Summer 8-13-2020

Does Debt Matter? Empirical Analysis of Sovereign Debt Default

Juan Pablo Espinosa

Does Debt Matter? Empirical Analysis of Sovereign Debt Default*

Abstract

Sovereign debt default can have significant economic, social, and reputational costs. For this reason, policy makers across the globe are constantly trying to balance fiscal policy and economic growth. Many of them, however, are still unable to do so and fall into sovereign debt default. This research paper looks at 52 sample countries from 1980 to 2018 and examines whether sovereign debt default can be explained by the gap between GDP growth and interest rates and/or debt-to-GDP levels. Through a series of empirical analysis, I find that if GDP growth is higher than interest rates, risk of default is typically reduced in sample countries. Moreover, I also find that increases in debt to GDP are positively correlated to risk of default.

Keywords

Debt to GDP

Debt threshold

Default

Debt rollover

Sovereign debt crises

JEL Classification:

G01

H63

G15

*Juan Pablo Espinosa, DBA Candidate, Olin Business School- Washington University St. Louis.

I thank the valuable comments, feedback, and guidance from faculty, specially from Prof. Manela, and Prof. Thakor as well as peers like Jorge Sabat.

1 Introduction

Public debt has become a topic of increased interest among policy makers, particularly as its levels continue to raise across the world. There is a widespread notion that governments debt levels are too high and should be urgently decreased (Blanchard; 2018). In the U.S., for instance, the ratio of Debt to GDP has increased from 93% in 1995 to 136% in 2015[1]. Similarly, in many emerging markets, public debt has accumulated to levels last seen during the 1980s debt crisis. Research suggests that emerging and developing economies, unlike developed markets, have less debt tolerance and can have decreased growth output as levels of debt to GDP increase (Reinhardt and Rogoff; 2011). Most recently, given the COVID-19 pandemic, many governments have accelerated their debt-to-GDP ratios with the goal of injecting liquidity to their economies and minimizing the effects of their economic shutdowns. For example, the U.S. increased government debt by $2.4[2] Trillion during the COVID-19 pandemic to alleviate the economic costs to businesses and individuals through "The Cares Act"[3]. At the same time, the Fed lowered interest rates in March 2020 to near zero percent in an effort to provide liquidity to the economy and minimize effects of the coronavirus disruption.[4] Meanwhile, for many emerging and developing countries who were already experiencing high levels of debt-to GDP ratios, fiscal deficits and low economic growth, the COVID-19 pandemic has magnified an already unsustainable debt and interest rate trajectory. As a result, 66 countries have received ~$23 Billion in Emergency Financing from the IMF[5] in the past 2-3 months.

High debt levels, however, are not necessarily an issue when real interest rates are low and funds are invested in public goods and productive capacity. To this effect, theoretical research suggests that countries that have a higher GDP growth vs. interest rates (hereafter growth to interest rate

[1] OECD Data: https://data.oecd.org/gga/general-government-debt.htm
[2] About 10% of total US GDP for 2019.
[3] Cares Act Info: https://home.treasury.gov/policy-issues/cares
[4] The Fed announced 1% point interest rate cut in Mid-march 2020. See figure 1 in Appendix for effect of GDP declined growth and interest rates.
[5] IMF's Financing and Debt Relief program has the goal to alleviate the effects of coronavirus in less developed economies. https://www.imf.org/en/Topics/imf-and-covid19/COVID-Lending-Tracker

gap"[6]), should be able to rollover their debt, meaning that the issuance of new debt might not need a later increase in taxes (Blanchard, 2018), allowing countries to reduce their debt to GDP ratios and the risk of default. In essence, countries like the US, Japan, Great Britain and other advanced economies can continue issuing debt at a zero fiscal cost because, for the most part, they have a positive "growth to interest rate gap". Under this premise, economists like Blanchard have even proposed lifting current debt-to-GDP caps in the EU, where the cost of borrowing is low and debt can be rolled over without tax increases.

On the other hand, in less developed economies, where rates are high and GDP growth is weak, high levels of debt can lead to increased borrowing costs and higher debt to GDP ratios, thereby increasing the probability of default. Most recently, in 2018, Barbados defaulted on its sovereign debt when its debt-to-GDP ratio reached 160%[7]. Soon after this default, the IMF Executive Board approved a four-year extended arrangement under the Extended Fund Facility (EFF) to support Barbados' stabilization program. Although, this agreement has helped Barbados improve their S&P credit rating from SD[8] to B-, their GDP declined 0.1% in 2019 as their economy continues to struggle.[9] Ultimately, the costs resulting from a debt crisis can be long, persistent, and hard to overcome. In my sample countries, for instance, it was found that defaulting countries stayed in default[10] for an average of 8 years[11] and in various instances a sovereign debt default was followed by a banking crises. Although this paper does not empirically analyze banking crises, it is important to understand the feedback loop that exists between a sovereign debt default and banking crises. (Reinhardt & Rogoff; 2011). Once a banking crisis explodes, this can have several negative consequences to an economy through credit shrinking and social unrest.[12] Moreover, Thakor suggests that there is a correlation between high leverage financial institutions and consumer leverage which increases fragilities of the financial system (Goel, Song and Thakor; 2013). These

[6] Gap is defined as GDP growth- Interest rates.
[7] Barbados IMF Country Report 2019.
[8] SD is defined as selective default by S&P 500. A country in SD does not get a rating.
[9] IMF database https://www.imf.org/en/Countries/BRB
[10] Default defined by Reinhardt's database, which means countries stay in default for local and/or foreign markets.
[11] Full list of defaults per country in Figure 1
[12] Most recently Lebanon's sovereign default has also caused a banking crises with significant social unrest. https://www.theguardian.com/world/2020/mar/07/lebanon-to-default-on-debt-for-first-time-amid-financial-crisis

fragilities in an event of sovereign debt default are only magnified given the fact that in many cases local banks are holders of public debt. For example, during the early 2010s European debt crises, reports of debt sustainability by some European countries (e.g. Greece, Spain, Portugal) caused financial turmoil to European banks exposed with debt from these nations (Gennaioli, Martinim Rossi; 2014). Most recently, Lebanon defaulted on their sovereign debt in early 2020 (pre-COVID), and it has caused banks to set limits to cash withdrawal[13] and shrink credit. The case of Lebanon is consistent with Sosa-Padilla's (2012) argument that "When these bankers are highly exposed to government debt a default triggers a banking crisis which leads to a corporate credit collapse and consequently to an output decline"

From an empirical standpoint, significant research has been done around levels of debt to GDP and its effects on economic growth. For instance, when debt to GDP reaches 90%, countries start experiencing a 1% decline in economic growth (Reinhart et al; 2010). Similarly, countries that experience persistent increases of Debt to GDP have lower output growth resulting from a "crowding out effect" and a "loss of confidence". Additionally, the more the government spends, the less the private sector does and as levels of debt to GDP increase, investors demand higher premiums, which can make debt self-fulfilling (Chudik et al; 2018). Significant research has also been done in the area of debt restructuring and its effects in economic growth and sovereign reputation (Forni et al; 2017). This paper contributes to existing research and literature by helping improve our understanding of historical default and our ability to predict probability of default by empirically testing the impact of "nominal GDP growth - nominal interest rate gap" as well as "debt to GDP" ratios. Like Blanchard, I use nominal GDP and interest rates in my sample countries in order to take into account inflation, given the fact, that most debt instruments as well as government taxes are calculated in nominal rates[14].. For these reasons, in order to more accurately measure the dynamics of "debt rollover"[15] I made both variables nominal in my calculations[16] . As previously stated, this paper tests Blanchard's as well as Reinhardt & Rogoff's arguments, not only by analyzing actual historical defaults but also probability of default per S&P ratings across

[13] https://internationalbanker.com/finance/what-is-behind-lebanons-deepening-financial-crisis/
[14] Only 15% of all US debt is issued in TIPS (Treasury Inflation Protected Securities). Tax systems calculate taxes in nominal terms: https://www.economics.utoronto.ca/jfloyd/modules/uinf.html
[15] Debt rollover is defined as the ability of a government to reduce debt ratios over time. In principle if nominal GDP growth is higher than nominal interest rates, debt should rollover time.
[16] Inflation was added to GDP real growth rates. Money market interest rates already include inflation.

a sample group of advanced, emerging and Latin American economies. Ultimately, this paper seeks to better understand what makes emerging and Latin American (hereafter Latam) countries more susceptible to a default than advanced economies? How did these economies behave the year of default or five years before a default? Can emerging and Latam countries also benefit from positive "GDP growth to interest rate gap"? How does the "GDP growth to interest rate gap" compare vs. increases in Debt to GDP at a regional level?

In an attempt to answer the above questions, this paper starts by analyzing existing theory around debt and the factors that may contribute to a default event, including high debt to GDP ratios and/or a negative "GDP growth to interest rate" gap (Section 2). Section 3 of this paper includes a description of data and summary statistics, Section 4 covers my empirical results, and Section 5 concludes this paper.

2 Theory and Literature Review

As previously stated, significant research has been done around the topic of debt and economic growth as well episodes of sovereign debt default. Most recently, significant attention has been placed in advanced economies where levels of debt to GDP have consistently been rising since the 2008 crises. This paper analyses two different theories around debt – those who argue that debt doesn't matter for countries where the cost of borrowing is low and debt can be rollover and those who argue that debt matters because it can hinder economic growth.

In his paper "Public Debt and Low Interest Rates," Oliver Blanchard argues that as long as the interest rate remains lower than the growth rate, the ratio of debt to GDP decreases overtime and higher debt may not result in a fiscal cost or higher taxes (Blanchard, 2018). Blanchard attempts to prove his argument not only through theory, but also by looking at historical data on interest rates and GDP growth rates in the U.S. where, he claims, a positive GDP growth gap ($g > r$) has been the standard rather than the exception.

A similar theory about debt rollover was proposed by Michael Woodford in 1990. Woodford claims that an increase in public debt can be rolled over forever without taxes ever having to be increased.

This paper suggests that debt rollover could be a realistic possibility in countries like the U.S., where the real rate of return on Treasury bills over the postwar period has been close to zero, while the average real GDP growth rate has been consistently over 3% per year (Woodford;1990).

Similarly, Summers (2019) also points out that given the low interest rates in advanced economies, politicians and policy makers should focus more on worthwhile investments in healthcare, education, and infrastructure rather than cutting deficits. His research claims that even though the current national debt of the U.S. represents a far larger percentage of GDP than in recent decades, the U.S. government currently pays around the same proportion of GDP in interest on its debt, adjusted for inflation, as it has on average since World War II.

Meanwhile, in their paper, 'A self-fulfilling model of Mexico's 1994–1995 debt crisis', Cole and Kehoe's prove that debt rollover is not always possible in countries like Mexico where $g > r$ is not the norm. In their paper, they explain how the Bank of Mexico found it difficult to rollover Mexico's government debt in the weekly bond auctions during December 1994 and January 1995 and explore the extent to which this phenomenon can be explained using their model of self-fulfilling debt crises. In other words, investors feared that Mexico would be unable to honor its commitments on bonds, which made them unwilling to purchase new bonds. Unable to sell new bonds or restructure debt, Mexico was forced into a position of default (Cole and Kehoe 1995)[17]. To this effect, Cole's and Kehor's paper relates to the theory of "multiple equilibria", which holds that if investors believe debt to be safe, then they will hold it at a safe rate. In this case, the fiscal cost of debt may be zero (like in the U.S.) but if investors believe that debt is risky and ask for a risk premium, debt payments will be larger, debt will indeed be riskier, and investors' expectations may be self-fulfilling (Blanchard; 2018).

Budget constrained[18] policy makers usually face a tradeoff analysis between sovereign debt default or austerity plans. Austerity plans helps governments funnel revenue to debt repayments, however the social and economic costs of austerity can also incentivize countries to default, therefore fiscal forward guidance can help nations reduce cost of debt while decreasing expenses and increasing revenue in the medium term (Bianchi et al; 2019). In this sense, similarly to corporate budgeting,

[17] Cole and Kehoe 604 citations Journal of International Economics
[18] Defined as governments with little room for counter cyclical fiscal policy.

policy makers should invest in projects with positive NPV and/or IRR. For example, if cost of debt for emerging markets is between 6% to 8%, policy makers should aim to invest in projects with IRR> 8%. One mechanism that can help policy makers achieve debt sustainability is by issuing "growth index bonds" (Blanchard; 2016). With this type of bond instrument, emerging markets in particular, could lower costs of debt in recession cycles and increase interest rate to investor during boom cycles.

Reinhart and Ragoff 's (2010) argue that debt thresholds matter because countries with a debt to GDP ratio higher than 90% experience roughly 1% lower GDP growth rates, which in turn can increase risk of default by increasing debt servicing costs and lower fiscal revenue. Lastly, according to Reinhart, the relationship between public debt and economic growth is remarkably similar across emerging markets and advanced economies.

Although there is substantial research on the dynamics of debt- to- GDP and GDP growth to interest rates (debt rollover), most papers are focused on advanced economies and none of them combine both theories when trying to understand sovereign debt default. In an effort to contribute to existing theories/research on the topic of debt, this research paper empirically tests both – whether a positive "GDP growth to interest rate gap" reduces the risk of default and whether a higher debt to GDP ratio indeed increases probability of default by hindering economic growth. Lastly, instead of focusing on one or two countries as case studies, this paper looks at a sample of 52 countries to determine if the above theories apply across the board, thereby helping explain historical defaults and probability of default per S&P ratings.

3 Data and Research Method

This paper looks at data from 1980 to 2018 for 52 sample countries, which are broken down into three groups: (1) Advanced economies[19], (2) Emerging countries, and (3) Latam countries only. During this timeframe, seventeen nations within the sample experienced at least one default event and 58%[20] of those occurred in the Latin American region. Seven nations in the emerging market group experienced at least one event of default, while none of the advanced economies experienced

[19] Defined per IMF classification of advanced economies.
[20] Please see Figure XX for count of countries with >1 default.

a default during this time frame. Historical defaults were pulled from Carmen's Reinhart data-website and confirmed in Harvard's "Global Crises Data" database. Probability of defaults are extrapolated from Standard & Poor´s Foreign Currency Long-Term Ratings, and the Sovereign Cumulative Average Default Rate (1975 - 2017) obtained from the 2018 Annual Sovereign Default Study and Rating Transitions published by S&P Global. GDP growth, inflation and interest rates (money market rates) are obtained from standard sources provided by Thomson Reuters Eikon, and Debt-to-GDP ratios are obtained from the historical World Economic Outlook reports.

In order to test the two main theories around debt mentioned in the literature review section, I set up two main hypotheses:

Hypothesis 1 (H1): Does a positive "GDP growth to interest rate gap" reduce risk of default through debt rollover?
Hypothesis 2 (H2): Does debt to GDP increase probability of default by hindering economic growth?

To test these hypotheses, I took two different approaches. In the first approach, I used actual defaults[21] and ran lagged variable regressions at year of default all the way up until 5 years before a historical default. To accomplish this, a dummy variable indicating the presence ("1") or absence ("0") of a default event (domestic or foreign) was used as the dependent variable. This approach helped identify what factors contributed to a default before the actual year of default. From an independent variable perspective, I applied Blanchard's "GDP growth to interest rate gap" formula and added inflation rates to GDP in order to calculate the "gap."[22] Interest rates in nominal rates were obtained from Thomson Reuters Eikon, and although Blanchard uses US government T-Bill interest rates, given that the same data was not available for all of my sample countries, I used money market interest rates in local currency. T-Bills influence money market's interest rates, and therefore can be used as a proxy to measure the "GDP growth to interest rate gap" in these sample countries. My other independent variable is debt- to -GDP ratio.

[21] Actual defaults are defined as the year when a country defaulted.
[22] "GDP growth – Interest rates"

In the second approach, rather than using the actual default event (0 or 1), I used the probability of default per S&P 2018 Annual Sovereign Default and Rating (1975-2018)[23]. and regress it to the same independent variables[24]. In this approach, I grouped my sample countries into three separate groups: Advanced, Emerging and Latam. Once grouped, I calculated the "probability of default" for each group based on their average credit rating[25], which I then regressed against my independent variables in order to determine change (increase or decrease) in probability of default. Please see summary statics section for rating and probability of default per region.

For both approaches, I found that (H1) a 1 percent point positive gap is associated with a decrease in the probability of default and (H2) a 1 percent point increase in debt to GDP ratio increases the probability of default. These results are significant at an aggregate level (all sample countries) as well as by regional and/or grouping[26] breakdown. For example, in Emerging Markets, five years before a default event, a 1percent point positive gap reduces probability of default by -0.00080 percent points. In Latin America the same relationship is observed at 4 years before a default event where a 1 percent point positive gap reduces probability of default by -0.00124 percent points. Although these results are significant at 5% and 10% respectively, the degree of representation is about 20%. In these regards, it is important for policy makers to understand other macroeconomic drivers that can help accelerate a default event such as "% of debt in foreign currency" as well as health of primary balance (Blanchard, 2019). Reinhart and Raggoff (2010) also suggest that the percentage of debt servicing seems to explain default likelihood under various default rates. This paper, however, does not test or investigate % of debt in foreign currency nor debt servicing.

4. Summary Statistics:

Table 1 report summary statistics of Latam, Emerging and Advanced countries including the following variables: Debt to GDP, Interest Rates, Inflation Rate, GDP Growth, # of Historical Defaults , S&P Probability of Default 15 years and ratings. Table 2 lists countries per category and time ranges (min and max) of data collected during analyzed timeframe. In Latin America, the

[23] S&P 2018 Sovereign Ratings. More info here
[24] Please see appendix for variable definition.
[25] See summary statistics per group for average Credit Rating and Probability of Default
[26] There are not "deafult events" in advanced economies during 1988 to 2018. Therefore, approach 1 does not include empirical analysis for "advanced economies".

region with most defaults from my sample we can also notice that it has the highest debt to GDP average, Interest Rates[27] and Inflation rates. In fact, when applying the gap formula GDP nominal – Interest Rates nominal I obtain the following number: 3.13% +135.65% - 397.99% = - 259.21%. This result can be explained by the large standard deviation and/or volatility of this market. For example, when doing the same analysis as above at 75% percentile we obtain the following value: 5.71% + 19.94 – 20.71 = 4.94%. The 4th section of Table 1 ("Defaulters") reports summary statistics of countries that had 1+ defaults. Interestingly debt to GDP at the 50% percentile in Defaulters group is 48% while in Latam and Emerging markets is 42%. This difference suggests that countries that did default, usually have a higher Debt to GDP ratio than those that did not. The ratings, per S&P 500 were collected at a country level and were later grouped based on the mode[28] and the average rating for Latam, Emerging and Advanced countries is at follows: B, BBB and AA. According to these ratings, the median default probability per S&P 500 for LATAM countries in a 15-year period is 30.21%, Emerging 8.51% and Advanced 0.21%.

5. Empirical Results

5.1 Regression Specification

For approach I, I begin testing hypothesis (I) in order to measure "GDP growth to interest rate gap" in historical defaults, data was winsorized in order to minimize effects of outliers. In then add "Debt to GDP" to my panel regression in order to test hypothesis (II) and horse race[29] them against in each other . My dependent variable is historical default at time *t*. In essence, if there was a default in a given year my dependent variable is "1" while "0" is there was no default. I use a lagged regression in this approach in order to get a better understanding the effects of "growth to interest rate gap" and "debt to GDP" before an actual default. I add country fixed effects to my regressions in both approaches in order to control for unobservable[30] variables in sample countries.

[27] See Figure XX for interest rate trend for Latin American Nations
[28] Most common rating for all countries in the region.
[29] Defined as comparing the effect of these variables side by side.
[30] Unobservable variables could be political risk, ease of doing business in country and any other factors that are not captured in my data and that vary between nations.

Please see below regression for approach I:

$$HistoricalDefault_{i,t} = \beta_1(g_{i,t-5} + \pi_{i,t-5} - r_{i,t-5}) + \beta_2\gamma_{i,t-5} + \alpha_i + \delta_t + u_{i,t}$$

It is important to mentioned that during by observation time frames (1980- 2018) there are no historical defaults in advanced economies. Therefore, approach 1 only contains regional breakdown for Emerging and Latam countries.

For approach II I take a slightly different approach with my panel regression. From an independent variable perspective, I use S&P credit rating default probability and my regression looks like this:

$$S\&PprobabilityofDefault_{i,t} = \beta_1(g_{i,t-5} + \pi_{i,t-5} - r_{i,t-5}) + \beta_2\gamma_{i,t-5} + \alpha_i + \delta_t + u_{i,t}$$

For this panel regression in addition to using country fixed effects I also add time fixed effects in order to control changes through time.

5.2 Main Regression Results

Panel A reports lagged explanatory variable results regressed against actual defaults. Here I find that at 5 years before a default a 1 percentage point gap increase, reduces probability of default by -0.00091% and it is significant at 1%. In lagged years 1 and 3 a 1% gap also reduces default risk by -0.00143% and -0.00061% with significance levels at 1% and 10% respectively. For other years, although the coefficients are also negative results are not significant. It is not surprising that a 1% gap during the year of a default ($\hat{I}_{,}$=0) does not reduce risk of default given that given that is the year of actual default. In this regression, I also added debt to GDP as my other independent variable and found that a1 % increases in debt to GDP increases probability of default by 0.00015% at ($\hat{I}_{,}$=5) and it is significant at a 1% level. It is also interesting to notice that in this panel the gap between GDP-interest rates are inversely correlated to debt to GDP. Results in Panel A show consistency with Blanchard's theory in regards of how a positive gap can have an effect in reducing risk of default. This regression also shows interesting results about increases in debt and their effect in risk of default by demonstrating that a 1% increase in debt can also increase

probability of default 5 and 2 years before a default and are significant at 5%. Other results are not significant; however they all share the same coefficient direction, therefore suggesting that both theories can help better explain risk of historical default.

<Insert Panel A here>

Panel B reports results at a regional level between Emerging and Latam countries. Since there are no historical defaults in advanced economies, there are no results for this region in this panel. Emerging markets have a dual impact at year 5 when a 1% gap increase reduces probability of default by 0.0008% while a 1% increase in debt increases default by 0.00015% and both results are significant at 5%. Total debt to GDP is also significant at year 2 , while a positive gap is significant at year 1. For most years, the coefficients of debt to GDP and GDP growth – interest rates are inversely correlated expect of year of default, when they both have a negative coefficient. In Latin America results show that the "growth to interest rate gap" is significant at in years 1 to 3 before a default, while total debt to GDP is significant at 1% in 5 years before a default and a 1% increase in debt to GDP ratio can increase probability of default by 0.00014%.

< Insert Panel B here>

Panel C shows the results with S&P sovereign rates probability of default as the dependent variable. I break down results per region and Columns (1) to (4) are for Latam results, while (5) to (8) Emerging and (9) to (12) Advanced. Results suggest that a 1% increase in Debt to GDP ratio causes an increase in probability of default across all regions and it is significant at 1%. Emerging economies seem to be the most sensitive to a 1 % increase in Debt to GDP since it increases probability of default by 0.12% (See column 8 – Panel C). From a gap perspective, a 1% difference reduces probability of default in all regions, however for advanced economies this coefficient is only significant when adding time fixed effect (column 11). Similarly as the results found in panel B, we can see that emerging markets are more sensitive to Debt to GDP rations than Latam and Advanced. Panel D only looks at "GDP Growth-Interest rates (gap) as the independent variable and Panel E only looks at "Total Debt to GDP". Columns (4), (8) and (12) include country and time fixed effects. Results show the same trend when independent variables are looked individually and significance of results ranges from 1% to 10% in all columns.

In Panel F, I lagged independent variables and broke down countries in two groups: a) Debt to GDP > 90% and b) Debt to GDP < 90%. My goal on doing this is, trying to test the impact of debt

trajectory as well as debt thresholds. Reinhardt and Rogoff argue that at 90% debt output starts to decline, therefore it can be implied that probability of default should increase. These results show that countries with Debt >90% (mostly advanced economies) can benefit from debt rollover, since the gap is significant at 1 % $\hat{I}_{,}$=1 to $\hat{I}_{,}$=4 and 10% at $\hat{I}_{,}$=5. These results confirm Blanchard's argument that the gap is able rollover debt and therefore not increase risk of default. On the other hand debt trajectory and/or debt thresholds play a more important role in countries with Debt < 90% and it is significant at 1%. A 1% gap also reduces probability of default at $\hat{I}_{,}$=5, however it is not significant for the rest of observations.

<Insert Panel F here>

6. Conclusion

This research paper empirically tests both – whether a positive gap "GDP growth to interest rate gap" can influences risk of default and whether a higher debt to GDP ratio increases probability of default by hindering economic growth. To do so, instead of focusing on one or two countries as case studies, I analyze a sample of 52 countries through two different approaches (historical defaults and S&P 500 ratings) in order to determine if the above theories apply across the board. I find that there is a significant positive relationship between a 1% increase in gap and decrease in risk and probability of default. There is also significant relation between debt to GDP and increased probability of default among emerging and Latam countries. Also when grouping countries by debt to GDP thresholds, results demonstrate that countries with high debt to GDP ratio > 90% can experience a debt rollover effect (majority of countries with >90% Debt to GDP are advance economies), consistent with Blanchard's debt rollover theory. On the other hand, nations with Debt to GDP with less < 90% (mostly emerging and Latam markets) can increase risk of default with increases of Debt to GDP. These results are similar to those found by Ragoff and Reinhart in "Debt in Time of Growth" were they demonstrate that emerging markets due to their higher levels of foreign debt have reduced economic growth. My findings can perhaps help us understand why nations like Japan can afford to have a debt to GDP ratio of 237%[31] without generating any concerns about its repayment capacity, therefore keeping cost of borrowing low. For example, the GDP- Interest rates gap for Japan in the past 5 years has average a positive gap of 2.2 percentage

[31] Data is obtained in World Bank data as well as Organization for Economic Cooperation and Development.

points.[32]Meanwhile, you have a less developed nations like Argentina whose debt to GDP ratio is only 86%[33] and their GDP growth -Interest rates gap for the past 5 years (pre-COVID) averaged -9.70%. The COVID-19 situation is amplifying risk of default in developing economies[34] due to negative GDP growth rates, high interest rates among other factors. In this sense, it would not be surprising that in the coming months more emerging and developing nations, similar to the path taken by Argentina, will enter debt restructuring or debt relief programs in order reduce or eliminate short term debt repayments while implementing fiscal forward guidance and/or fiscal austerity plans.

7. References

Angeletos G & Collard C & Dellas H, 2016. "Public Debt as Private Liquidity: Optimal Policy," NBER Working Papers 22794, National Bureau of Economic Research, Inc.

Asonuma T & Chamon M & Erce A & Sasahara S, 2019. "Costs of Sovereign Defaults: Restructuring Strategies, Bank Distress and the Capital Inflow-Credit Channel," IMF Working Papers 19/69, International Monetary Fund.

Blanchard, Oliver 2018,. “Public Debt and Low Interest Rates” ; NBER Working Paper No. 25621

Calvo G, 1988. "Servicing the Public Debt: The Role of Expectations," American Economic Review, American Economic Association, vol. 78(4), pages 647-661, September.

Chudik A & Mohaddes K & Pesaran M & Raissi M, 2015. "Is There a Debt-threshold Effect on Output Growth?," Cambridge Working Papers in Economics 1520, Faculty of Economics, University of Cambridge

Cole H & Kehoe T, 1996. "A self-fulfilling model of Mexico's 1994-95 debt crisis," Staff Report 210, Federal Reserve Bank of Minneapolis.

DeLong B & Summers L, 2012. "Fiscal Policy in a Depressed Economy," Brookings Papers on Economic Activity, Economic Studies Program, The Brookings Institution, vol. 43(1 (Spring), pages 233-297

Diamond P. National debt in a neoclassical growth model. American Economic Review, 55 (5-1); 1126-1150 December 1996

[32] See Figure XX for Japan GDP-interest Rates historical figures.
[33] Argentina is also facing negative GDP growth at-2.8%,
[34] Fitch Latin America Sovereign Ratings May 2020. About 50% of Latam countries in report have been downgraded.

Forni L & Palomba G & Pereira J & Richmond C, 2016. "Sovereign Debt Restructuring and Growth," IMF Working Papers 16/147, International Monetary Fund.

Gennaioli A, Martin A, Rossi S, 2014 " Sovereign Default, Domestic Banks and Financial Institutions", The Journal of Finance VOL LXIX NO.

Goel A, Song F, Thakor A, 2014 "Correlated leverage and its ramifications" Journal of Financial Intermediation, Volume 3, Issue 24

Gluzmann P, Guzman M, Stiglitz J; (2019) An Analysis of Puerto Rico's Debt Relief Needs to Restore Debt Sustainability; NBER Working Paper

International Monetary Fund Western Hemisphere Department, 2019, Country Report No. 19/181 Barbados Default.

Reinhart C. & Rogoff K, 2011. "A Decade of Debt," NBER Working Papers 16827, National Bureau of Economic Research, Inc

Reinhart, C., Ragoff, 2010 Growth in Time of Debt; NBER WORKING PAPER SERIES

Reinhart C & Rogoff K, 2009. "This Time Is Different: Eight Centuries of Financial Folly," Economics Books, Princeton University Press, edition 1, number 8973, March.

Reinhart C & Rogoff K, 2011 "From Financial Crash to Debt Crises" American Academic Review

Savona R & Vezzoli M, 2012. "Fitting and Forecasting Sovereign Defaults Using Multiple Risk Signals," Working Papers 2012_26, Department of Economics, University of Venice "Ca' Foscari".

Sosa-Padilla C 2012 "Sovereign Default and Banking Crises". University of Maryland

Summers L , Rachel L, 2019, "On Falling Neutral Real Rates, Fiscal Policy, and the Risk of Secular Stagnation" Brookings Papers on Economic Activity.

Woodford M 1990,. "Private Debt as Private Liquidity" The American Economic Review, Vol. 80, No. 2

7. Appendix

Appendix A lists all variables examined in this paper, description and data sources

Variable	Description	Source
Debt to DGP (%)	Total Debt vs. GDP in a given country	World Bank
Interest Rate (%)	Money Market Interest rates for deposits. This was the best proxy available for all sample groups as "T-Bill" interest rates.	Thomson Reuters Eikon
Inflation Rate (%)	Inflation rates per country in a yearly basis.	Thomson Reuters Eikon
Real GDP Growth (%)	Real GDP growth per country in a yearly basis.	Thomson Reuters Eikon
Gap (GDP growth - Interest Rates)	Difference between GDP growth nominal-Interest Rates	Calculated by Blanchard's method. Explained in Public Debt and Low Interest Rates
Historical Default	Defined as year in which a country entered in default	Carmen Reinhart's database
Debt threshold	Total amount of Debt to GDP in a given year for a country and/or region.	Reinhart and Ragoff threshold used in "Growth in time of Debt"
S&P 500 probability of default	Sovereign rating per country	Annual Sovereign Default and Rating Transition
Emerging countries	Countries that are emerging but not in Latam	World Bank definition of emerging markets
Latam	Emerging markets from Latam including those that data was mostly available	World Bank definition of emerging markets plus Latam

Table 1: Summary Statistics (1988-2018)

Table 1 reports summary statistics by subgroup samples. All variables are reported annually, and S&P Rating is deter
mode per region/category. There are no defaults in advanced economies during the time frame analyzed. Variables
50% and 75% percentile. Details about variable definitions can be found in Appendix A. Defaulters are countries with 1
my observation.

1.1. LATAM

	N	Mean	SD	p25	p50	p75
GAP	376	-268.16	5370.36	-3.87	1.80	7.61
Total Debt To GDP	389	103.53	476.74	29.80	42.32	61.40
Interest Rate	386	397.99	5536.83	5.60	10.02	20.71
Inflation Rate	380	135.65	698.34	3.98	8.02	19.94
GDP Growth	377	3.13	3.69	1.64	3.71	5.17
Probability Default S&P	300	22.36	17.07	9.45	16.44	30.21
Average Credit Rating			B			

2.2 Emerging

	N	Mean	SD	p25	p50	p75
GAP	934	-105.02	3407.39	-1.36	2.85	6.93
Total Debt To GDP	993	69.17	300.38	27.68	42.47	61.40
Interest Rate	987	162.62	3464.98	4.50	8.17	14.49
Inflation Rate	972	60.69	441.98	3.01	5.82	11.62
GDP Growth	939	4.20	4.09	2.40	4.36	6.49
Probability Default S&P	803	16.64	14.76	8.51	9.45	16.44
Average Credit Rating			BBB			

1.3 Advanced

	N	Mean	SD	p25	p50	p75
GAP	758	0.044	3.199	-1.63	0.26	2.09
Total Debt To GDP	784	63.21	36.80	39.49	57.50	75.7
Interest Rate	769	5.54	4.54	2.18	4.52	8.22
Inflation Rate	782	3.75	5.71	1.44	2.37	4.06
GDP Growth	764	2.30	2.33	1.20	2.34	3.57
Probability Default S&P	743	0.94	2.84	0	0	0.21
Average Credit Rating				A		

1.4 Defaulters

	N	Mean	SD	p25	p50
GAP	416	-265.45	5090.72	-3.90	2.36
Total Debt To GDP	459	92.43	439.68	27.37	39.3
Interest Rate	454	339.48	5106.01	6.23	11.45
Inflation Rate	445	96.10	521.12	4.42	8.44
GDP Growth	418	3.68	3.95	2	4.34
Probability Default S&P	344	22.38	17.39	8.51	16.44

Table 2: This table provides list minimum and maximum years of available data for my sample countries.

LATAM (Min Max)			EMERGING (Min MAX)			Advanced(Min Max)		
Argentina	1980	2018	China	1981	2018	Australia	1980	2016
Bolivia	1988	2018	Czech Republic	1993	2018	Austria	1980	2017
Brazil	1980	2018	Egypt	1988	2018	Belgium	1980	2017
Chile	1980	2018	Greece	2003	2018	Canada	1980	2017
Colombia	1988	2018	Hungary	1991	2018	Denmark	1980	2017
Costa Rica	1997	2018	India	1980	2018	Finland	1980	2017
Ecuador	1994	2018	Indonesia	1980	2018	France	1980	2017
El Salvador	1988	2018	Israel	1995	2018	Germany	1980	2017
Mexico	1980	2018	Korea	1980	2018	Iceland	1980	2017
Nicaragua	1988	2018	Malasya	1980	2018	Ireland	1980	2017
Peru	1988	2018	Pakistan	1988	2018	Italy	1980	2017
Uruguay	1988	2018	Phillipines	1980	2018	Japan	1980	2017
			Poland	1989	2018	Netherlands	1980	2017
			Qatar	1997	2018	New Zeland	1980	2018
			Russia	1990	2018	Norway	1980	2017
			South Africa	1994	2018	Portugal	1996	2018
			Taiwan	1980	2018	Spain	1980	2017
			Thailand	1980	2018	Sweden	1980	2017
			Turkey	1980	2018	Switzerland	1980	2017
						UK	1980	2017
						USA	1980	2017

PANEL A: Approach 1 all Regions

This panel reports results for risk of default (based on historical defaults) for all regions combined with lags of 1 to 5 years. Country fixed effects are included in all lags. Standard errors are reported in parenthesis. * indicates that coefficient is significant at 10% level, ** 5% level and *** at 1% level.

	Î¸=0	Î¸=1	Î¸=2	Î¸=3	Î¸=4	Î¸=5
Gap	-0.00003	-0.00143***	-0.00035	-0.00061*	-0.00028	-0.00091***
	(0.00030)	(0.00043)	(0.00040)	(0.00034)	(0.00041)	(0.00029)
Debt to GDP	0.00000	0.00005***	0.00014***	0.00002	0.00006***	0.00015***
	(0.00001)	(0.00002)	(0.00004)	(0.00001)	(0.00002)	(0.00003)
Observations	1684	1665	1614	1563	1512	1461
R-squared	0.04096	0.05593	0.06357	0.03574	0.03615	0.06776
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

PANEL B: Approach 1 per Region

This panel reports results for risk of default (based on historical defaults) for all regions combined with lags of Î= 0 to Î =5 years. Country fixed effects are included. Standard errors are reported in parenthesis. * indicates that coefficient is significant at 10% level, ** 5% level and *** at 1% level. Advanced economies are not included since there are no defaults for advanced economies between 1980 to 2018.

	Latam						Emerging					
	Î¸=0	Î¸=1	Î¸=2	Î¸=3	Î¸=4	Î¸=5	Î¸=0	Î¸=1	Î¸=2	Î¸=3	Î¸=4	Î¸=5
Gap	-0.00106*	-0.00253***	-0.00103**	-0.00124*	-0.00009	-0.00056**	-0.00011	-0.00148**	-0.00038	-0.00059	-0.00006	-0.00080***
	(0.00048)	(0.00072)	(0.00045)	(0.00058)	(0.00036)	(0.00021)	(0.00037)	(0.00054)	(0.00047)	(0.00047)	(0.00043)	(0.00025)
Debt to GDP	-0.00006***	-0.00007**	0.00009	0.00001	0.00005*	0.00014***	-0.00001	0.00001	0.00012***	0.00002	0.00006***	0.00015***
	(0.00002)	(0.00003)	(0.00006)	(0.00001)	(0.00002)	(0.00004)	(0.00002)	(0.00003)	(0.00004)	(0.00001)	(0.00002)	(0.00003)
Observations	376	376	364	352	340	328	926	926	896	866	836	806
R-squared	0.24820	0.29065	0.29874	0.19013	0.16169	0.20954	0.08607	0.09911	0.10852	0.06602	0.06133	0.09114
CFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Panel C: Approach 2 All Regions

Panel C is probability of default per S&P ratings related to Growth-Interest rates (gap) variables. Subgroups are divided as Latam, Emerging and Advanced. Country and Time Fixed effects are included in columns 4, 8 and 12. Other columns include one or the other fixed effect. **Standard errors are reported in parenthesis. * indicates that coefficient is significant at 10% level, ** 5% level and *** at 1% level.**

	LATAM				Emerging				Advanced			
	1	2	3	4	5	6	7	8	9	10	11	12
GAP	-0.00073***	-0.00150***	-0.00066	-0.00153***	-0.00125***	-0.00153***	-0.00144***	-0.00153***	-0.00167	0.02778	-0.17507**	-0.08084
	(0.00022)	(0.00049)	(0.00042)	(0.0005)	(0.00033)	(0.00049)	(0.0005)	(0.00048)	(0.05138)	(0.03835)	(0.08691)	(0.06548)
Total Debt / GDP	0.20355***	0.11260***	0.19357***	0.08605**	0.17421***	0.13311***	0.17095***	0.12849***	0.02320***	0.02643***	0.01655***	0.01800***
	-0.03725	-0.03765	-0.03895	-0.03785	-0.02003	-0.0309	-0.02048	-0.03196	-0.00436	-0.00488	-0.0037	-0.00481
Observations	288	288	288	288	744	744	744	744	730	730	730	730
R-squared	0.15027	0.67382	0.18815	0.71797	0.13901	0.6635	0.15355	0.67774	0.10153	0.5089	0.20401	0.56249
Time Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Country Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Panel D: Approach 2 per Region

Panel D is probability of default per S&P ratings related to Debt to GDP only. Regional subgroups are divided in Latam, Emerging and Advanced. Country fixed and Time effects are included jointly in columns (4) (8) and (12). Other columns include one or the other fixed effects. Standard errors are reported in parenthesis. * indicates that coefficient is significant at 10% level, ** 5% level and *** at 1% level.

	LATAM				**Emerging**				**Developed**			
	1	2	3	4	5	6	7	8	9	10	11	12
Debt to GDP	0.20208***	0.11091***	0.19324***	0.08652**	0.17485***	0.15335***	0.17265***	0.14870***	0.02256***	0.02619***	0.01707***	0.01933***
	(0.03652)	(0.03676)	(0.03829)	(0.03718)	(0.01964)	(0.03225)	(0.01986)	(0.0333)	(0.00434)	(0.00482)	(0.00396)	(0.00477)
Observations	300	300	300	300	803	803	803	803	743	743	743	743
R-squared	0.14681	0.65722	0.18742	0.70373	0.14234	0.64222	0.15956	0.66011	0.08663	0.55861	0.14699	0.60264
Time Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Country Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

PANEL E: Approach 2

Panel D is probability of default per S&P ratings related to gap only. Regional subgroups are divided in Latam, Emerging and Advanced. Country fixed and Time effects are included jointly in columns (4) (8) and (12). Other columns include one or the other fixed effects. Standard errors are reported in parenthesis. * indicates that coefficient is significant at 10% level, ** 5% level and *** at 1% level.

	LATAM (1-4)				**Emerging (5-8)**				**Developed (9-12)**			
	1	2	3	4	5	6	7	8	9	10	11	12
Gap	-0.00068***	-0.00133***	-0.00064	-0.00138***	-0.00121***	-0.00133***	-0.00158***	-0.00134***	0.00179	0.02439	-0.19967**	-0.11878*
	(0.00023)	(0.00048)	(0.00041)	(0.00049)	(0.00038)	(0.00048)	(0.00059)	(0.00046)	(0.05279)	(0.03879	(0.08968)	(0.06678)
Observations	288	288	288	288	744	744	744	744	730	730	730	730
R-Squared	0.006	0.646	0.081	0.706	0.011	0.636	0.045	0.654	0.006	0.458	0.169	0.542
Time Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Country Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Panel F: Approach 2 with Debt Thresholds

Panel C is probability of default related to gap and total debt to GDP. Î indicates years lagged and country fixed effects are included. standard errors are reported in parenthesis. * indicates that coefficient is significant at 10% level, ** 5% level and *** at 1% level.

	Debt < 90%						Debt = or > 90%					
	Î¸=0	Î¸=1	Î¸=2	Î¸=3	Î¸=4	Î¸=5	Î¸=0	Î¸=1	Î¸=2	Î¸=3	Î¸=4	Î¸=5
Gap	0.00013	-0.01163	-0.02328	-0.02311	-0.03895	-0.06327*	-0.38519***	-0.35946***	-0.89904***	-0.93129***	-0.38436***	-0.17439*
	(0.03651)	(0.03764)	(0.03780)	(0.03484)	(0.03350)	(0.03432)	(0.08269)	(0.05994)	(0.20666)	(0.27266)	(0.06305)	(0.10060)
Total Debt / GDP	0.08832***	0.08804***	0.06403***	0.01814	0.00491	0.00214	-0.03183	-0.00750	-0.03214	-0.02360	-0.04455*	-0.06253***
	(0.01676)	(0.01667)	(0.02023)	(0.01511)	(0.00501)	(0.00190)	(0.03606)	(0.02508)	(0.02428)	(0.02182)	(0.02302)	(0.02046)
Observations	1290	1298	1276	1253	1229	1204	184	185	183	181	178	176
R-squared	0.79717	0.79194	0.78923	0.78387	0.78458	0.78772	0.83672	0.83942	0.85115	0.85600	0.86241	0.86429

Figure 1: US GDP-Interest Rates Gap & COVID Forecast

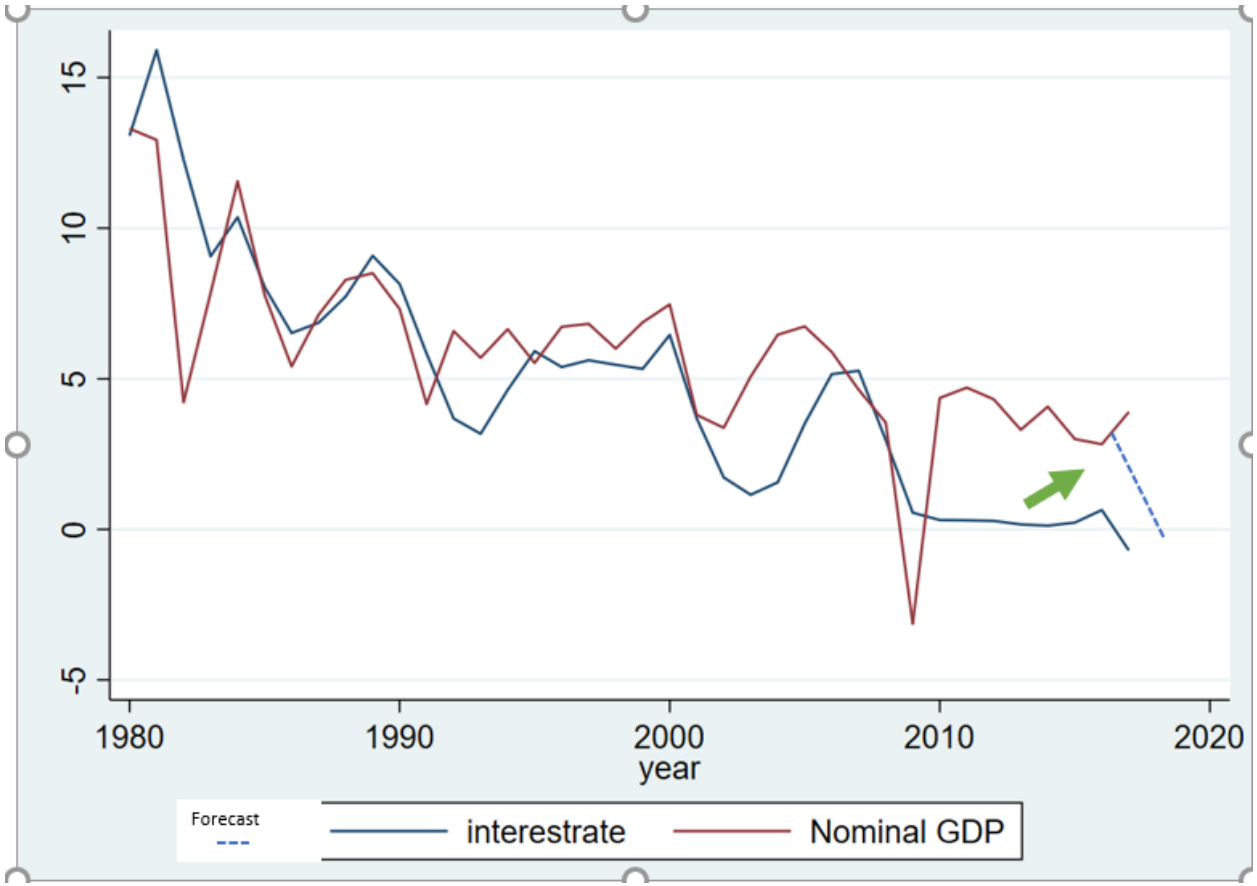


Figure 2: GAP vs. Probability of Default Ecuador and Covid-19 Impact

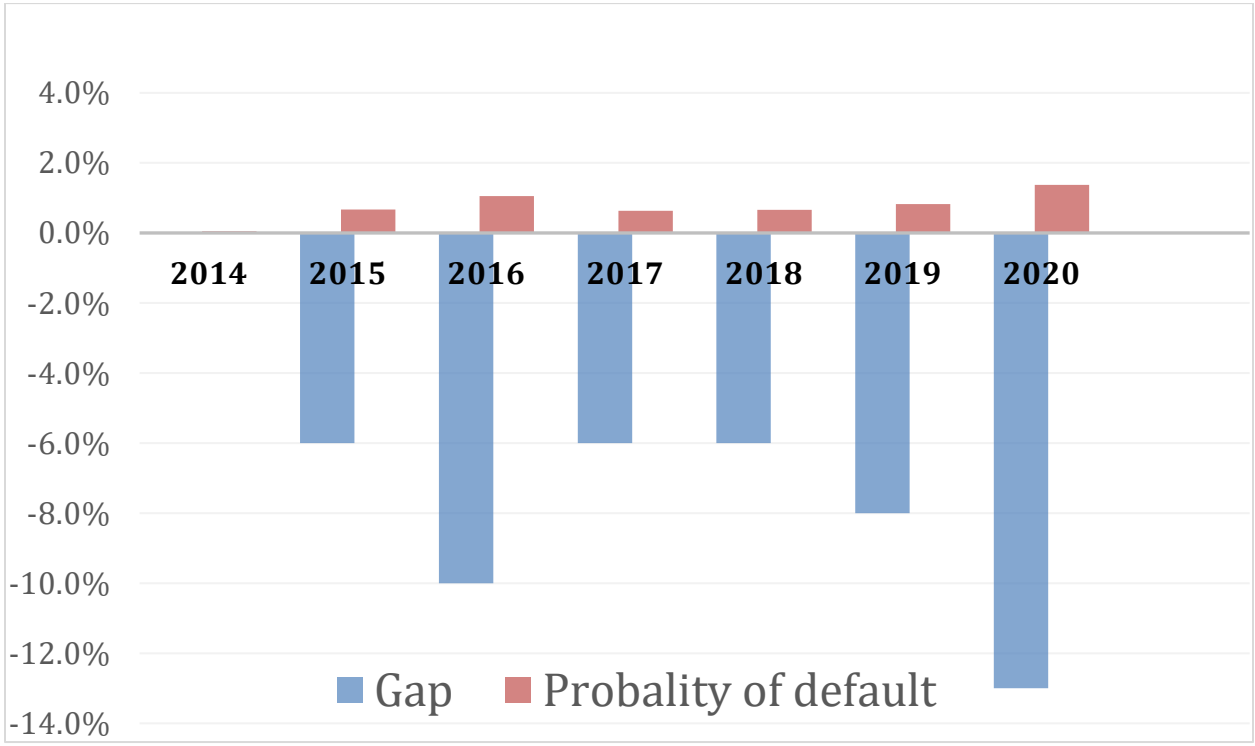
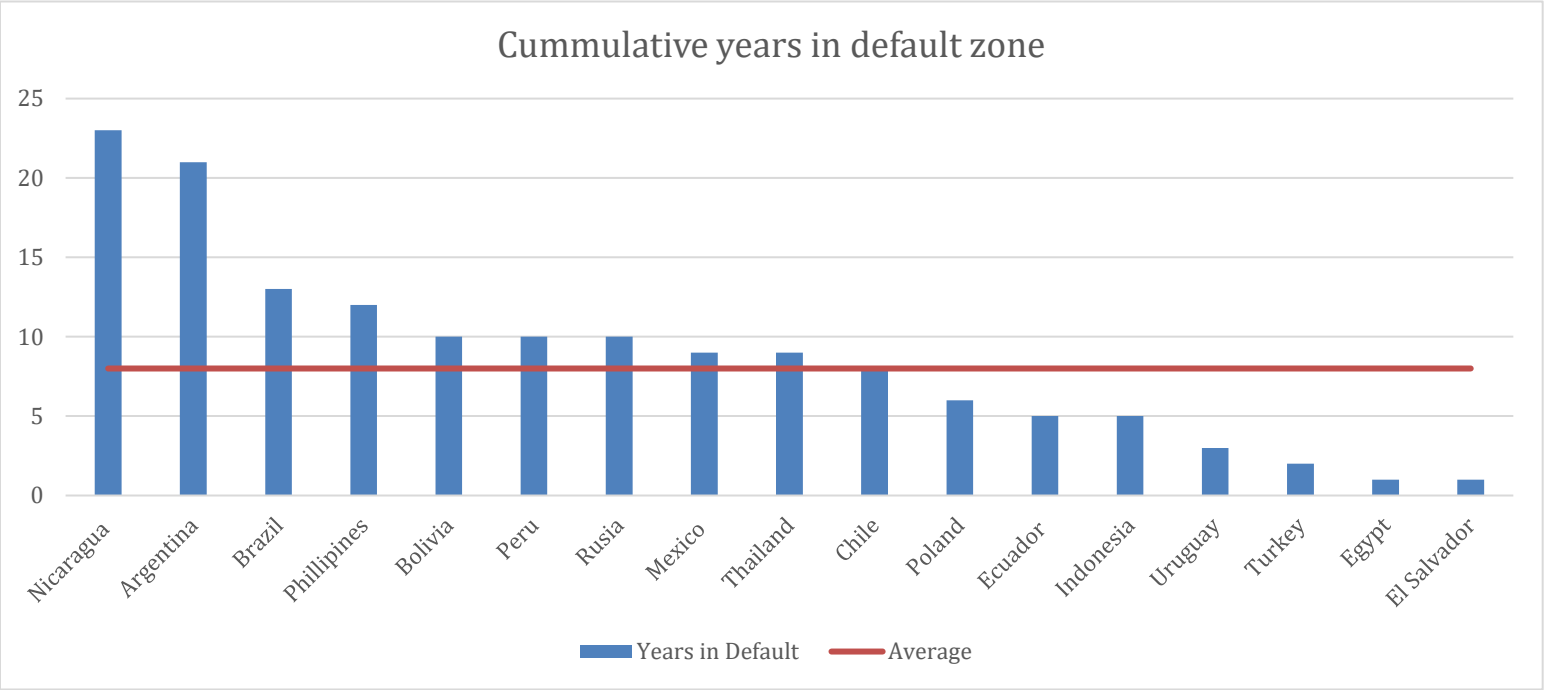


FIGURE 3: This table measures the total number of years that a country has spent in default per data in Reinhart's database. This graph helps visualize the severity and duration that a default can have in a country.



*Years in default is full duration of default and/or inability of a country to go back to the market/issue new bonds. Source: Reinhardt Database-This time is different.

Figure 4
This graph shows the “growth to interest rate gap” between regions across time. We can see that Latam countries although they also experience positive gaps, they also spend more time in the negative gap zone area compared to other regions.

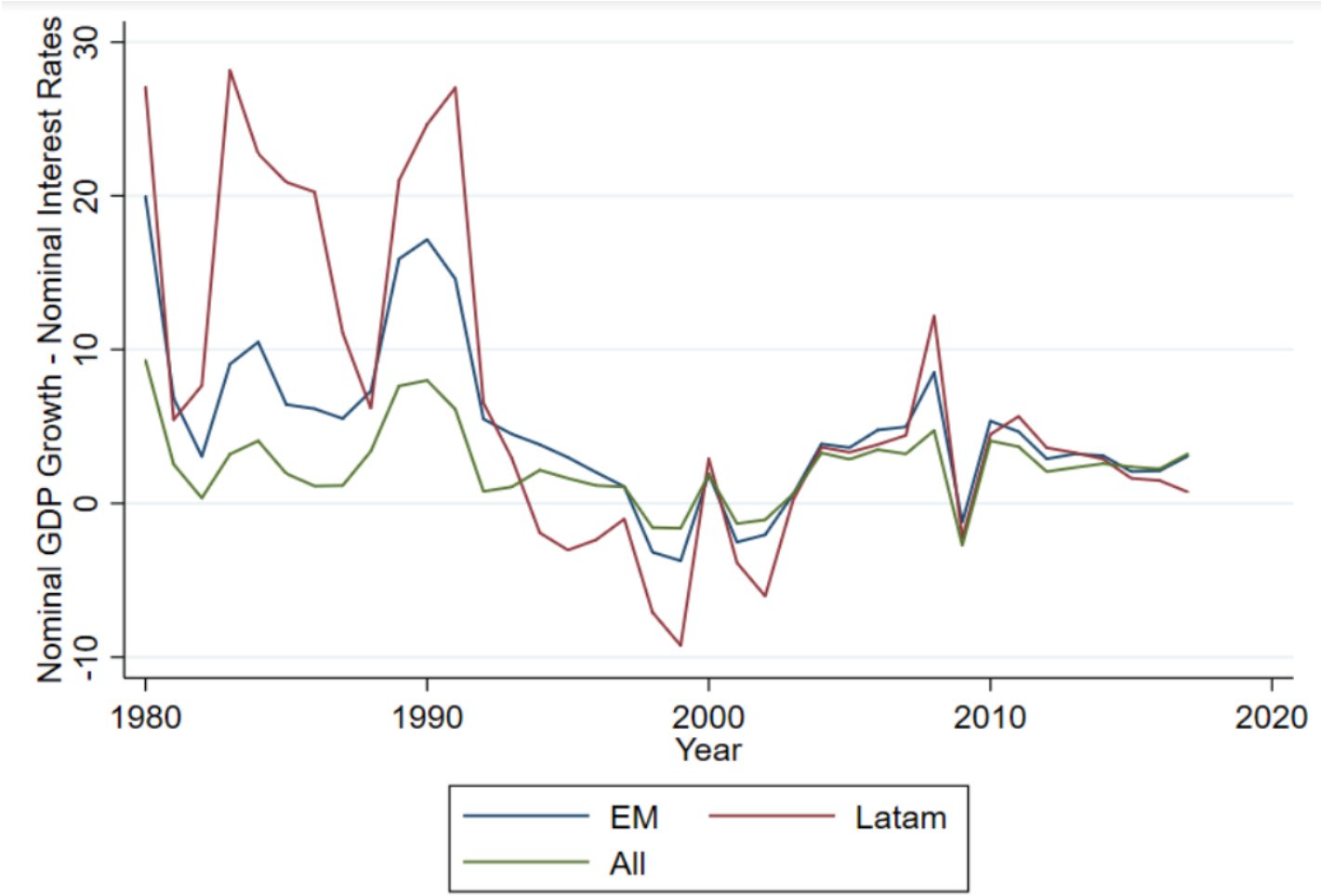

Nominal GDP Growth - Nominal Interest Rates
30
20
10
0
-10
1980
1990
2000
2010
2020
Year
EM
Latam
All

Figure 5: Japan's GDP -interest Rates Gap

Japan for the most part has experienced a positive gap, consistent with Blanchard's argument. This positive gap suggests Japan can continue issuing debt with zero fiscal cost due to their positive difference between their GDP growth-Interest rates

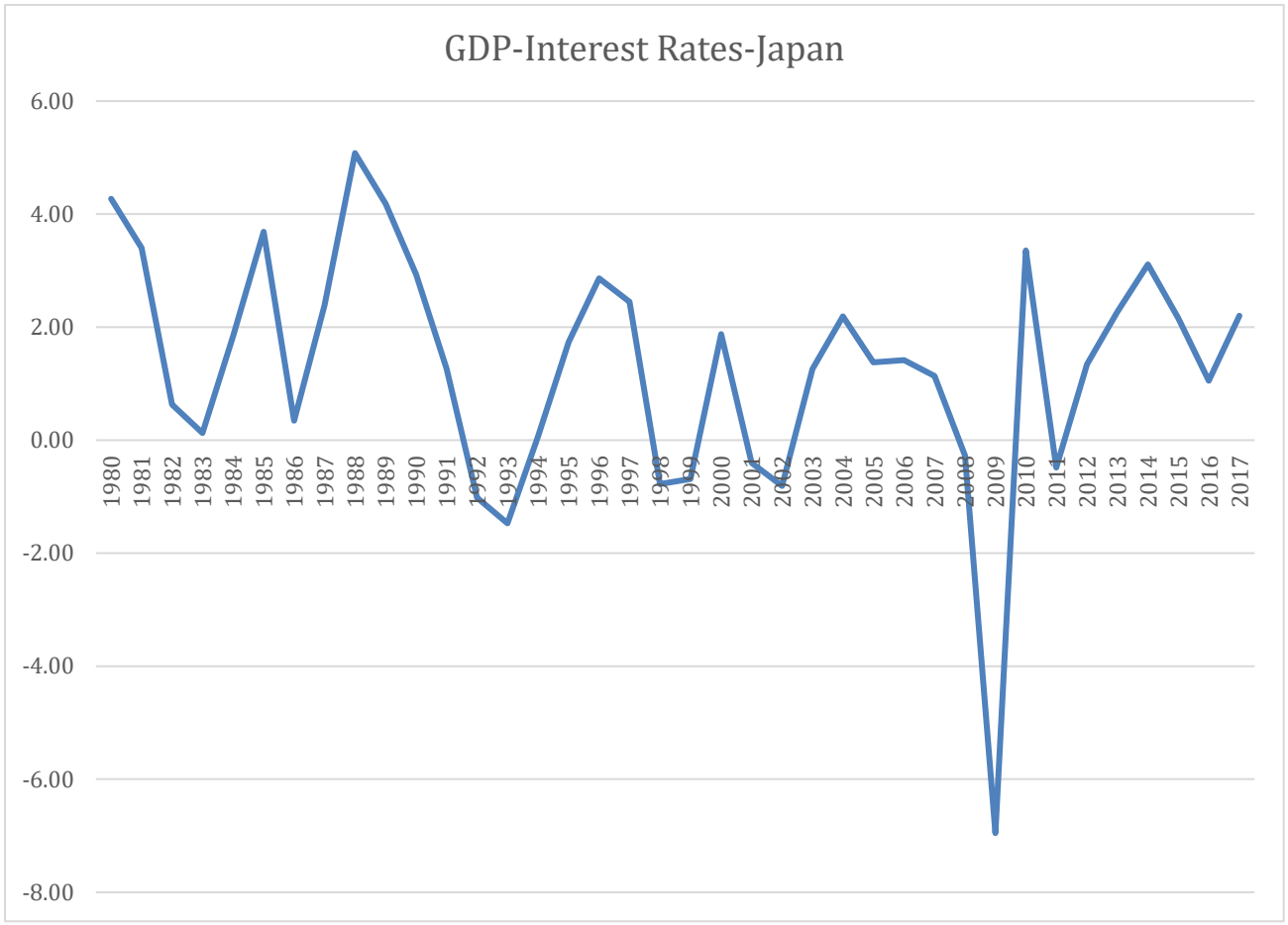


Figure 6: Argentina's GDP -Interest Rates Gap

Argentina, like many countries that have defaulted in the Latam region have significant periods where their GDP-Interest Rate gap is negative, therefore increasing the government likelihood to increase taxes and in some cases increase risk of default.

Figure 8: Debt to GDP rates per Groups

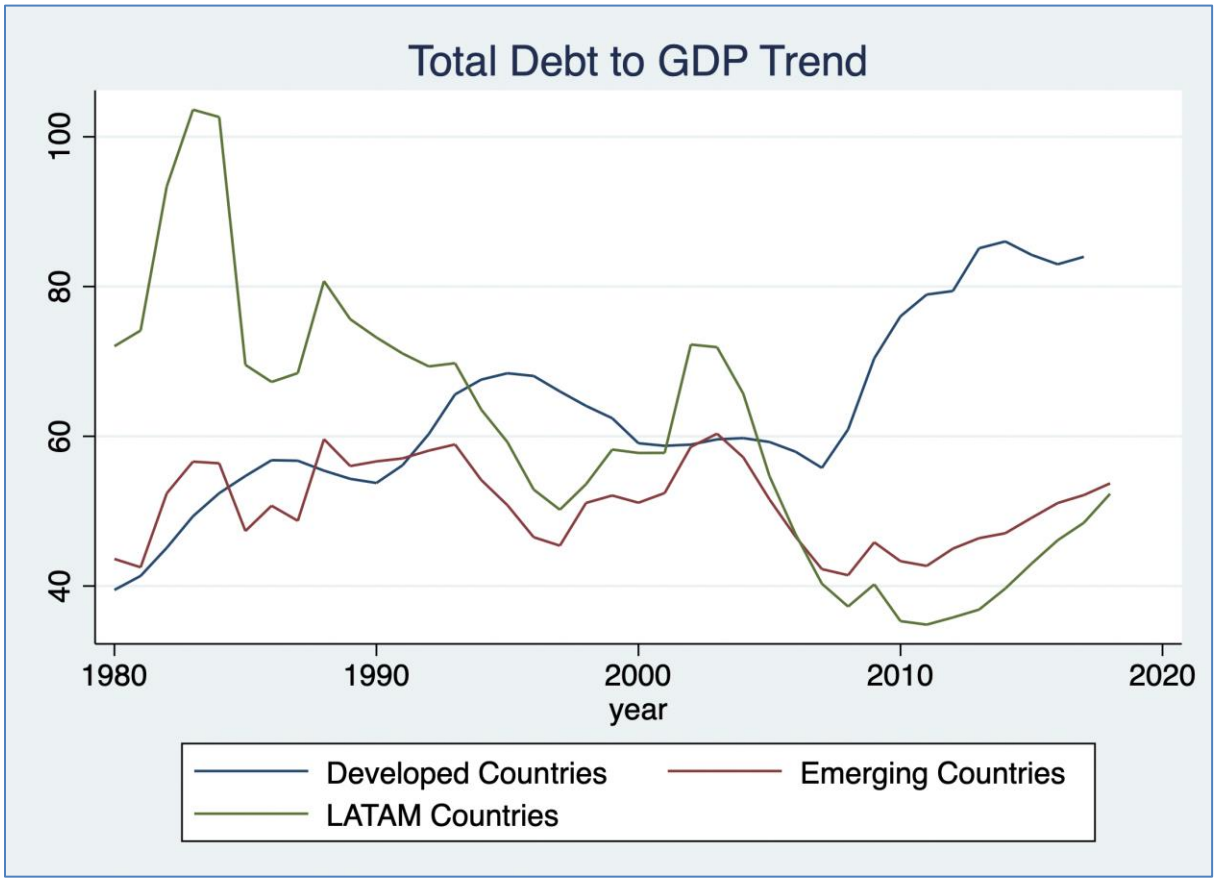


Figure 9: Median Interest Rates Latin American