MACROECONOMIC EFFICIENCY OF PUBLIC SPENDING AND CLIMATE CHANGE

ABSTRACT

This paper looks at the heterogenous efficiency gains of public spending in infrastructure in countries with varying degrees of vulnerability and readiness to adapt to climate change. This macroeconomic analysis of the impacts of climate change, uses Notre Dame Global Adaptation Initative's newly estimated indices on countries' levels of vulnerability and readiness to climate change adaptation alongside data from 1980 to 2017 on countries' infrastructure levels to estimate the multiplier effect a one-dollar investment in infrastructure has on a countries' output over time. Using a local projections model, our empirical model finds a multiplier effect of up to 2.5 dollars in infrastructure investment over a four-year period in countries with lower scores in both vulnerability and readiness to climate change adaption. We find heterogenous results in countries with different levels of both readiness and vulnerability, finding lower multiplier effect results in countries with lower vulnerability scores. Overall, given other possible multiplier effects from other investments, we find that infrastructure investment is a very cost-efficient way to ensure long output gains in countries that are ranked as very vulnerable to the effects of climate change.

INTRODUCTION

In 2018, NASA estimates showed that 16 of the 17 warmest years on record have occurred since 2001. As climate change's consequences increasingly unfold, in 2015 almost every nation in the world took action and signed the Paris Agreement showing an unprecedented global concern on the subject. While the ambitious goal of the Paris Agreement is to limit the rise in global temperatures to below 2°C above pre-industrial levels, negative consequences such as an increase in the frequency of natural disasters or widespread rise in water levels are already having an impact on the planet.

Such effects led to the 2017 Atlantic hurricane season which broke all records in terms of intensity and frequency of extreme events, completely devastating the Caribbean. Around this period, both Mexico and Chile recently suffered from a series of unprecedented strong earthquakes and South Asia endured one of the worst monsoon flooding seasons in its history.

The picture gets worse when we add rapid urbanization to the world's regions most vulnerable to climate change. [1] Among those suffering the most, small island states events endured damages amounting to up to 10% of GDP from extreme events. These states alone represent over 60% of countries with the highest losses from disaster.

[1] According to UN-Habitat, more than 880 million urban residents are estimated to live in urban slums, where the concentration of climate and disaster risk is highest.
An estimated 875 million schoolchildren live in earthquake-prone regions of the world.
Sea-level rise in the 136 largest coastal cities could result in losses of $1 trillion or more per year by 2050.

Thus\ immediate action is needed to slow down these effects and to buffer the impending consequences amongst the most vulnerable population groups. According to the “Shock Waves” report, without major investments in preventive infrastructure, perverse consequences of climate change may push up to 100 million people into poverty by 2030.

Given that most of the solutions to these issues require the supply of public good infrastructures such as levies, better transportation systems and other types of general infrastructure, efficient public investment stands out as one of the best possible public tool that can be used by governments to achieve their pollution reduction goals and increase our adaptability to the inescapable changes coming to coastal and other populations soon.

While investment in new modern infrastructure using climate-friendly technologies could clearly help directly mitigate the effects of climate change [2] this paper focuses on other important spillover of infrastructure investment; to help the most vulnerable communities adapt to the undergoing changes in climate and rising sea levels. This new or improved infrastructure could buffer these communities from the unavoidable negative economic and social consequences of natural disasters and rises in sea water levels. In this sense, higher public investment among these populations could help sustain economic growth in the medium run.

[2] Some examples of how new infrastructure could help mitigate the effects of climate change include enabling investment for more energy-efficient and low-carbon transport solutions green building projects aimed to reduce the environmental impact of buildings over their lifespan by targeting water-saving and energy-efficient initiatives such as smart meters and LED lighting.

Building resilience

Thus, the risks generated by climate change call for adaptation projects aimed to strengthen the resilience of buildings and critical infrastructures. Projects like flood levies to protect coastal areas from rise in sea levels or storm surges as well as better and more robust transportation infrastructure can protect large populations from weather related effects caused by climate change. Building resilience in our infrastructure will soften the blow of natural disasters and allow relief efforts to be conducted more effectively. Apart from potentially saving lives and improving living conditions in many affected communities, these types of prevention[3] infrastructure projects can also be cost effective as a decrease in total devastation after extreme weather events could alleviate the typically vast expenditures sunk into the recovery efforts.

On the bright side, estimations show that over the next 20 years, humans will build more infrastructure than what has been built in recorded history. From the "Investing in Urban Resilience" report, we know that global infrastructure needs are at more than $5 trillion per year. When meeting this demand, it will be important to be strategic in providing a strong line of defense against natural disasters, especially in the most vulnerable and often faster growing parts of the planet.

In this paper, we investigate the role of public infrastructure as a buffer to the negative economic consequences of climate change. Our estimates show that public investment leads to large

[3] In a recent edition in Bonn, UN Framework Convention on Climate Change (UNFCCC) COP23 highlighted the need for these types of fortifying infrastructure projects.

returns in terms of medium run economic growth in countries with high vulnerability and low readiness to climate change related shocks.

Our results clearly enhance the role of public infrastructure as an effective tool to fight the worse consequences cause by climate change events and to protect medium term economic growth in the most vulnerable regions. In other words, building resilience among the most vulnerable and least prepared communities pays off.

In section 2, we explore the evolution of country specific vulnerabilities and the state of readiness to climate change events across the last 25 years on a global sample using the ND-GAIN dataset. We also, study the correlation between these two variables and between each of those and different income per capita levels. In section 3, we look at the evolution of public expenditure across a global sample of countries and its correlation with the ND-GAIN indicators. In section 4, we model output growth impulse responses to increases in public investment under different levels of vulnerability and readiness. Section 5 concludes.

VULNERABILITY TO CLIMATE CHANGE AND ADAPTABILITY

To understand the different positions countries find themselves when dealing with the effects of climate change, we use two key dimensions of adaptation provided by the Notre Dame Global Adaptation Initiative (ND-GAIN): vulnerability and readiness.

In ND-GAIN, the vulnerability index measures a country's exposure, sensitivity and capacity to adapt to the negative effects of climate change. ND-GAIN measures the overall vulnerability by considering six life-supporting sectors – food, water, health, ecosystem service, human habitat,

and infrastructure. Exposure is represented by the degree to which a system is subjected to significant climate change from a biophysical perspective. It is a component of vulnerability independent of its socio-economic context. Exposure indicators are projected impacts for the coming decades and are therefore time invariant in ND-GAIN. Meanwhile, sensitivity is taken as the extent to which a country is dependent upon a sector negatively affected by climate hazard, or the proportion of the population particularly susceptible to such hazard. A country's sensitivity can vary over time. Finally, adaptive capacity represents the availability of social resources for sector-specific adaptation. In some cases, these capacities reflect sustainable adaptation solutions. In other cases, they reflect capacities to put newer, more sustainable adaptations into place. Adaptive capacity also varies over time.

On the other hand, the readiness index measures a country's ability to leverage investments and convert them to adaptation actions. ND-GAIN measures overall readiness by considering three components – economic, governance and social readiness. Economic readiness captures the ability of a country's business environment to accept investment that could be applied to adaptation that reduces vulnerability (reduces sensitivity and improves adaptive capacity). Meanwhile, governance readiness captures the institutional factors that enhance the allocation of investment for adaptation. Finally, social readiness captures factors such as social inequality, ICT infrastructure, education and innovation that enhance the mobility of investment and promote adaptation actions.

A country's ND-GAIN Score is composed of a vulnerability score and a readiness score:

$$GAIN\ INDEX = [READINESS\ - VULNERABILITY + 1] * 50$$

Where the readiness indicator goes from 0 to 1 (the higher the number, the more ready a country is said to be), vulnerability goes from 0 to 1 (where a low number indicates low vulnerability) and the GAIN index goes from 0 to 100 (where a higher number reflects a more ready and less vulnerable country).[4]

Table 1 showcases the summary statistics of these indexes. For the readiness index, most values concentrate between .27 and .59 with New Zealand being the "readiest" nation in the world in 2014 with a score of .9 and Angola being the least "ready" nation in the world in 2000 with a score of .1. In terms of vulnerability, most values in the distribution fall between .33 and .55. wit Eritrea in 2000 being the most "vulnerable" country in the world and the United Kingdom in 1996 being the least "vulnerable". Overall, most of the values of the GAIN index fall between 36 and 62 with Eritrea scouring the worse combined score in 2007 and New Zealand the best in 2014.

When looking at the correlations between these two key measures, Figure 1 gives us a set of good and bad news. On the bright side, looking at the evolution of the indexes between 1995 and 2014, we can clearly see an overall push towards higher readiness and lower vulnerabilities. On the other hand, we observe that the most vulnerable communities are those least ready to

[4] Climate vulnerability and adaptation readiness are based on compiled indicators. Thirty-six indicators contribute to ND-GAIN's measure of vulnerability and nine indicators contribute to the measure of readiness. An explanation of each indicator and their data sources can be viewed on the Indicators page.

deal with the consequences of climate change (observing a very clear negative correlation between the two measures). More dishearteningly, we do not see any significant change on this correlation over time.

Figure 2a confirms the positive evolution of the combined vulnerability and readiness indexes overtime. Nevertheless, while high income countries, which unsurprisingly have the highest Gain Index scores, have steadily improved their ability to fight climate changes' consequences, low income economies have only started improving their scores after 2005; creating an even larger gap across income strata. These differences across income levels are highlighted when we decompose the evolution of the GAIN index in figure 2b. From this figure we observe how vulnerabilities have remained high and constant in low-income countries during the last two decades while they have been consistently decreasing in middle-income economies. However, the differences in the evolution of the readiness index across different economies is perhaps more striking. While high income economies have been steadily improving resilience, middle and low-income economies only started improving their ability to fight the effects of climate change after 2005. Even after 2005 there does not seem to be a fast convergence path between high-income and low-income countries. From Figure 2C, when we divide our sample into regions, we observe that Latin America has consistently scored higher in the GAIN index than other non-OECD economies and has even experienced a slightly faster growth in such index over the last decade. Meanwhile, not only did Caribbean countries score higher than other island economies but also scored significantly higher than other emerging economies in general. As seen from the decomposition of the index in figure 2d, the relatively high GAIN score for Latin America arises from its significantly lower vulnerability compared to other emerging nations. On the other hand,

the high GAIN score of the Caribbean economies stems from a combination of low vulnerability and especially, a high readiness score. Unfortunately, the readiness of Caribbean economies has been increasing at a much slower pace than other island economies and than most other emerging economies. This means that the gap has been closing in quickly over the last ten years.

EVOLUTION OF PUBLIC EXPENDITURE AND ITS COMPOSITION

In this paper, we try to argue for the important positive effects of building resilience to the large economic and social consequences of climate change through the creation of more and better infrastructure. A large portion of all infrastructure projects are considered to provide public goods thus, are normally undertaken by either the public sector directly or in partnership with the private sector. To understand the public-sector's engagement in infrastructure investment, this section gives a summary of the evolution of the role the public sector has had in the economy and in its composition.

Over the last centuries, economic growth, benevolent demographic structures and changes in the socio-political behavior vis-a-vis the role of the government in the economy have pushed emerging economies to catch up with the levels observed in industrialized countries.

Early studies of optimal size of government argued that as income increased the demand for more public goods would increase as well (Wagner Law). This empirical relationship can be seen from the positive correlation between the size of the public sector (primary expenditures over

GDP) and aggregate income shown in Figure 3. Beyond these early theories, we find a recent wave of attempts to empirically pinpoint an extended set of drivers of public expenditure. These studies focused among other potential driver's country size, trade openness, economic and institutional development[5]

In the last two decades, emerging markets have enjoyed external macroeconomic tail winds in the shape of large amounts of international liquidity and a positive trend in commodity prices (all the way up to 2011). As seen from Figure 4, widespread commodity terms of trade (CTOT) improvements over the last decade effectively lead to high output growth for commodity exporting regions such as Latin America and the Middle East. Jointly with the time of high commodity prices and high growth, emerging markets were also enjoying an unprecedented era of high international liquidity. These low policy rates translated into low debt service costs in advanced economies and emerging countries.

There was a clear heterogeneity in the way emerging regions reacted to these tailwinds. For example, while other commodity-exporting regions like the Middle East took advantage of the positive economic environment to increase their savings through current account surpluses, Latin American economies did not. On the flip side, as shown in Figure 5, the windfall allowed many emerging markets to increase public primary expenditure catching up to their industrialized counterparts. Unfortunately, most of these increases in expenditures translated into increases in public consumption and thus emerging markets missed the opportunity to increase public

[5] See Alesina and Wacziarg (1998), Rodrik (1998), Easterly and Rebelo (1993), Stein et al. (1999), Persson and Tabellini (1999), Milesi-Ferretti et al. (2002), Fatas and Mihov (2001) Shelton (2007), and (Lamartina, S. and Zaghini, A. (2011).

investment to ensure future growth and build resilience. This set of missed opportunities was highlighted in Izquierdo et al.'s2008 report "*All that glitters may not be gold: assessing Latin America's recent macroeconomic performance*". In this early warning, the authors show that the strong external tailwinds across the region could be masking underlying macroeconomic problems and argue for the need of using the windfall to address investment in the future growth of the region and a set of costly macroeconomic structural reforms. Unfortunately for the region today, the authors' much needed advice was disregarded and most of the windfall across the region was dedicated to increases in public consumption.

In summary, emerging markets have used the increases in income per capita to increase the delivery of public goods in the economy but have failed to invest enough of that windfall into long term growth initiatives such as infrastructure investment.

Thus, climate change's dire effects we talked about in section 2 combined with a lack of public capital accumulation in emerging markets paint bleak picture. As shown in Figure 6, economies that tended to accumulate the least amount of capital (either public or private) per capita in the last 20 years are precisely the economies that are the most vulnerable to the effects of climate change.

FISCAL MULTIPLIERS UNDER DIFFERENT LEVELS OF VULNERABILITY AND READINESS

In previous sections we have argued for the importance of building resilience through infrastructure projects for vulnerable communities. In this section, we use econometric methods

to highlight the large returns to public investment for the least ready and most vulnerable economies.

Data

Apart from the GAIN index and its components explained above, our empirical requires data on real gross domestic product, government expenditure and its components. Both data on real GDP and data on the components of government expenditure is taken from the 2016 WEO dataset. Public expenditure is normally decomposed into the following categories: Interest payments on debt, public consumption of intermediate goods and services, wages of public employees, government transfers which include social security payments as well as unemployment insurance and conditional cash transfers and public gross fixed capital formation. In this paper, we want to put a spotlight on the effects of expenditure in public infrastructure which is collected under public gross fixed capital formation. On the other hand, interest payments are normally not considered in the analysis of fiscal policy since they are a highly non-discretionary part of public expenditure. Thus, we separate primary (or net of interest payments) public consumption and transfers from public investment (gross capital formation).

Focusing on our measure of pubic investment, public gross fixed capital formation (PGFCF) is a macroeconomic concept measuring the value of acquisitions of new or existing fixed assets by the governments less disposals of fixed assets. PGFCF is a component of the expenditure on gross domestic product (GDP), and can be used to show how much of the new value added in the economy is invested rather than consumed.

PGFCF is called "gross" because the measure does not make any adjustments to deduct the consumption of fixed capital (depreciation of fixed assets) from the investment figures. For the

analysis of the development of the productive capital stock, it is important to measure the value of the acquisitions by subtracting the disposals of fixed assets beyond replacement for obsolescence of existing assets due to normal wear and tear. "Net fixed investment" includes the depreciation of existing assets from the figures for new fixed investments and is referred as net fixed capital formation.

PGFCF is not considered as measure of total investment, as only the value of net additions to fixed assets is measured and all kinds of financial assets are excluded; as well as stocks of inventories and other operating costs (the latter included in intermediate consumption). If, for example, one examines a company balance sheet, it is easy to see that fixed assets are only one component of the total annual capital outlay.

The most important exclusion from PGFCF are land sales and purchases. These are excluded because, leaving aside complex valuation problems involved in estimating the value of land in a standard way, if a piece of land is sold, the total amount of land already in existence, is not regarded as being increased. Therefore, all that happens is that the ownership of the same land changes. The stock of produced fixed assets consists of tangible assets (e.g. residential and non-residential building, roads, bridges, airports, railway, machinery, transport equipment).

Empirical Strategy

In our basic linear specification, each response of percent changes in real gross domestic product relative to the contemporaneous percent changes of government expenditure at horizon h is obtained from the equation (1). In order to account for the potential non-linearities along the

vulnerability and changes in readiness of different countries, our Linear Projections methodology uses the following specification:

$$(1)\ \Delta Y_{i,t+h} = \alpha_{i,h} + \beta_{1,h}\Delta G^{e}{}_{i,t} + \beta_{2,h} I * \Delta G^{e}{}_{i,t} + \chi_{H,h}(L)\Delta Y_{i,t-1} + \Psi_{H,h}(L)\Delta X_{i,t-1} + \sigma_{t,h} + \mu_{i,t,h}$$

with $\Delta Y_{i,t+h} = Y_{i,t+h} - Y_{i,t-1}$

where I() is our index of the different degrees of readiness and vulnerability of each economy. $\Delta \mathrm{Y_{i,t+h}}$ and $\mathrm{LnG^{e}{}_{i,t}}$ represent the accumulated measure of real GDP growth at time *t+h* and Government Expenditure as percent of previous expenditure respectively. $\Delta X_{i,t-1}$ represents a vector of lagged controls including lagged expenditure. We control for the dynamics of the system including a set of lags of the dependent and independent variables plus a complete set of additional controls. Finally, we include a full set of country and year dummies. Every equation for each *h* is estimated using a standard LSDV approach. We use robust Driscoll and Kraay (1998) standard errors for our coefficients to correct for potential heteroskedasticity, autocorrelation in the lags and error correlation across panels.

Each component of the estimated vector β_h represents the step in the accumulated impulse response function at a forward time h and reads as the effect in the accumulated output growth of a one percent increase in the accumulated government expenditure growth $\mathrm{LnG^{e}{}_{i,t}}$.

The typical multiplier discussed in the literature refers to the increase in real domestic currency units in output after a one-unit increase in real domestic currency government expenditure. To obtain this multiplier from our regressions we make the following transformation:

$$Multiplier\ at\ period\ h = \frac{\mathrm{Y_{i,t+h}}}{\mathrm{G_{i,t}}} = \frac{\frac{\Delta \mathrm{Y_{i,t+h}}}{\overline{Y_h}}}{\frac{\Delta \mathrm{G_{i,t}}}{\overline{G_h}}} * \frac{\overline{G_h}}{\overline{Y_h}} \approx \frac{\Delta \mathrm{LnY_{i,t+h}}}{\Delta \mathrm{LnG_{i,t}}} * \frac{\overline{G_h}}{\overline{Y_h}} \approx \beta_h * \frac{\overline{G_h}}{\overline{Y_h}}$$

where $\overline{G_h}$ over $\overline{Y_h}$ is taken as the sample average.

It's important to note that in this approach each step in the IRF is obtained from a different individual equation. In this context, we obtain the IRF values for high vs. low levels of economic vulnerability to environmental disasters or that of high versus low level or readiness directly from the $\beta_{1,h}$ and $\beta_{2,h}$ estimated coefficients. Contrarily to the VAR specification, the estimated coefficients contained in $\chi(L)$ and $\Psi(L)$ are not use directly to build the IRF values but only serve as controls, thus capturing the effects from the dynamic effects of output and the effects of past government expenditure and consequently removing such effects from the betas themselves.

As in the linear specification the estimations of $\beta_{H,h}$ and $\beta_{L,h}$ serve directly as the steps in the accumulated impulse response functions. We apply the same transformation as before to obtain the "dollar" multiplier (in domestic currency).

Results

As expected, applying the non-linear specification to the data, Figure 7 show that, in general, fiscal multipliers are higher in countries with high vulnerability to negative climate change effects. This means that in countries with high exposure to climate change effects, public expenditure is most cost effective. More specifically, our results show that investing one dollar in public expenditure in countries on the right tail of the vulnerability index distribution such as Haiti, in average, would transform into 1.2 dollars in output after 4 years.

Figure 8 give similar results for our Readiness Scores. Countries with low degree of readiness would, on average, benefit substantially more from increases in public expenditure than those with already high readiness scores. In this sense, relatively ill-prepared countries such as Honduras, would enjoy a return after of approximately 1.6 dollars in output after four years for each dollar increase in public expenditure. For emerging markets with higher scores in the readiness index such as Chile these returns would be much smaller.

Looking at the composition of these returns, Figures 9 and 10 gives us a story that aligns very well with the arguments used in earlier in the paper. From these figures, we can observe that the output gains obtained by the most unprepared nations come mainly from public investment. We believe that such effect proxies the impact building resilience through public infrastructure has.

In this case while Honduras would obtain relatively modest returns in the long run from increases in public consumption (around 1.4 dollars in output per dollar spent), those returns are much larger when the government invests in infrastructure (2.5 dollars in output per dollar spent).

Combining the two previous dimensions of readiness and vulnerability through the GAIN index substantially strengthens our previous results. Figure 11 shows that for countries with low GAIN scores such as Haiti, Honduras or Guatemala, they could obtain relatively large returns from public expenditure (up to 1.5 dollars in Output for each dollar spent). Meanwhile, high achievers (most industrialized economies) would get essentially very low and close to zero returns for their extra public expenditure.

Looking at the composition, again we observe that public infrastructure delivers the larger bang for buck in countries with low GAIN scores with returns of up to 2.5 dollars in output per dollar spent.

CONCLUSIONS

This paper has explored the role of public investment to build resilience against the negative effects of climate change. Using a local projections model, our empirical strategy we find that, unfortunately, the countries that are the most vulnerable are the ones that prepare the least for the consequences of climate change. Moreover, during the last 20 years, our data shows that these vulnerable communities are the ones that have spent the least amount of resources to build resilience through the accumulation of private and public capital and specially through the (re)building of effective and "green" infrastructures. These perverse policies probably do not stem from a lack of optimal strategies but, instead, to resource constraints these countries experience. Unsurprisingly, the most vulnerable communities are those with the lowest income per capita and thus are also those with the least resources to build resilience. Nevertheless, in this paper we have shown that an emphasis on building resilience in this communities could help them loosen their resource constraint problems in the long-run by promoting and protecting future economic growth. Additionally, we have also shown that in the most vulnerable and least prepared economies, a one-dollar investment in public infrastructure could generate up to 2.5 dollars in aggregate output after 4 years.

While the large returns of building resilience can lessen financing constraints, the sheer cost of all the infrastructure needed and the current resource and financing constraints suffered by the most vulnerable communities calls for a sustained and coordinated effort on behalf of major development partners, country governments, and the private sector. In these cases, the financing and knowledge transfers in the form of smart engineering, careful land-use planning, and strategic investments in resilience provided by multilateral partner institutions like the IADB and the World Bank, would play a critical role in giving these communities a better chance to adapt to the large and unavoidable changes brought by climate change.

REFERENCES

-Dabla-Norris, Era, Brumby, Jim, Kyobe, Annette, Mills, Zac and Papageorgiou, Chris (2010) "Investing in public investment: an index of public investment efficiency," IMF working paper 11/37, International monetary fund

-Lamartina, S. and Zaghini, A. (2011), "Increasing Public Expenditure: Wagner's Law in OECD Countrie". German Economic Review, 12: 149–164.

-Puig, J. 2014. "Multiplicador del Gasto Público en Argentina." Económica 60: 188–210.

-Puig, J. and G. Vuletin. 2016. Forthcoming. "Capital versus Current Spending Multiplier: Evidence from Argentinean Provinces." Universidad Nacional de La Plata and Inter-American Development Bank, Washington, DC.

-Riera-Crichton, D., C. Vegh, and G. Vuletin. 2015. "Procyclical and Countercyclical Fiscal multipliers: Evidence from OECD countries." *Journal of International Money and Finance* 52: 15–31.

-Izquierdo, A., D. Riera-Crichton, and G. Vuletin. 2016. Forthcoming. "Government Consumption versus Government Investment Multiplier." Inter-American Development Bank, Washington, DC.

- Izquierdo, A. and Ernesto Talvi, 2008, "All that glitters may not be gold: assessing Latin America's recent macroeconomic performance". IADB Macroeconomic Report 2008.

-Auerbach, A. and Y. Gorodnichenko. 2012. "Fiscal Multipliers in Recession and Expansion," NBER Working Paper No. 17447.

-Gonzalez-Garcia, J., A. Lemus, and M. Mrkaic. 2013. "Fiscal Multipliers in the ECCU." International Monetary Fund WP/13/117.

-Guy, K. and A. Belgrave. 2012. "Fiscal Multiplier in Microstates: Evidence from the Caribbean." International Advances in Economic Research 18: 74–86.

-Ardanaz, M. and A. Izquierdo. 2016. Forthcoming. "Public Expenditure in Latin America: Pro-cyclicality in good times only for consumption but in bad times only for investment?" Inter-American Development Bank, Washington, DC.

-A. Izquierdo. 2016. Forthcoming. Chapter 7 on public saving, Development in the Americas 2016 report on Saving in Latin America.

-Vegh, C. and G. Vuletin. 2014. "The Road to Redemption: Policy Response to Crises in Latin America." *IMF Economic Review*, 62: 526–568.

-Frankel, J., C. Vegh, and G. Vuletin. 2013. “On Graduation from Procyclicality.” *Journal of Development Economics* 100: 32–47.

-Céspedes, L.F. and A. Velasco. 2012. “Macroeconomic Performance During Commodity Price Booms and Busts,” IMF Economic Review , Volume 60: 570–599.

-Céspedes, L.F. and A. Velasco. 2014. “Was this Time Different?: Fiscal Policy in Commodity Republics," Journal of Development Economics , Volume 106 (Issue C): 92–106.

-Frankel, J. 2011. “A Solution to Fiscal Procyclicality: the Structural Budget Institutions Pioneered by Chile,” Journal Economía Chilena (The Chilean Economy), Central Bank of Chile, 14(2): 39-78, August.

-Velasco, A. 2000. “Debts and Deficits with Fragmented Fiscal Policymaking.” Journal of Public Economics, Volume 76 (1): 105-125.

-Velasco, A. 2007. “Fiscal Policy and the Reaction to Shocks: Some Theory and the Experience of Chile.” Presidential address at the LACEA Conference. 2007.

- Qureshi, Zia (2017),” Could infrastructure investment help tackle climate change?”, The World Bank

- Wilkins, Michael (2018), “Fighting climate change with green infrastructure” Infrastructure & Public-Private Partnerships Blog, World Bank Group

- Ijjasz-Vasque, Ede (2017), “Engineering our way out of disasters – the promise of resilient infrastructure” Sustainable Cities Blog. World Bank Group

Table 1: Summary Statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Readiness Index	3,620	0.43	0.17	0.09	0.9
Vulnerability Index	3,540	0.45	0.12	0.2	0.69
GAIN Index	3,540	49.28	13.63	24.45	81.87
Private Capital Stock per Capita	5,166	22652.22	28853.55	243.93	237207.1
Public Capital Stock per Capita	5,166	11615.19	16862.15	22.7	196580.5
Total Capital Stock per Capita	5,166	34267.41	43167.54	403.57	433283.5
Population (Mill)	5,613	33.08	127.05	0.01	1367.82
Overall Institutional Quality	1,339	4.03	0.86	2.06	6.19
Public Institutional Quality	1,339	3.57	0.87	1.43	6.1
Infrastructure Quality Index	1,339	4.24	1.18	1.57	6.76
Real GDP	6,030	50581.1	384732.9	0.03	8568116
Real Government Expenditure	4,560	6513.84	48685.69	0.01	1066263
Real Government Investment	4,598	2225.76	16067.16	0.003	282664.3

Table 2: Sample of Countries

Afghanistan	Congo, Republic of	Indonesia	Montenegro, Rep. of	South Africa
Albania	Costa Rica	Iran	Morocco	South Sudan
Algeria	Cote d'Ivoire	Iraq	Mozambique	Spain
Angola	Croatia	Ireland	Myanmar	Sri Lanka
Antigua and Barbuda	Cyprus	Israel	Namibia	St. Kitts and Nevis
Argentina	Czech Republic	Italy	Nepal	St. Lucia
Armenia	Denmark	Jamaica	Netherlands	St. Vincent & the Grenadines
Australia	Djibouti	Japan	New Zealand	Sudan
Austria	Dominica	Jordan	Nicaragua	Suriname
Azerbaijan	Dominican Republic	Kazakhstan	Niger	Swaziland
Bahamas, The	Ecuador	Kenya	Nigeria	Sweden
Bahrain	Egypt	Kiribati	Norway	Switzerland
Bangladesh	El Salvador	Korea	Oman	Syria
Barbados	Equatorial Guinea	Kosovo	Pakistan	Taiwan
Belarus	Eritrea	Kuwait	Palau	Tajikistan
Belgium	Estonia	Kyrgyz Republic	Panama	Tanzania
Belize	Ethiopia	Lao P.D.R.	Papua New Guinea	Thailand
Benin	Euro area	Latvia	Paraguay	Timor-Leste
Bhutan	Fiji	Lebanon	Peru	Togo
Bolivia	Finland	Lesotho	Philippines	Tonga
Bosnia & Herzegovina	France	Liberia	Poland	Trinidad and Tobago
Botswana	Gabon	Libya	Portugal	Tunisia
Brazil	Gambia, The	Lithuania	Qatar	Turkey
Brunei Darussalam	Georgia	Luxembourg	Romania	Turkmenistan
Bulgaria	Germany	Macedonia, FYR	Russia	Tuvalu
Burkina Faso	Ghana	Madagascar	Rwanda	Uganda
Burundi	Greece	Malawi	Samoa	Ukraine
Cabo Verde	Grenada	Malaysia	San Marino	United Arab Emirates
Cambodia	Guatemala	Maldives	Sao Tomas & Principe	United Kingdom
Cameroon	Guinea	Mali	Saudi Arabia	United States
Canada	Guinea-Bissau	Malta	Senegal	Uruguay
Central African Republic	Guyana	Marshall Islands	Serbia	Uzbekistan
Chad	Haiti	Mauritania	Seychelles	Vanuatu
Chile	Honduras	Mauritius	Sierra Leone	Venezuela
China	Hong Kong SAR	Mexico	Singapore	Vietnam
Colombia	Hungary	Micronesia	Slovak Republic	Yemen
Comoros	Iceland	Moldova	Slovenia	Zambia
Congo, Dem Rep	India	Mongolia	Solomon Islands	Zimbabwe

Figure 1: Correlation Between the Vulnerability and Readiness Indexes (1995 vs 2014)

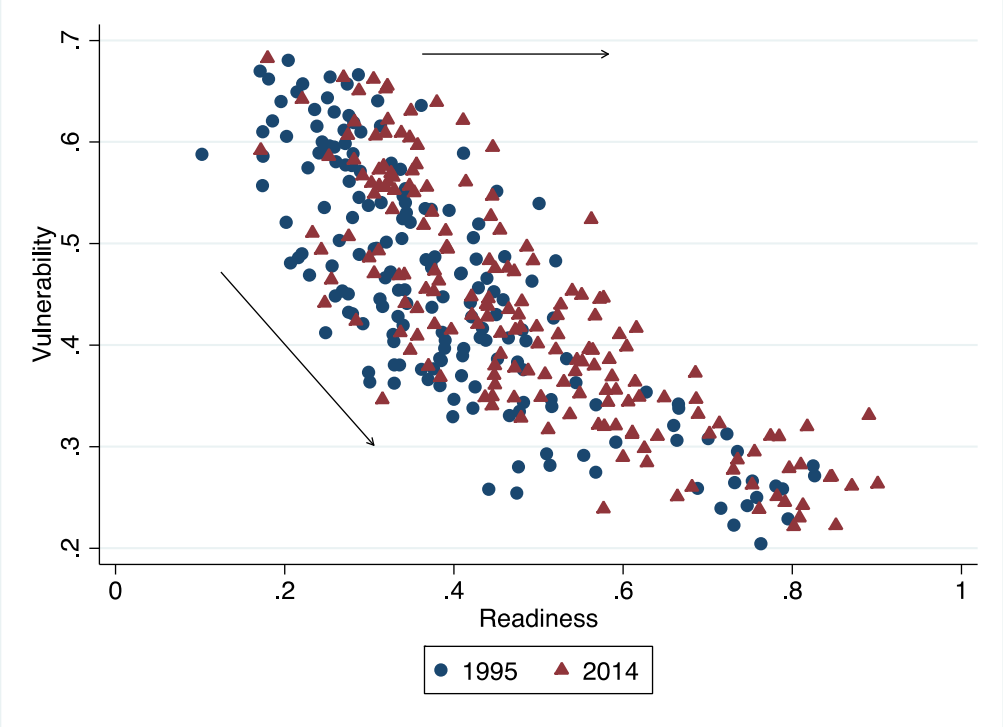

Figure 2A: Evolution of the GAIN Index over time by income level

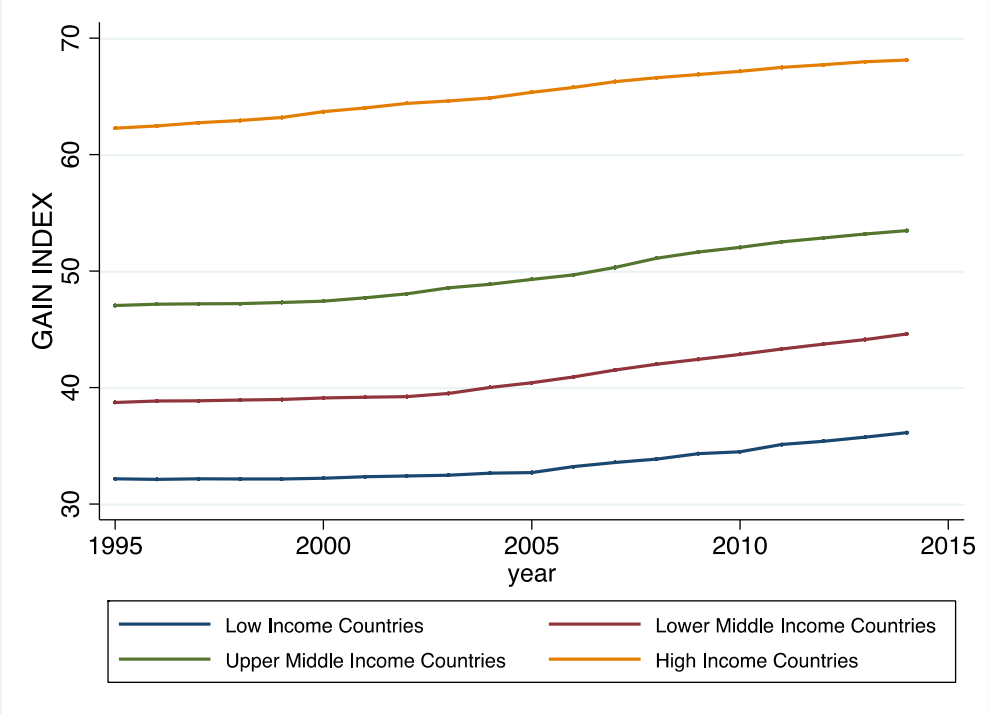

Figure 2B: Decomposition of the evolution of the GAIN Index over time by income level

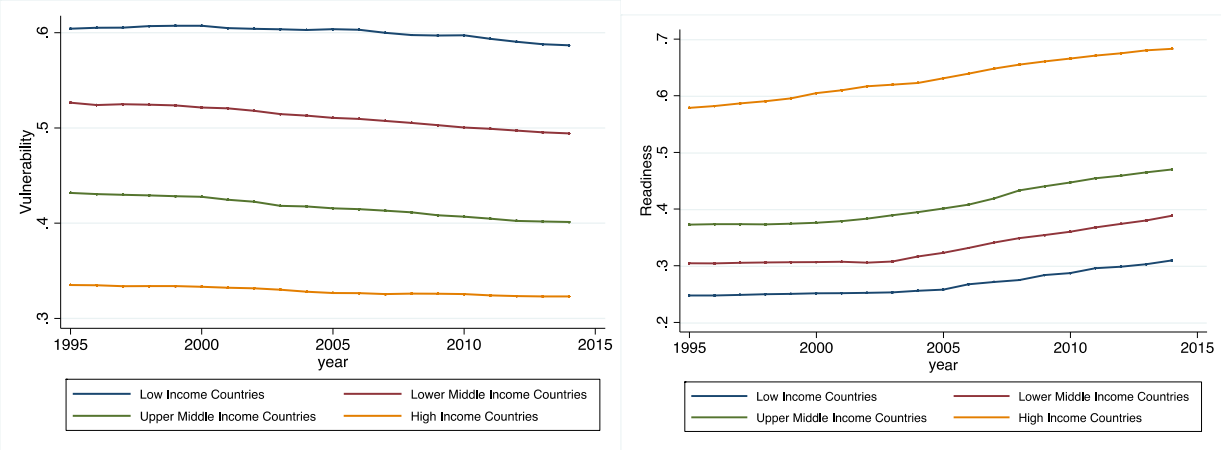

Figure 2C: Evolution of the GAIN Index over time by Region

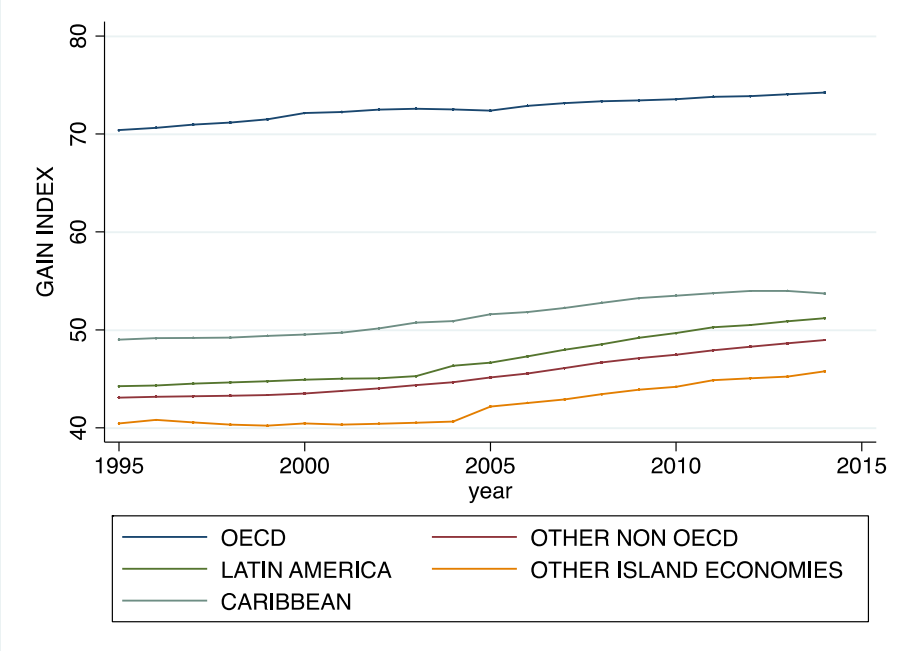

Figure 2D: Decomposition of the evolution of the GAIN Index over time by Region

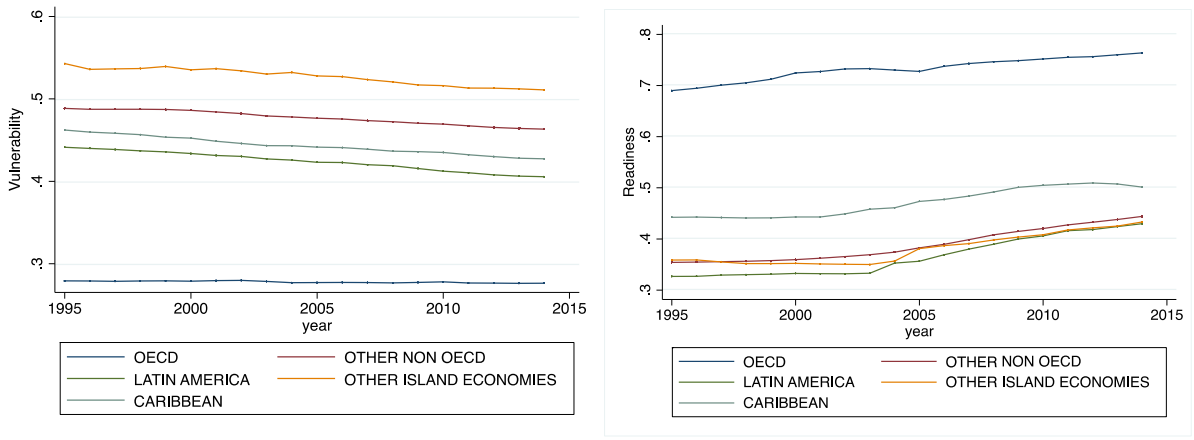

Figure 3: Wagner's Law. Relationship between Income and the Size of Public Sector. 2014

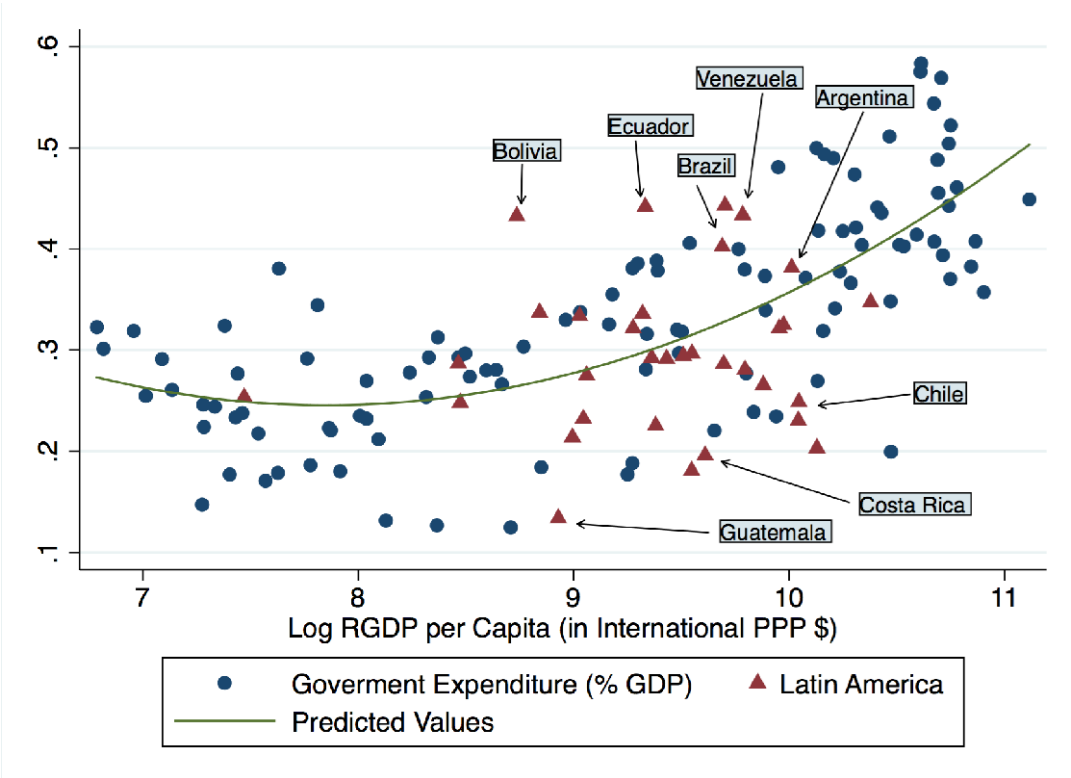

Figure 4: Real GDP Growth in the last 2 decades by region

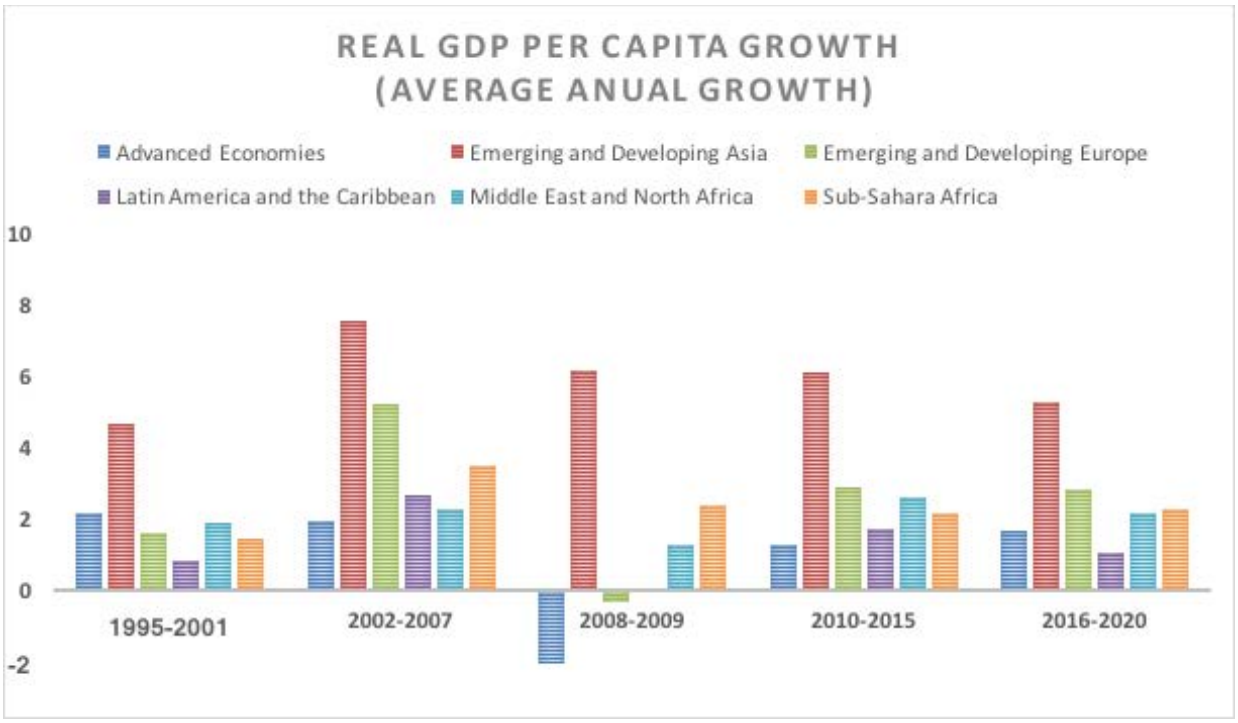

Figure 5: Primary Expenditures by Region

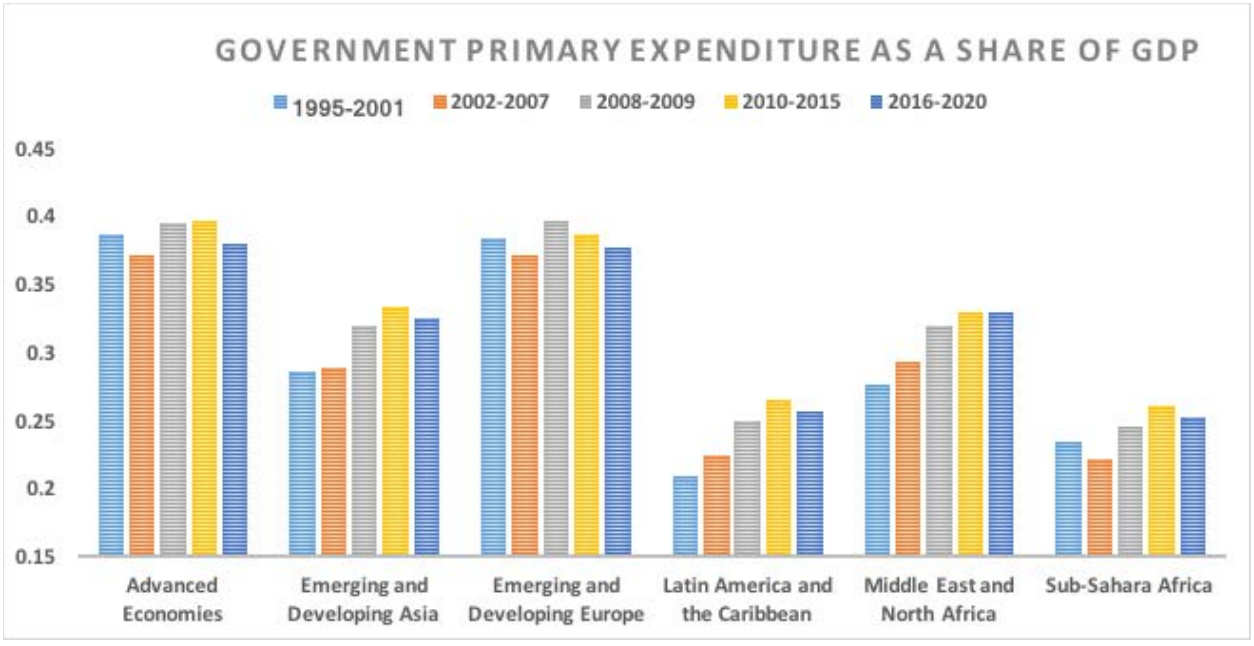

Figure 6: Correlation between Vulnerability and the Change in the Capital Stocks

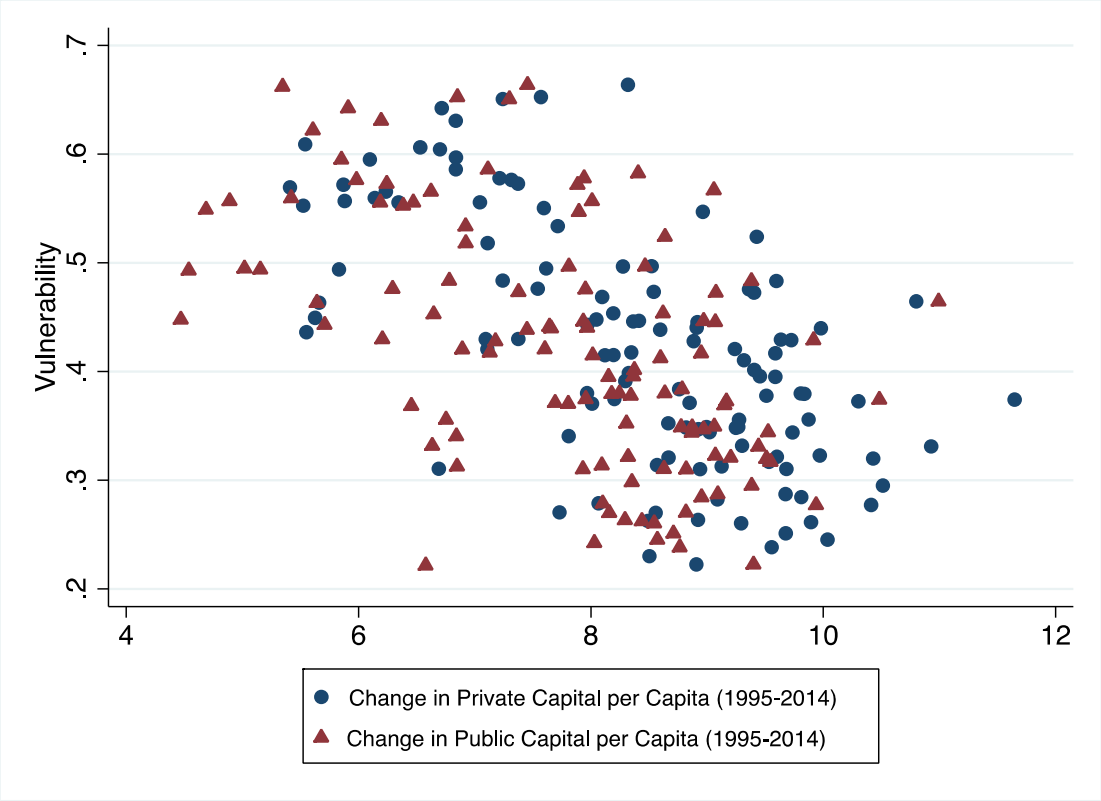

FIGURE 7: Fiscal Multiplier. Total Primary Government Expenditure. Low vs High VULNERABILITY Index

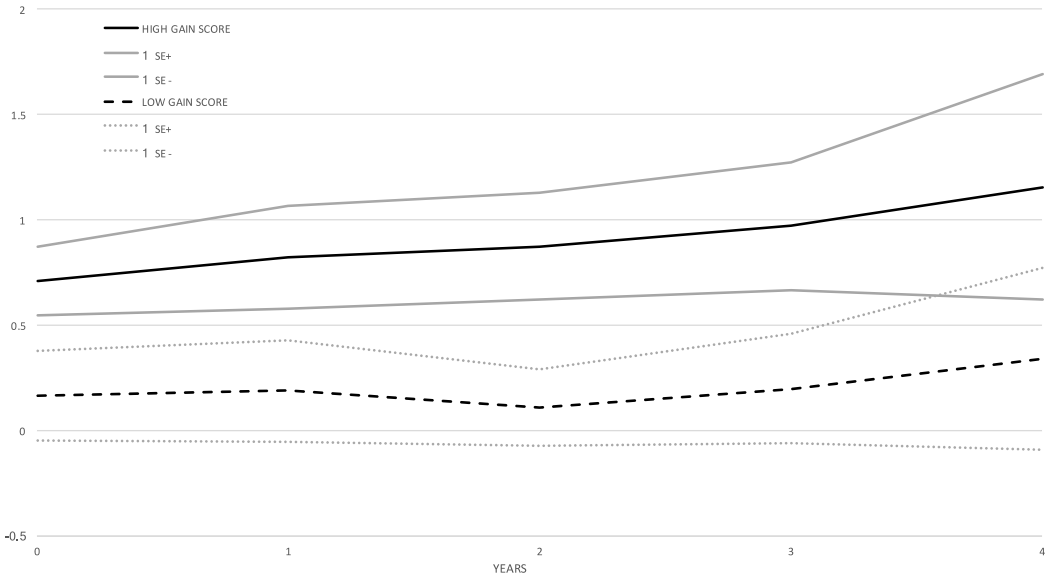

FIGURE 8: Fiscal Multiplier. Total Primary Government Expenditure. Low vs High READINESS Index

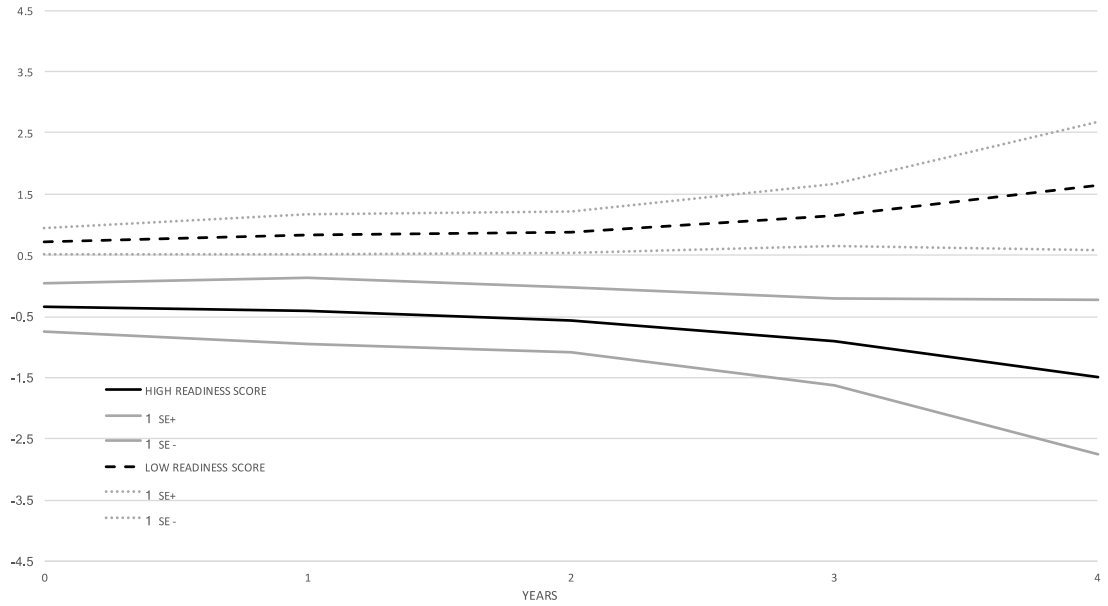

FIGURE 9: Fiscal Multiplier. Consumption Government Expenditure. Low vs High READINESS Index

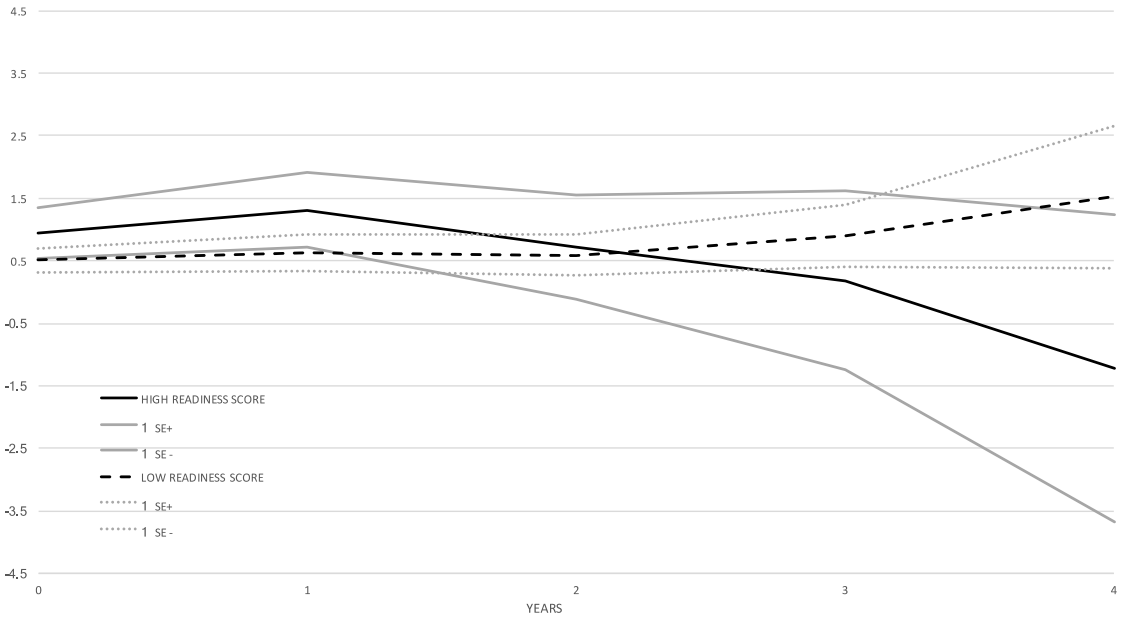

FIGURE 10: Fiscal Multiplier. Investment Government Expenditure. Low vs High READINESS Index

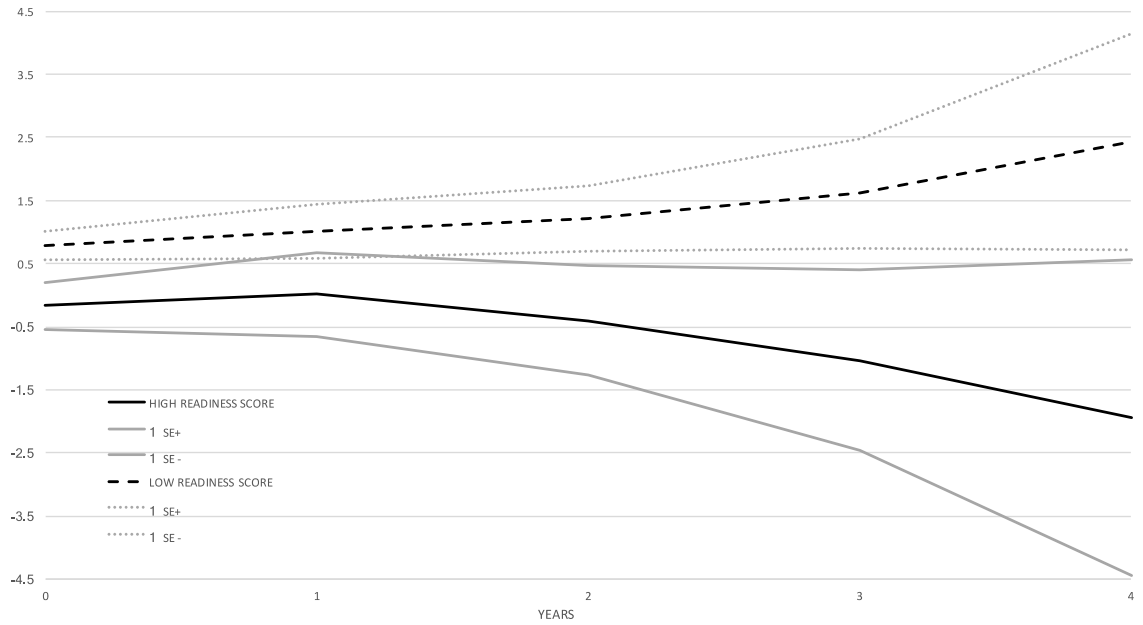

FIGURE 11: Fiscal Multiplier. Total Primary Government Expenditure. Low vs High GAIN Index

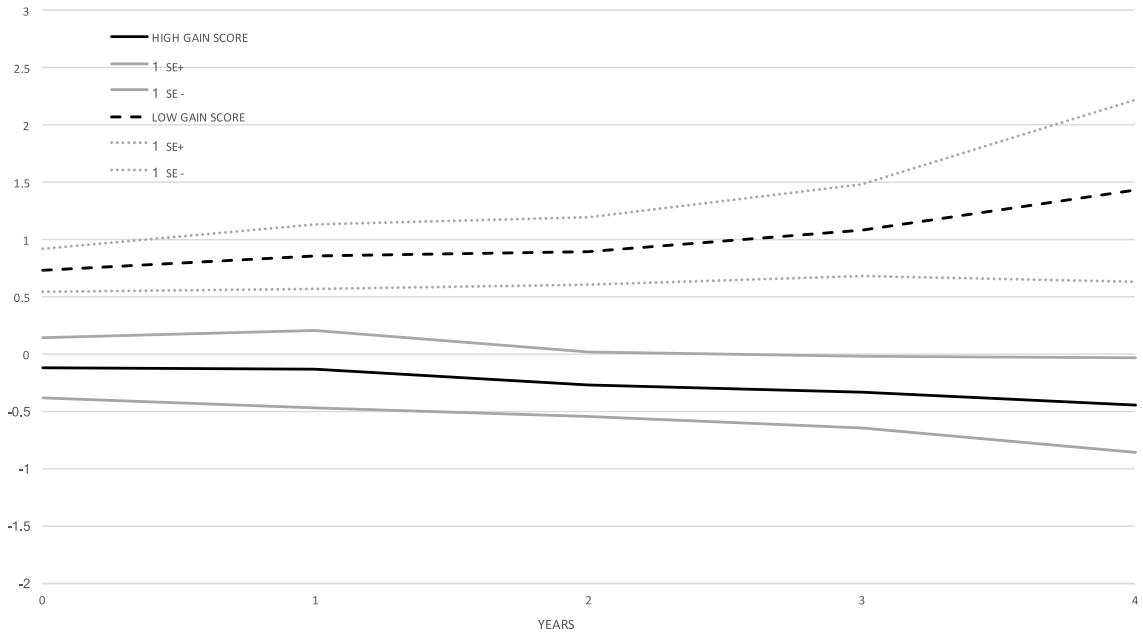

FIGURE 12: Fiscal Multiplier. Consumption Government Expenditure. Low vs High GAIN Index

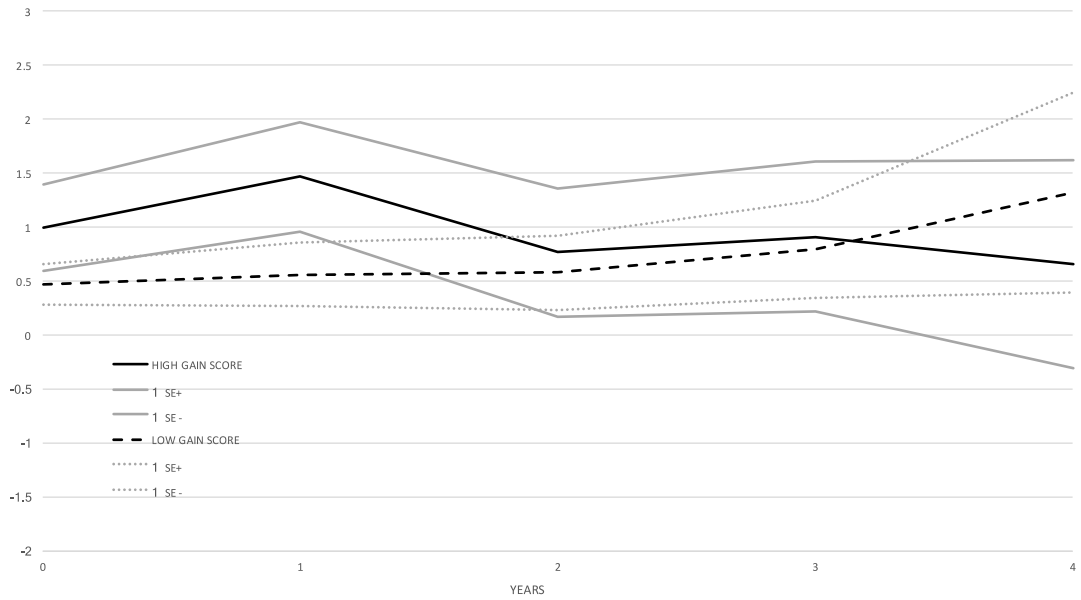

FIGURE 13: Fiscal Multiplier. Government Investment Expenditure. Low vs High GAIN Index