investment and high cost. There is also the risk that those firms accessing the stimulus funding are not those suffering more from the recession (Jones and Rothschild, 2020). Temporary stimulus programs seem more successful at shifting resources within industries than at expanding the industry itself.

Within this context increased maintenance spending may be a promising option for stimulus spending, as it may both create jobs (with corresponding income effects) and maintain the capital stock. There is likely to be substantial room for this across many lower-income countries as maintenance spending tends to be chronically under-budgeted. Maintenance spending is also one of the few areas of government consumption spending where increases can easily be made temporary without risking raising the long-term level of government spending (see the literature starting from Schwartz *et al.*, 2007).

2.3 Multipliers across Infrastructure Sectors

The literature on fiscal multipliers has mostly focused on the overall effects of public investments and expenditures on growth. However, infrastructure spending is distinct from general public investment, and each infrastructure sector is unique in the way that it interacts with other sectors and in the contribution that it provides to the economy. Hence, the composition of infrastructure investment and expenditure also determines the size of the impact. So far, the literature estimating the effects of infrastructure components such as investments in transportation, energy, and ICT is not only much more limited, but also uses much less sophisticated tools than the ones we examined in the previous sections.

Within this last section, the concept of “multiplier” is different and simply captures the rate of return of infrastructure investment in terms of income, GDP or simply reports a crude estimation of the direct, indirect, and induced job creation of a given investment/spending in infrastructure. Indeed, this section reviews both the evidence related to income as well as job multipliers, as particularly during crises protecting or creating employment is of crucial relevance. Job multipliers capture the ratio of indirect and induced employment to direct employment created in the creation of an infrastructure asset.

Table 3: Infrastructure Multipliers by Type

Country & Region	Author(s)	Infrastructure Type	Multiplier Type	Multiplier (direct and indirect effects)
Germany	Katz <i>et al.</i> (2010)	Broadband	Employment	1.45, 1.92*
Switzerland	Katz <i>et al.</i> (2008)	Broadband	Employment	1.38
United Kingdom	Liebenau <i>et al.</i> (2009)	Broadband	Employment	2.76*
United States	Atkinson <i>et al.</i> (2009)	Broadband	Employment	3.60*
United States	Crandall <i>et al.</i> (2003)	Broadband	Employment	2.17*
United States	Katz and Suter (2009)	Broadband	Employment	1.83, 3.42*
United States	Bivens (2003)	Communications	Employment	2.52
Malaysia	Bekhet (2011)	Electricity & Gas Water works & supply Building & Construction	Employment	3.5* 2.4* 1.7*
United Kingdom	Kelly <i>et al.</i> (2016)	(i) Electricity production & distribution (ii) Land transport (iii) Railway (iv) Telecommunications	Income	3.56, 5.56* 1.54, 2.40* 2.00, 3.10* 1.54, 2.41*
United States	Pereira (2000)	Transport (Highway)	Income	1.97 (long-run)
United States	Chi and Baek (2016)	Transport	Income	0.55
United States	Leduc and Wilson (2012)	Transport	Income	2.7 (Short-term) 6.2 (Long-term)
United States	Perotti (2004)	Transport	Income	1.47 (Short-term) 0.37 (Long-term)
Egypt, Arab Rep.	Estache <i>et al.</i> (2012)	(i) Electricity (ii) Construction & Building (iii) Transport & Communications	Employment	1.06, 1.49* 1.36, 1.63* 1.34, 1.82*

Country & Region	Author(s)	Infrastructure Type	Multiplier Type	Multiplier (direct and indirect effects)
United States (Montana)	Comings <i>et al.</i> (2014)	(i) Photovoltaic projects (ii) Wind & energy efficiency	Employment	5 - 9 jobs 1.5 jobs
United States	Crandall <i>et al.</i> (2007)	Broadband	Employment	293,000 jobs
World	IEA (2020a)	Investment (for \$1 million): (i) Building retrofit, efficient buildings, PV (ii) Grids (iii) Urban transport and high-speed rail (iv) Gas-fired plants	Employment	10 - 15 jobs 5 - 8 jobs 7 - 12 jobs 4.5 jobs
World	IEA (2020a)	Capital spending (for \$1 million): (i) Solar PV (ii) Wind power (iii) Upgrades and construction at hydropower (iv) Nuclear lifetime extensions (v) Biofuels and recycling (iv) New vehicles, appliances and batteries	Employment	3 constr & 6 manufacturing jobs 1 constr & 1.5 manufacturing jobs 3 jobs 2-3 jobs 11 – 12 jobs (advanced economies), 29 - 46 jobs (the rest of world) 6 – 9 jobs (advanced economies), 9 – 15 jobs (the rest of the world)

*includes induced effects in addition to direct and indirect effects

Source: Compiled by authors

Table 3 presents the income and employment multiplier results for studies focusing on different countries for the various sub-components of infrastructure investments. Despite the broad variation in estimates across countries, and the fact that a small number of studies refers to developing countries, we can draw a few general insights. Low employment multipliers are typically associated with sectors with high wages and with relatively complex, capital intensive projects whereas sectors with low wage employees and low material costs usually generate high employment multipliers (International Energy Agency, IEA, 2020a).

Transportation spending has often played a prominent role in government efforts to stimulate the economy during downturns. For instance, of the estimated US\$ 825 billion over ten years in the American Recovery

and Reinvestment Act of 2009, about two-thirds came from increased federal government spending, with the Department of Transportation receiving US\$ 48 billion.⁴

Chi and Baek (2016) document the bidirectional relationship between transport infrastructure and GDP for the period 1960-2012. Their findings suggest that expanding transport infrastructure improves aggregate economic output, and enhanced economic output increases public investment in transport infrastructure in the period. However, the magnitude of the impact of transport infrastructure (0.55) on GDP is smaller than that of non-transport public infrastructure (1.02), implying that non-transport infrastructure investment is a more effective long-term fiscal stimulus than expanding transport infrastructure.

Pereira (2000), based on the US highway spending data for the period between 1956 and 1997, finds a long term multiplier of 1.97 for investment in transportation infrastructure (the lowest across different types of infrastructure investments) well below 4.5, the long run multiplier for total public investment. This finding implies a 3.4 percent rate of return on public investment in transportation infrastructure. Similarly, Leduc and Wilson (2012) estimate 2.7 and 6.2 for the short- and long-run multiplier for the period 1993-2010, while Perotti (2004) finds 1.47 in the short-run and 0.37 in the long-run for the period 1960-2001.

Turning to the energy sector, the report of Blyth *et al.* (2014) surveys the literature on the employment effects of selected policies and note that renewable energy has a higher jobs multiplier in the short run, while it requires less labor for operation and maintenance in the long-run. Comings *et al.* (2014) show that for each megawatt of renewable energy capacity added, photovoltaic projects would add 5 to 9 jobs depending on the size of the project. The contribution of wind projects, on the other hand, is around 1.5 jobs for each megawatt of capacity added.

Broadband infrastructure has been identified as an important area of public investment during an economic downturn in several studies. Due to the scope for user-funded private finance in the telecommunications sector, broadband investment tends to make much smaller demands on public expenditure. Spending initiatives on next-generation telecommunications networks at a time when labor market conditions are particularly weak can help preserve jobs and head off a potential burden on social safety nets. Bringing forward longer-term aggregate spillover effects of broadband can improve the productivity of the entire economy and is consistent with enhancing long-run growth and development. Public support also "crowds in" private investment when access to private financing is decreasing and more expensive.

Investing in broadband and next-generation networks, as a counter-cyclical tool, creates jobs and provides the foundation for economic recovery and long-term sustainable growth (Qiang, 2010). IT infrastructure projects create more jobs than traditional infrastructure investments, in part because of the network multiplier, they also create better jobs in terms of higher skill and higher pay. An additional \$10 billion broadband investment would create about 64,000 direct jobs in telecommunications and 116,000 jobs (multiplier of 3.60) in related industries (Atkinson, 2009). Crandall *et al.* (2003) estimate the employment impact of a \$63.6 billion investment in broadband deployment aimed at increasing household adoption from 60 percent to 95 percent. They find 140,000 jobs (a multiplier of 2.17) are created per year over ten years.

Jobs in the communications sector in the US economy have an employment multiplier of 2.52 (Bivens, 2003). This indicates that the 50,000 service jobs created by a \$10 billion broadband stimulus package create an additional 125,500 jobs. The multiplier for manufacturing jobs is 2.91. Hence, the 13,800 communications/computer equipment manufacturing jobs created to support an additional 40,000 indirect and induced jobs. Crandall *et al.* (2007) find that for every 1 percentage point increase achieved in

⁴ Similarly, Japan initiated a series of stimulus packages with a significant emphasis on spending for public work (among which spending on roads figured prominently) during the stock market collapse in 1989 (Leduc & Wilson, 2014).

broadband penetration, employment rises from 0.2 to 0.3 percent, or about 293,000 jobs for an economy at less than full employment.

Strand & Toman (2010) discuss the short-run and long-run effects of green stimulus efforts. They find that most green stimulus programs that have large short-run employment and environmental effects are likely to have less significant positive effects for long-run growth, and vice versa. This is because programs that create more (less) job opportunities tend to employ lower- (higher-) skilled workers, and therefore yield smaller (larger) long-term growth effects. For example, most jobs in the wind or solar PV sector are high-skilled; investment in these sectors can contribute substantially to future technical development and growth. Most jobs in solar-thermal and biomass production are by contrast lower-skilled, with less scope for technological enhancement and learning effects for the individuals employed. One-fifth of employees in clean-energy production and energy-efficient occupations have college degrees (Muro *et al.*, 2019).

By the same token, capital-intensive investments such as digitalization and 5G are more likely to show economic benefits over the longer term and therefore much less likely to create strong short-term stimulus effects. Strand and Toman's (2010) analysis implies a tradeoff in many cases between skill levels and labor intensities, reinforcing the point that different instruments are needed for addressing different problems. A recent paper by Hepburn *et al.* (2020) based on expert surveys also shows that there are limited policy options that generate both large economic multipliers and climate impact.

Despite the recognition of limited availability of triple win-win-win opportunities, countries that invested the most in green stimulus after the Great Recession such as the United States, Germany, and the Republic of Korea boosted their economies and created jobs. The green stimulus supported 900,000 job-years in clean energy fields from 2009 to 2015 in the United States, and 156,000 new green jobs from 2009 to 2011 in Korea. Korea included green measures in almost 80 percent of the stimulus in the fourth quarter of 2008. Almost one-half of the stimulus targeted energy-efficient projects and low carbon vehicles (UNEP, 2009; Jaeger, 2020). The 2008 Green New Deal Stimulus in Korea estimated to generate 960,00 jobs in energy-efficient and low-carbon energy sectors such as energy conservation in villages, fuel-efficient vehicles, expanding mass transit, and railroads (Barbier, 2010; Robins *et al.*, 2009).

Green construction projects, such as insulation retrofits or clean energy infrastructure, can similarly deliver higher multipliers. These large construction projects are less amenable to offshoring via imports (Jacobs, 2012). Clean energy infrastructure is also labor intensive in the early stages – Garrett-Peltier (2017) suggests that every US\$ 1 million spent generates 7.49 full-time jobs in renewables infrastructure, 7.72 in energy efficiency.

In the European Union, each US\$ 1 in green investment boosted GDP by up to \$1.50 across the region (Cambridge Econometrics, 2011). In China, rapid investment in railways, grid networks, and other green initiatives boosted the GDP about 4.2 percent above the baseline in 2009 and 3.6 percent above the baseline in 2010 (Cambridge Econometrics, 2011). There were around 400,000 jobs in low carbon businesses and their supply chains in the UK in 2017. The offshore wind sector in which 7,200 people were employed in 2019 is such an example. Energy efficiency is identified as a job-intensive form of clean energy investment for the post-crisis stimulus (IEA, 2020b). Capital-intensive clean energy infrastructure in technologies represents a prospect for long-term employment (KPMG, 2020). These public investments offer high returns in the long run (Henbest, 2020) and could serve to kick start green innovation ecosystems (Acemoglu *et al.*, 2012). At the same time, adoption of green technologies could create higher spillovers by driving an efficient, innovative, and productive economy (Aghion *et al.*, 2014).

In addition, compared to traditional stimulus, green stimulus, in many cases, has been singled out as more effective in creating jobs. Spending on public transit in the United States led to 70 percent more job-hours than equivalent spending on highways. Job intensity is estimated at 8 jobs per US\$ 1 million invested in

green electricity, 2-13 jobs in efficient new buildings such as schools and hospitals, and 6-14 jobs in green water and sanitation through efficient agricultural pumps and recycling in advanced economies (IEA, 2020a; Popp *et al.*, 2020). Each US\$ 1 million of green ARRA created 15 new jobs in the post ARRA period of 2013-2017 (Popp *et al.*, 2020).

2.4 Summary of Evidence on the Impact of Fiscal Multipliers

The key lessons learned from the literature review conducted so far indicate that fiscal multipliers estimates are highly sensitive to different modeling and methodological choices as well as even more innocuous choices such as the time period considered in the analysis.

Whereas in general public investments are characterized by the highest multiplier, during downturns or times of unemployment, transfers may represent a more powerful source of fiscal stimulus. However, not all crises are the same, and for some of the deeper ones, such as the Great Depression, spending and investment multipliers are still greater than one. Evidence on other macroeconomic “states” is not robust, with the most notable exception of a coordinated fiscal and monetary policy, especially under interest rates close to zero. Other institutional factors play a crucial role in determining the size of the public investment multiplier, in particular the country’s absorptive capacity, and the selection of high-quality shovel ready projects.

However, relatively little is known about the size of public investment multipliers for developing countries and emerging economies (mainly due to data constraints) and the existing evidence is mixed. Furthermore, there is scant knowledge on the specific impact of investments in infrastructure. The limited evidence available is less rigorous and focuses on estimates of the rate of returns of investment in transport, energy and digital. Although results vary extensively, on average the strongest evidence for larger multipliers is associated with energy efficiency retrofits and road maintenance in the near term, and broadband infrastructure in the longer term.

Green investment in infrastructure seems to have higher multipliers and may have the potential to create jobs in the short-run (since it is labor-intensive in the early stage) and higher investment returns in the long-run (align with energy security and climate goals). Countries that invested the most in green stimulus after the Great Recession boosted their economies and created jobs. However, the trade-off between short- and long-term impacts as well as between skill-levels and labor-intensities need to be carefully considered.

3. Fiscal Stimulus Programs during Crises: Historical Experience

As the COVID-19 pandemic brings the world economy into a downturn, governments around the world are looking back at the lessons learned from the global experiences from the historical crisis to reduce the severity of the current one. Many countries have used fiscal stimulus programs to attempt to assist the economic state of their countries during crises. However, the composition of fiscal stimulus packages differs across regions and countries, depending on the magnitude and type of impacts of the economic crises, the degree of integration, and other related factors. In this section, we discuss the historical experience.

3.1 The Great Depression

The Great Depression was triggered in the United States by the Wall Street crash in October 1929 and became worldwide. It resulted in a massive loss of income, record unemployment rates and output loss, especially in industrialized nations. In the United States unemployment hit almost 25 percent at the peak of the crisis in 1933.

In the United States during the Great Depression, a large fiscal stimulus package was introduced to increase funds to public works. Noticeably, the Federal Reserve slashed interest rates down to zero in an attempt to manage the negative real effects of the financial crisis. The New Deal used historic spending to fund entirely new categories of forward-looking projects: delivering clean water, electricity, and telephone service to people for the first time; demonstrating mega-project capabilities such as New York City's Lincoln Tunnel; and reinvigorating the civic commons through projects such as San Antonio's River Walk and Charleston. Programs such as the Works Progress Administration⁵ and the Tennessee Valley Authority were key elements of the government's economic stimulus. The Works Progress Administration granted state and local government funds to provide work relief and direct relief and to build and maintain infrastructure. The Tennessee Valley Authority provided jobs and electricity to the rural Tennessee River Valley that spans seven states in the South as a part of Depression-era New Deal programs. In addition, Congress passed a series of infrastructure bills to build major bridges, roads, and other improvements such as Hoover Dam in Nevada and the Golden Gate Bridge in California. The bills not only met the needs of modernization but also supplied jobs during the crisis. About 85 percent of the grants were used to hire the unemployed on work relief jobs. These jobs include maintenance activities such as building sidewalks, local roads, schools, and improvements in the local infrastructure (Fishback *et al.*, 2004).

Using data on New Deal Grants to each US county from 1933 to 1939, Fishback *et al.* (2005) estimate how relief and public works spending and payments to farmers through the Agricultural Adjustment Administration influenced retail consumption. They find that an additional dollar of public works and relief spending was associated with 44 cents increase in 1939 retail sales. This implies a weak effect of fiscal policy consistent with results from Romer (1992).

Similarly, Fishback and Kachanovskaya (2011) examine the impact of federal stimulus programs and find that state per capita personal income multiplier with respect to per capita federal grants is around 1.1. In another study, Fishback and Kachanovskaya (2015) estimate that an added dollar of federal spending in the state increased state per capita income by between 40 and 96 cents by using an annual panel data set for the period 1930-1940.

Federal grants had stronger effects on consumption than on personal income, but they had no positive effect on various measures of private employment. The multiplier for wages, salaries, and retail sales is substantially less than one indicating "crowding-out". The multiplier for farm payments to take land out of production was -0.57 (Fishback and Kachanovskaya, 2011). This implies that the program actually reduced personal income. These results may help to explain why measures of income have recovered more rapidly than measures of employment in the 1930s. Based on these findings, the New Deal spending might have raised the productivity of local producers if it was devoted to building infrastructure that cut transport costs to other areas (Fishback and Kachanovskaya, 2010).

⁵ Renamed as Works Projects Administration in 1939.

3.2 The Asian Crisis of 1997

The Asian Crisis originated in Thailand in 1997 and quickly spread to the rest of East Asia and its trading partners. It was a currency crisis. In July 1997, the Thai government had to abandon its fixed exchange rate against the US dollar that it had maintained for so long, citing a lack of foreign currency resources. Among others, Indonesia, Korea, and Thailand were affected the most. Relatively less impacted were countries, including Brunei, China, Singapore, Taiwan, China, and Vietnam, however, also suffered from a sharp decline in demand in the region.

Infrastructure PPP investments and the number of projects in transport and energy sectors declined substantially soon after the Asian Crisis in the East Asia and Pacific (Figure 4). Currency conversion risk in infrastructure financing projects translated into reduced government willingness to provide explicit guarantees for projects in the period following the crisis. The investments in the region were also affected during the Global Recession but the impact was relatively smaller.

Figure 4: Greenfield Transport and Energy Investment (by US\$ and number) in East Asia Pacific



Source: Authors' calculation based on private investment in infrastructure database (<https://ppi.worldbank.org/en/ppi>). Vertical lines represent 1997-98 Asian Crises and 2008-09 Great Recession. This figure shows the total number of greenfield projects in transport and energy sectors for the period 1990-2019 in the East Asia and Pacific countries. There is a sharp decrease in the number of projects and associated investment starting with the Asian crises in 1997, which continues till 2000. Countries included in the analysis: Cambodia, China, Indonesia, Lao PDR, Malaysia, Mongolia, Myanmar, Papua New Guinea, Philippines, Solomon Islands, Thailand, Timor-Leste, Tonga, Vanuatu, Vietnam.

The 1997 Asian financial crisis seriously hampered infrastructure investments. In the case of Indonesia, public infrastructure investment fell dramatically after the crisis, to about 1 percent of GDP in 2000. Even a decade after the crisis, total public infrastructure investment—public, state-owned enterprises and private sector combined—stood at 3.4 percent of GDP, which is still significantly below pre-crisis levels of around 5 to 6 percent of GDP, leading to a ‘lost decade’ in infrastructure investments since then. More broadly, the Indonesian government failed to invest sufficiently in its economy and the public investment rate became one of the lowest among middle-income countries. Total investment, both public and private, declined from 27 percent of GDP in 1996 to less than 20 percent in 1999. There was even sharper decline in the public development spending -- a proxy for public investment. It declined from 6.5 percent of GDP in 1996 to around 4 percent in 2000 (World Bank, 2007). In countries such as Indonesia and Korea where public austerity prevailed, public works programs were used in the attempt to provide targeted income support to the poor. However, many flaws were discovered during the implementation of such projects. For example, in Indonesia, nearly two-thirds of the poor did not participate in the projects (World Bank, 2000).

Some Asian countries adopted an economic package with a focus on infrastructure investments. For instance, China implemented an ambitious infrastructure investment program worth approximately US\$ 12 billion for the period 1998-2000 to relieve the binding constraint on growth, with a focus on roads and highways, which in turn opened up the interior region to more commerce. Japan's US\$ 127 billion stimulus package is yet another example that targeted spending on infrastructure projects mainly for science, technology, and telecommunications (Richardson, 1998). In addition, Japan also announced a scheme of a special yen loan facility of a maximum amounting to a total of up to 600 billion yen (approximately US\$ 5 billion) to contribute to economic structural reforms in the wider East Asia region by promoting the infrastructure developments.⁶

There is macroeconomic evidence documenting the fast recovery in some of the countries in the region that implemented fiscal stimulus packages, but more detailed evidence on the assessment of multipliers is scarce. In the case of China, improvements in the highway system, port facilities, telecommunications, and education helped the economy to get out of deflation in 2003 and increased the average growth in GDP. This was followed by an increase in government revenue that allowed public debt to decline from about 30 percent of GDP in the 1990s to about 20 percent in 2007 (Jha, 2009). Despite the large and decisive fiscal stimulus in the 1990s (7 percent of GDP per year on average), Japan continued to face an ongoing challenge of promoting faster economic growth. Chari and Henry (2015) show that the divergence in recoveries does not depend on the size of fiscal stimulus but also on its persistence. Unlike Europe, some East Asian countries continued to implement stimulus in response to the Asian Financial Crisis of 1997 until growth recovered. On the other hand, large and rapid fiscal consolidation in Europe exerted a strong, negative impact on growth.

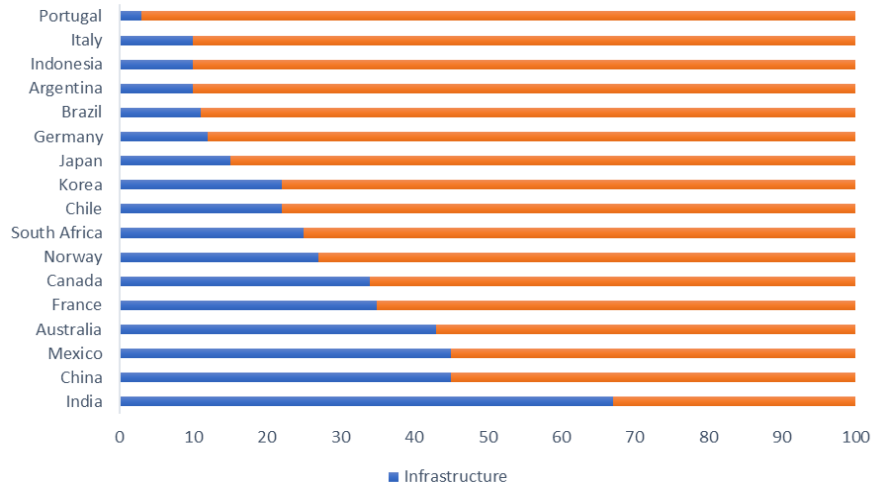
3.3 The Great Recession

The Great Recession (also referred to as the financial crisis of 2008-2009) started with the bankruptcy of a US investment bank, Lehman Brothers, followed by an unprecedented dislocation of financial markets. It severely hit the stability and confidence of financial systems. To ease the negative economic impacts of the 2008-2009 financial crisis, many countries implemented fiscal stimulus packages. As each country responded differently to the 2008-2009 global crisis, the impacts of their fiscal stimuli are unique as well.

Countries such as the Russian Federation and the United Kingdom mostly focused on tax cuts, while spending measures were the main focus in countries like Argentina, China, and India. Expansion of social security benefits by increasing spending on public health and unemployment benefits (Canada, France, Russia, the United Kingdom, and the United States), cash transfer programs (Brazil, Canada, Chile, France, Italy, Japan, Mexico, and Korea), pensions (Argentina, Australia, Canada, and China) and extending concessional loans to low-income citizens (Saudi Arabia) are some of the mostly preferred components of stimulus packages (Jha, 2009). Infrastructure investment programs were parts of the stimulus programs that were enacted in the wake of the 2008-09 financial crisis to bolster economic conditions, with the share allocated to infrastructure varying substantially across countries (Figure 5).

⁶Ministry of Foreign Affairs of Japan (2000). <https://www.mofa.go.jp/policy/economy/asia/crisis0010.html> (Accessed in September 21, 2020). During the crisis, there had been pressure on Japan to stimulate its economy and increase its imports from the region to contribute to economic recovery of other Asian economies. Sales to Japan account for 12 percent of Malaysia's GDP, and in the range 5 to 7 percent for Indonesia; Korea; Taiwan, Chian; and Thailand (The Economist, 1998).

Figure 5: Infrastructure spending as a % of total stimulus packages, 2009



Source: Authors' calculation based on ILS and OECD (2009)

By contrast with the New Deal, the transportation bills during the great recession mostly focused on building traditional highways and transit lines. Just as importantly, workforce development programming was central to the New Deal, while the transportation bills take as a given that more spending creates more employment opportunities.

The American Recovery and Reinvestment Act (ARRA) used a hybrid approach, differing from the fiscal stimulus used during the Great Recession. Some infrastructure funding went into preexisting programs, which did accelerate spending when recipients were prepared. But ARRA also launched the National Broadband Plan and the innovative Broadband Technology Opportunities Program. Funding toward clean energy programs used renewable generation, weatherization, and even new financing models to invest in long-term sustainability. Those innovative programs now serve as models for the next wave of digital and resilience efforts. However, the impact on output, jobs, and crowding out were modest, even though the presence of a large range of multipliers may mask the heterogeneity of the hybrid approach used, combining pre-existing programs with innovative ones. Recent rigorous micro-research, such as Fowlie *et al.* (2018) and De Groote and Verboven (2019), however, points at low returns (or benefit-cost ratio) and serious design flaws in some high-profile policies.

Total spending on infrastructure across state and federal sources remained relatively unchanged as states cut their own-source funding (Michel, 2021). Cogan and Taylor (2010) found that ARRA grants have “not increased [state and local government] purchases of goods and services. Instead, they reduced borrowing and increased transfer payments” almost entirely offsetting the increased federal spending. Whalen and Reichling (2015) reported a wide range of multipliers for infrastructure spending, ranging from 0.4 to 2.2, indicating a disagreement among economists about the effects of new spending. This highlights the fact that in federal states, stimulus efforts by federal governments can only be effective if there is coordination with fiscal policy at the state level, otherwise offsetting measures may simply be taken, pointing at the need to ensure the needed consistency and coordination both at the central and local levels.

The employment effects of the American Recovery and Reinvestment Act were relatively modest, the transportation funding allowed state and local governments to maintain employment in the transportation construction sector as well as in other sectors (Mallett, 2020). Dupor (2017) found that “the number of workers on highway and bridge construction did not significantly increase.” Several surveyed firms turned

down private-sector non-ARRA-funded work, highlighting the fact that government spending was directly competing with private activity. The same researchers found that “rehiring of laid-off workers was rare,” with only 4.4 percent of their surveyed workers being rehired after a layoff. Almost half (47 percent) of the measured ARRA-created jobs were filled from the ranks of the already employed at other competing firms (Jones and Rothchild, 2020). Federal dollars also crowded out state and local project funding, by allowing recipient governments to decrease own-source funding on infrastructure and reduce debt issuances or fund other priorities.

The impact of the temporary value-added tax (VAT) cut has also been documented and found to be small and not be long-lasting. A prediction of Barrell and Weale (2009) indicates that a 2.5 percent reduction in VAT (from 17.5 percent to 15 percent) in the United Kingdom is likely to result in consumption being augmented by less than 1 percent by the fourth quarter to 2009. This contributes less than 0.5 percent to GDP compared to the case without the VAT increase. Moreover, after the temporary reduction is over, both consumption and GDP are depressed as a result of the policy.

In addition to tax reductions, fiscal stimulus packages in many countries consisted of transfers to households and expenditures on public works. Australia is such an example. As a part of stimulus, 21 billion household payments were delivered between December 2008 and May 2009, and 40 percent of households who received a payment spent it (Leight, 2012). This rate is high compared to the records in surveys assessing the 2001 and 2008 tax rebates in the United States and indicates that people are more likely to spend “bonuses” than “rebates”.

Giesecke and Schilling (2010) highlighted the importance of a package more targeted at employment promotion to increase the effectiveness of the fiscal stimulus. New Zealand’s fiscal stimulus package, for instance, largely comprised three policies: cuts to personal income taxes; cuts to business taxes; and increased infrastructure spending (0.3 percent of GDP for 3 years; 2009-2011). However, it had a small impact on employment – around 10,000 jobs- in the short-run, at a cost to long-run consumption (Giesecke and Schilling, 2010).

In sum, governments all over the world eventually introduced budget measures intended to provide fiscal stimulus to the economy, often including some component of infrastructure spending. However, the limited evidence available suggests that these measures met with only varying degrees of success. Table A1 in the Appendix provides more details of fiscal stimulus programs mainly discussed here.

3.4 Summary of Evidence on the Impact of Fiscal Responses to Major Macroeconomic Crises

A comparison of the Great Depression of the 1930s with the Great Recession of 2008-2009, in the specific case of the US where more evidence is available, we can draw a few lessons.

First of all, resilient recovery requires smart policy decisions and balancing of sometimes conflicting objectives: accelerating shovel ready projects (to create and maintain employment in the short run) and spending on innovative programs (as part of the next wave of digital and resilience efforts). Within this context, the ARRA used a hybrid approach, differently from the fiscal stimulus used during the Great Recession. Some infrastructure funding went into preexisting programs. But ARRA also launched innovative digital programs such as the National Broadband Plan and Broadband Technology Opportunities Program as well as green programs (renewable generation, weatherization, and even new green financing models). Those innovative programs now serve as models for the next wave of digital and resilience efforts.

In terms of estimated results, the impact of federal grants during the Great Recession are mixed, with a stronger impact on consumption, and a negligible (sometimes even negative impact) on state per capita

income, due to the presence of significant crowding out. Public works and relief spending also generated a weak multiplier. The wide range of multipliers for infrastructure spending, ranging from 0.4 to 2.2 for the ARRA programs reveal a disagreement among economists about the effects of new spending, but can also be interpreted as the differential impact of different types of investments some with short-run shovel ready impact and others more oriented towards innovation and boosting longer-run growth. The employment effects of ARRA were relatively modest, but nevertheless, transportation funding allowed state and local governments to maintain employment in the transportation construction sector as well as in other sectors.

Despite more limited evidence, the Asian crisis also provides a few lessons. The resulting fiscal austerity regime led to a ‘lost decade’ in infrastructure investments for many Asian countries. In countries such as Indonesia and Korea, where public austerity prevailed, public works programs did lack targeting, and failed to reach the poor who did not participate in the projects (World Bank, 2000). Unlike Europe, the few East Asian countries that implement stimulus continued to do so until growth recovered, which led to a stronger recovery. The large and rapid fiscal consolidation in Europe, instead, exerted a strong, negative impact on growth.

4. Assessing the Impact of COVID-19 and Recent Infrastructure Programs

Of course, no crisis is the same. Nevertheless, the COVID-19 recession lands at an ideal time to learn from these past stimulus programs. In fact, comparing historic crises with the economic crises induced by the 2020 COVID-19 global pandemic, there are at first sight some reasons to expect that spending might have smaller multipliers. First, if the uncertainty in the current crisis is deeper than in previous crises, individuals and firms could engage in more precautionary behavior, hoarding cash. Second, if fear of COVID-19 means that people choose not to engage in travel and social activities, efforts to stimulate economic activity will be less effective. Third, it may be difficult to target government injections to where there is a high marginal propensity to spend. Fourth, the impact on expectations may be shaped more by emerging health risks than by financial responses (Stiglitz, 2020). Additionally, employment impacts are very different with construction unemployment rates almost half those of the harder-hit service-sector industries that have been most negatively affected by the pandemic restrictions (US Bureau of Labor Statistics, 2021).

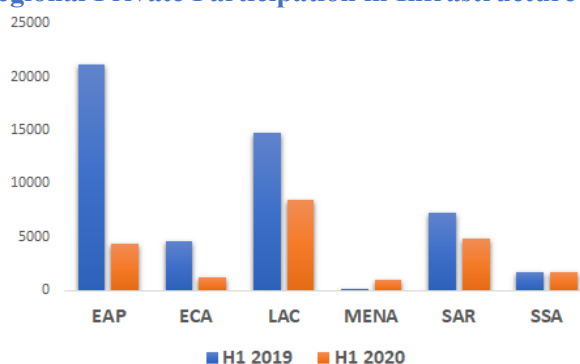
Although, the lessons learned from the literature would point to the higher effectiveness of providing transfers rather than engaging in new investments during such a severe recession as COVID-19. The coexistence of extremely low interest rates provides exactly the monetary policy setting in which investment and spending are known to deliver the highest multipliers. Since the pandemic is still ongoing and there is yet no relevant literature, the purpose of this section is to reflect on what the earlier literature could mean in the current context.

The peculiarity of the COVID-19 crisis also has implications for the prioritization of different types of infrastructure spending as part of any fiscal stimulus. Availability and access to infrastructure in many developing countries have become more urgent amid the threat of COVID-19. The ability to mitigate immediate health risks is often compromised by a lack of access to sanitation and public health infrastructure. In 27 Sub-Saharan African countries, almost 60 percent of health center facilities are without access to electricity (IEA, 2019a), and over 860 million people worldwide lack access to electricity, severely limiting their ability to store medicines and food, charge phones, access digital information, maintain access to education remotely or light their homes effectively (IEA, 2019b). Power outages and blackouts could cost lives and be detrimental to critical medical equipment. Interruption of supply chains for transport service could equally threaten the basic minimal delivery of food, fuel, medical supplies as well as the movement of critical workers that keep the economy functioning.

In the context of COVID-19, digital technologies are providing the main channel for governments, individuals and businesses to cope with social distancing, ensure business continuity, and prevent service interruptions. The demand for online digital goods and services has soared. Even countries characterized by adequate broadband connectivity, are experiencing increased data and voice traffic congestion that compromise service quality. In a wide range of sectors, such as education, e-commerce, health, finance and public sector service provision, essential goods and services are provided digitally within and across national borders to substitute for goods and services that were previously acquired as a result of social interaction. The shift to telework and distance learning only raises the urgency to reach universal access to broadband connectivity.

The COVID-19 outbreak has resulted in supply chain disruptions and restrictions that led to delays and cancellations in infrastructure projects. In addition, macroeconomic uncertainties and negative economic outlook have decreased the availability of private financing for infrastructure projects. Compared to the first half of 2019, Private Participation in Infrastructure (PPI) investments decreased by 56 percent in the first half of 2020, with East Asia and Pacific being the most affected region characterized by a decrease of 79 percent, due to the redirection of funds to the health care and social protection sectors (World Bank, 2020). Private investment commitments are mainly directed towards a limited number of countries, pointing also at the importance of public sector financing when private investments languish.

Figure 6: Regional Private Participation in Infrastructure (US\$ million)



Source: Authors' calculation based on World Bank's Private Participation in Infrastructure (PPI) 2020 Half Year Report

In many countries, attention has now started to turn to long-run recovery plans. A trillion-dollar infrastructure plan as a part of the new stimulus package has been announced in the United States. The infrastructure plan would help boost the economy with a particular focus on roads, bridges, tunnels, 5G wireless infrastructure and rural broadband.⁷ The United Kingdom also announced a national infrastructure plan involving capital spending of £100 billion.⁸ The Malaysian government allocated 2 billion ringgit (US\$ 450 million) for infrastructure projects such as maintaining roads, bridges and streetlights at the federal, state and local government level to protect small-scale contractors and encourage local economic activities.⁹

Measures undertaken at the beginning of the COVID-19 crisis were similar to those employed during the 2008-09 financial crisis and focused on immediate responses such as direct payments (stimulus checks).

⁷<https://www.forbes.com/sites/zackfriedman/2020/06/16/trump-may-want-1-trillion-of-infrastructure-for-next-stimulus/#4deb1d9126ad>

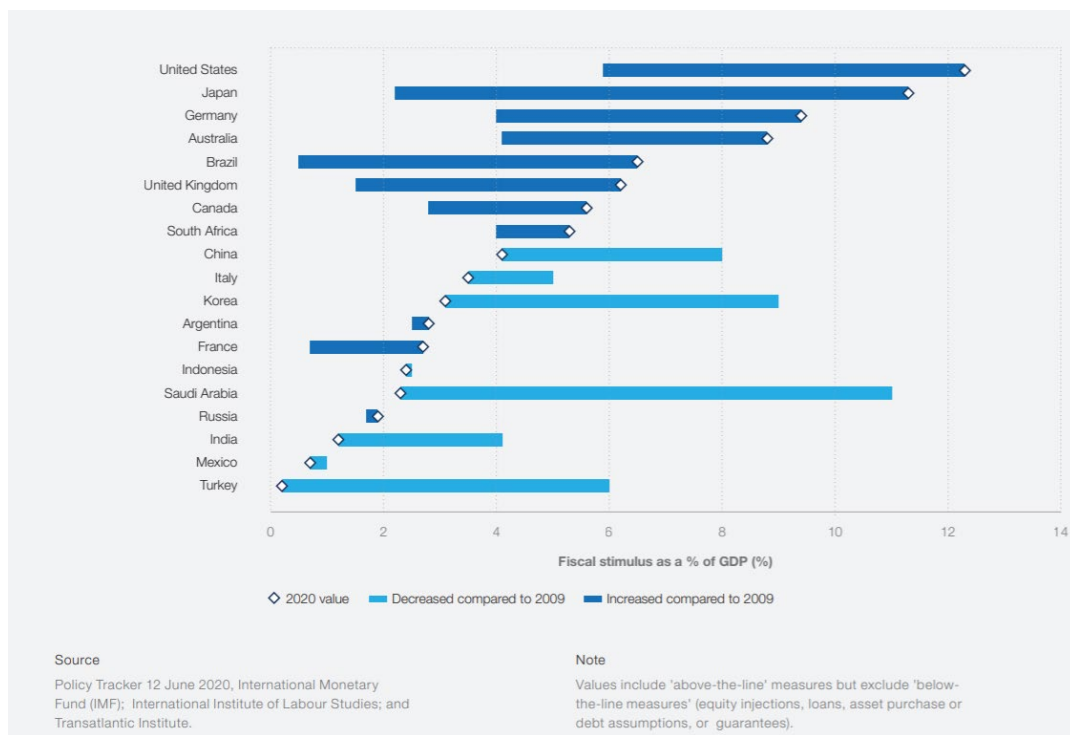
⁸<https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/uk-preps-stimulus-for-infrastructure-projects-tech-firms-8211-ft-58866134>

⁹ <https://www.aseanbriefing.com/news/malaysia-issues-stimulus-package-combat-covid-19-impact/>

Historical experience reveals that in the absence of other interventions, when there is decline in economic growth, public investment declines too (Abadie, 2020).

However, there is heterogeneity in terms of the focus of the infrastructure stimulus and spending. While the stimulus of many advanced economies contain support for innovation (France), green growth (France, Germany, Italy, Japan, Korea, United Kingdom), and expansion of digital infrastructure (Germany, Korea, Japan), low-income developing countries have cut their total and capital spending (the Republic of Congo, Sudan, Zambia) and increased several taxes (Angola) to offset pandemic related expenses, specifically in health care, due to financial constraints (IMF, 2020). Indeed, compared to the previous global financial crisis, some developing countries announced lower fiscal stimulus packages as a percentage of GDP, as Figure 7 illustrates.

Figure 7: Comparison of 2009- 2020 Fiscal Stimulus Packages

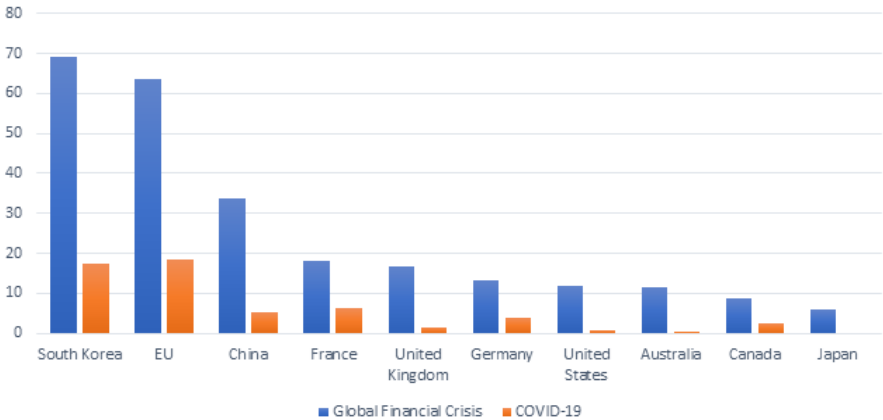


Source: World Economic Forum, Future of Jobs Report October 2020

A stimulus can also address the country's long-run needs, charting a new path for infrastructure policy for decades to come. Based on lessons from past programs a promising fiscal stimulus is one that can deliver immediate and long-lasting benefits, protect infrastructure investment and the current infrastructure workforce and accelerate clean energy adoption, expanding broadband networks and digital skills development. A path to build back better both for developed and developing countries include investment in green infrastructure. This requires expenditures on fast and labor-intensive investments in the short run that have high multipliers and co-benefits. Hence, it is crucial that these packages promote a cleaner, environment-friendly alternatives instead of locking-in traditional, polluting energy production (Mundaca and Damen 2015; Jaeger, 2020; Kaufman, 2020; Volz, 2020).

Some green measures also appear in the stimulus spending in response to COVID-19 (Figure 8). However, compared to the Great Recession, green stimulus as a percentage of total stimulus is much lower. This is due to the overall size of the economic recovery packages (much larger in 2020) and the fact that most of it targets the essential emergency responses (Jaeger, 2020). As our previous analysis demonstrated, compared to traditional stimulus, green stimulus, in many cases, has been singled out as more effective in creating jobs. Focusing on green recovery can help not only in the short-run relief process but also in achieving long-term recovery.

Figure 8: Green Stimulus as a Share of Total Stimulus



Source: Jaeger (2020)

5. Conclusions

The Keynesian approach according to which government spending can be used as a powerful stimulus, particularly during times of high unemployment, led to extensive debates that started during the Great Recession. While a large body of subsequent empirical work estimated fiscal multipliers, our review also reveals major gaps in the literature, which point to an agenda for the future.

First, most of the empirical literature on the impact of fiscal stimuli is confined almost exclusively to developed countries, and treats only broad categories of expenditure (transfers, tax cuts, public expenditure). The lack of quality data on developing countries makes it difficult to understand to what extent existing results would carry over to these very different economic settings. At the same time, the lack of sectoral disaggregation of fiscal data, even for developed countries, limits what the literature can cover on the relative efficacy of different types of spending with a view to providing guidance on prioritization.

Second, there is no one-fits-all recipe for fiscal stimulus to stimulate the recovery as well as to find the conditions under which the multiplier is more effective. We do not find robust evidence of multipliers being higher during the different states of the economy and particularly during a recession. Moreover, under crises, transfers are sometimes more effective than spending multipliers. Not every crisis is, however, the same: deeper crisis can yield higher multipliers. The strongest evidence is that multipliers can be higher when there is coordination between fiscal and monetary policy, especially under zero policy rates lower bound.

A few emerging policy recommendations on the effectiveness of countercyclical fiscal policies against the current COVID-19 crisis are explored. There are several reasons why COVID-19 spending might have smaller multipliers, including more precautionary behavior, hoarding cash, amplified by fear that people choose not to engage in travel and social activities, so that efforts to stimulate economic activity will be less effective. At the same time, a countervailing consideration is that many countries are also facing the kind of loose monetary policy conditions that help to increase the efficacy of fiscal stimulus.

Two types of infrastructure investments look to be of particular relevance to recovery from the COVID-19 crisis. The first is digital technologies, which have come into their own to support economic and social resilience while complying with public health directives on social distancing. Accordingly, the demand for digital goods and services has soared across the public and private sectors and exposed major deficiencies in the availability and performance of broadband infrastructure. The second category is green infrastructure, which offers relatively good performance on job creation, while at the same time shifting economies to lower carbon emission trajectories in the context of increasingly pressing global climate targets. Investments such as rural electrification, public transport, energy efficiency and renewable energy offer the possibility of contributing simultaneously to economic, environmental and social goals.

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Table A1: Experience of 2009 Stimulus Around the World

Country/Region	Authors	Data	Time Coverage	Stimulus	Findings
Australia	Li & Spencer (2016)	Output growth rate, inflation, domestic interest rate, growth rate of government transfer payments (quarterly)	March 1993- December 2013	More active spending measures- transfers to households and expenditures on public works	Stimulus transfers were almost equally important as the concurrent monetary easing actions in helping the economy to avoid recession
Australia	Leight (2012)	Household survey data	December 2008 - May 2009	US\$ 21 billion household payments between December 2008 and May 2009	40% of households who received a payment spent it indicating individuals are more likely to spend “bonuses” than “rebates” as in the US
Australia	Buddelmeyer&Peyton (2014)	Expenditure data for 62 local government area and electronic gaming machine data	July 2004 - June 2012	Lump-sum cheques sent to households as compensation for the introduction of Carbon Tax	Increased spending in electronic gaming machine in December 2008 amounted to 1% of total stimulus for that period. Individuals are more likely to spend “bonuses”
China	Xiang <i>et al.</i> (2019)	Sample of 143 banks (including the big five, joint stock, city, rural and foreign)	2006-2013		the effect of the 2007 Global Financial crisis and the 2009 stimulus package on various overall and segment efficiencies is inconsistent & inconclusive
New Zealand	Giesecke & Schilling (2010)	Real consumption, investment, public consumption, export & import volumes, employment real wage terms of trade	October 2008- March 2009 (with predictions till 2017)	Cutting to personal income & business taxes and infrastructure spending (0.3% of GDP for 3 years; 2009-2011)	Small positive impact on short-run employment with a gain around 10,000 jobs but at a cost to long-run consumption
Thailand	Muthiacharoen <i>et al.</i> (2019)	Account-level loan data (loan composition and history, demographic information)	December 2009- March 2016	Car-buyer tax rebate during 2011-2012	The design of durable goods stimulus policy should focus more on productive business durables than on consumer durables since it may lead to excessive debt burden and create an adverse consequence in the longer term
The Caucasus, Central Asia and Mongolia	Mitra (2010)	Macroeconomic indicators (GDP growth, current account balance, terms of trade, loan to deposit ratio...)	2000-2009 (main focus)		Need for more concessional financing to moderate the tradeoff between stimulus and sustainable debt levels. Importance of distressing in the banking sectors through liquidity support and deposit guarantees
Turkey	Misch & Seymen (2019)	Financial Crisis Surveys Data, change of sales of firms, additional firm specific controls (number of employees, share of	2009-2010	Cutting the value added tax and special consumption tax in the first quarter of 2009	Positive and robust effects of consumption tax cuts on the change of firm sales

		exports, received state aid or not...)			
Turkey	Taymaz (2010)	Changes in domestic demand for passenger and changes in exports	2008-2009	Special Consumption Tax reduction on motor vehicles	Special consumption tax cuts increased automobile sales and domestic automobile production
United Kingdom	Barrell & Weale (2009)	Aggregate consumption data (quarterly)	1992-2010 (with a focus on 2009-2010 period)	Temporary VAT cut	A 2.5% reduction in VAT is likely to result in consumption being augmented by less than 1% by the fourth quarter to 2009. GDP is likely to be raised less than 0.5% relative to the case without the VAT increase.
United States	Taylor & O'Sullivan (2017)	Real per capita federal expenditures, government revenue	11 postwar recessions (1948-2015)		Fiscal stimulus policies should follow three T's—timely, targeted, and temporary: (1) it took 10.9 months on average before a recession's start and the first major countercyclical fiscal policy action. (2) The stimulus was not temporary in the 4/8 recessions where fiscal policy was attempted. (3) In many cases recessions provided politicians an avenue in which to implement policies that were part of their long-run reform agenda rather than being carefully targeted countercyclical fiscal policy.
United States	Mian & Sufi (2012)	957 U.S. metropolitan or micropolitan statistical areas (CBSAs) for	January 2004 -June 2010	The Car Allowance Rebate System program - temporary subsidies to encourage the trading in old cars and buying new ones	Program induced the purchase of an additional 370,000 cars in July & August 2009. reversal impact 10 months after the program expired
United States	Chodorow-Reich <i>et al.</i> (2012)	State level income and employment	December 2008-July 2009 (main focus)	\$88 billion of aid to state governments through the Medicaid reimbursement	Positive relationship between receiving fiscal relief and increases in employment
Europe (17 countries)	Nickel and Tudyka (2014)	Real GDP, government consumption, private investment, debt-to-GDP ratio, trade balance	1970-2010		A one percentage point of GDP increase (expansionary fiscal shock) in government consumption is first followed by positive cumulative responses of real GDP and negative responses of private investment and the trade balance as a share of GDP
G20	Spilimbergo, Symansky, and Schindler (2009)		2008 Global crisis		The low set of fiscal stimulus multipliers included 0.3 on revenue, 0.5 on capital spending and 0.3 on other spending
World	Agnello <i>et al.</i> (2017)	Panel of 157 countries (Gini, real GDP growth rate, fiscal stimulus packages)	1960-2010		An increase in inequality increases the probability of government crises. However, this impact is decreased when expansionary fiscal stimulus episodes are in place.
World	Aizenman & Jinjark (2011)	Size of fiscal stimulus, exchange rate depreciation, trade openness, fiscal capacity	2007-2009 (main focus)		A lower debt/average tax base is associated with higher fiscal stimulus and lower trade openness is associated with a higher fiscal stimulus and lower depreciation rate during the crisis