

# PERU'S DEBT TO GDP RATIO, WARS AND EARTHQUAKES: 1822-2022<sup>1</sup>

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## Abstract

This essay explores Public Debt in Peru from a historical perspective from Independence until 2022. The main objective is to analyze the relations between natural disasters, human disasters and Public Debt. A wide variety of sources are compiled to generate this long-term estimate of the Debt to GDP ratio. Time series analysis is performed to find correlations between the Debt to GDP ratio, internal wars, external wars and army races. To deal with non-stationarity, the Augment Dickey Fuller tests were performed followed by differences and Fourier transformations. Robust standard errors are applied to deal with heteroskedasticity. Because it's such a long-term analysis, structural breaks are expected, therefore Zivot-Andrews tests and structural break identification strategies are also applied. Wars have a stronger impact on Public Debt Sustainability than earthquakes. Even though results change according to each specification, Internal Wars and Army races seem to impact contemporarily. External wars seem to have an impact 4 years later. The government seems to react slowly to earthquakes no generating the deficit that is totally justified in that situation.

Key words: Sovereign Debt, National Security and War, Natural Disasters and Their Management, Time-Series Models, Economic History

JEL codes: H63, H56, Q54, C32, N00

## 1. Introduction

In a broader South American perspective, Public Debt is a key discussion due to shared historical and economic dynamics (Marichal, 1989). In Figure 1, we can see that even though each country has its own specific episodes, there seems to be shared trends, particularly during the 20<sup>th</sup> century. There are common mechanisms. If the risk free interest rate increases, everybody gets punished. Another mechanism could come from credit and funds availability. Finally, besides the risk free mechanism, there could be a South American premium in the approach creditors have towards the region which could be completed with country premiums.

Yet, there is still space for historical research for many countries. Only Chile and Argentina had a long term history in the classic study by Reinhart and Rogoff's (2010) key study. This working paper tries to provide also a long-term history for Peru. Future research should complete information for Bolivia, Paraguay and Uruguay to have histories of the 20<sup>th</sup> century. Guyana and Suriname are the countries with least data available. Key to notice is the appearance of natural resources which have different effects in all these countries. Venezuela was the least indebted country around 1942, but now is the most indebted in the group. Research for the 19<sup>th</sup> century remains a key task for Colombia, Ecuador and Brazil.

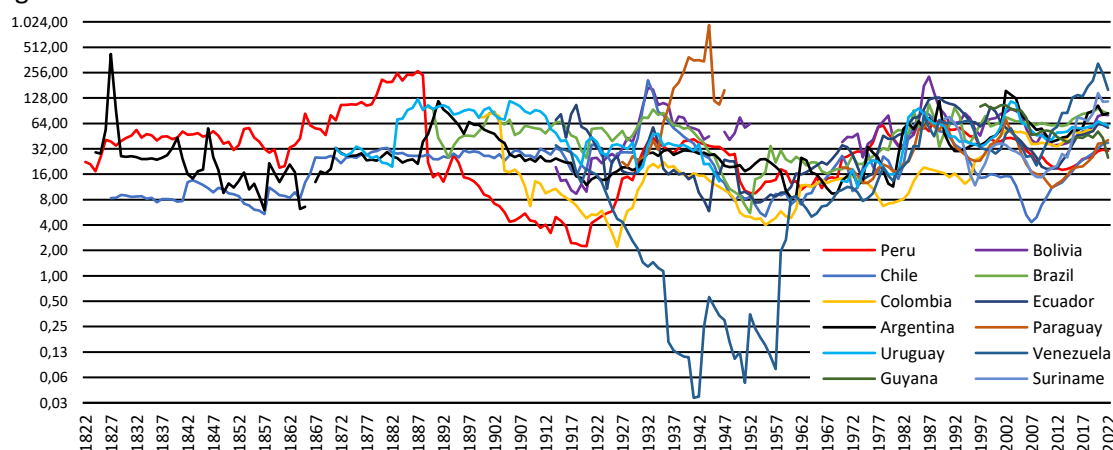
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<sup>1</sup> The main source of public debt data is the Thesis "Public Debt in Peru in 1824-2016: Sustainable Development and Sustainable Finance" to obtain my master's degree in international development at the Graduate School of International Development, Nagoya University. It revises the sources and updates the Debt Estimates until 2022, 200 years of Public Debt Data.

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Figure 1. Public Debt to GDP ratio evolution in 12 South American Countries: 1822 - 2022



Source: Leiva (2024), IMF (2024) and Reinhart & Rogoff (2011). Note. The information for Perú comes exclusively from Leiva (2024), the other countries were found in Reinhart & Rogoff (2011) and information after then is completed with the World Economic Outlook of 2024. If there was information in both sources, the maximum estimate was chosen.

Public Debt has always been a central topic in economic and historical discussions in Peru. Economists interested in it vary from the Dependence Theory School and Heterodox Economy to the Neoclassical and Public Choice ones. In contrast, many books have been written about it by Historians with other perspectives and tools. The so-called lost decade in Peru and Latin America directly relates to this. Still, differences must be considered between the lost decades in each country of Latin America because even though they share some features (external-supply related), they also have different historical paths (internal-demand related). We should also add the importance that Seminario (2015) put on the topic of Catastrophes on GDP growth. He argued that the Independence War, the War with Chile, and the 1980s Debt Crisis significantly impacted Peru's growth. Had Peru not had those catastrophic events, it would have been like the United Kingdom. However, we should be careful with this kind of conclusion because we could argue that the UK had its catastrophes, such as WWII.

Collecting data during the 19th century was challenging because not even the Government knew exactly how much it owed or to whom, particularly regarding the Internal Debt. This would become even more difficult during war times, whether these were civil or with other countries because the military would offer to pay back when they won during civil wars or just because everything becomes chaotic during them.

There were internal and external possible causes of the loss of the decade of the 1980s. Some possible internal causes were 1) an excessive dependency on debt (particularly foreign debt) due to excessive investments (many of which were not productive but destructive, such as weapons and ammunition in the previous decade) and public consumption (mainly salaries) and 2) lousy management of debt service from a diplomatic perspective. (Montoya, 1994; Ugarteche, 1991, 1998) and 3) arms race-related debt demand (Ferrero Costa & Obando Arbulli, 1992). Some possible external causes were 1) excessive bank lending due to excess savings in developed countries. (Devlin, 1989), 2) political interests from foreign countries in expanding their influence in Latin America (Ugarteche, 2019) and 3) excess of weapons supply after World War II (Ferrero Costa & Obando Arbulli, 1992).

However, this lost decade is nothing compared to the Lost Decades in the 19<sup>th</sup> century. The guano-salt-peter-rubber era was, by far, the worst for Public Finance Sustainability. Indeed, as Revilla (1993) points out, in the UK, people did not know what to do with the money, and even

The Economist advised people to invest in Peru until, of course, Peru could not pay anymore. There were external (supply motives) and internal (demand motives) for that specific crisis. And this should make us think about the concept of hegemony. Hegemony is not driven necessarily by the will of the Government but by the rules of Political Economy in the classical sense. And, as the Greeks would say, Hegemony has the seed of its destruction inside of it if the Hegemonic Power does not act with caution. Other different approaches would consider that war is not only in the hands of the Government or the market but that the People's Sentiment and the ability of the Military play a crucial role in the war outcome (Summers, 1983).

Many studies have paid attention to debt related to guano and other commodities, railroads, and military efforts in the 19<sup>th</sup> century (Revilla, 1993; Vizcarra, 2009) And even some, like Revilla (1993), try to model the gap between the risk-free interest rate and the actual interest rate of Peruvian debt. Research on Public Debt in the long term was usually from a historical perspective, such as the ones of Quiroz (1993) for the period 1850-1950 for Peru and Marichal (1989) Latin America's time span is from 1820 to 1930. This article covers the most extended period of Peru's Public Debt, which is itself a contribution.

Many articles have been written on the issue of three specific wars or conflicts in Peru: Independence, the Pacific War, and the Terrorism Epoch. In the case of Independence, some documents reflect on the economic impact of it in Peru, whether it made her poor (de Haro, 2021) and the consequences of it in Latin America (Prados de la Escosura, 2005). In the case of the Pacific War, some explore the fiscal impact of it and how it was seen in the London bond market (Sicotte et al., 2009, 2010), others explore the impact of that war on frontiers between countries (Soto Lara et al., 2022; Stefoni et al., 2022). Regarding the conflicts between the Republic of Peru and internal subversive groups, which we call the Terrorism Epoch to make the difference with other internal armed disputes (particularly those during the 19<sup>th</sup> century in which they were majoritarian), most publications are related to the human rights research (Koc-Menard, 2014; Laplante & Theidon, 2009) or to describe the process dynamics (Arbulú, 1993; Fielding & Shortland, 2012; Taylor, 1998). However, the impact on Public Debt is not a general discussion. All these reflections on war are important (whether the conflict is internal or external), but still, more discussion is required.

Besides these, other papers on the Republican Consolidation and Civil Wars have been written (Perea, 2009; Pinto Vallejos, 2016) with the explicit role of the Army building politics and the idea of Peruvian Society (Silva, 2018). Other important groups of papers have been written on the issue of the Peru-Bolivia Confederation around 1835-1839 (Del Pozo, 2018; Figueroa & Del Pozo, 2018; Ruiz, 2020; Serrano del Pozo, 2023) and on the Chincha island "guano" fertilizer-related conflict in which foreign powers had diverse interests (Sheldon-Duplaix, 2017) to guarantee food security and access to fertilizers.

Civil wars' impact on Peruvian identity is less significant than in other countries, which requires a proper study (Méndez G. & Granados Moya, 2012). Still, we should point out that they may be an actual and troublesome source of debt since each time there is a power shift, the expenses by the rebel group that got into power sum up to the expenses the group in power had before either in the form of pensions or in the form of recognition of prior costs. If accountancy is not held correctly, it's not necessary to have a particularly corrupt situation, as other studies pointed out before, to have high debts because evaluating how much the State owes to those groups is complicated. Corruption does exist, taking advantage of the war's disgrace and profiting from the suffering of others (Quiroz, 2013). We should also point out that army races play a role in Public Debt even though war does not come explicitly into reality (Ferrero Costa & Obando Arbuli, 1992).

This article continues with the efforts of Gamboa and Leiva (2013) and Leiva (2019) to compile data on Public Debt and add other variables related to War and Natural Disasters (starting with Earthquakes). The objectives are the following:

- 1) Generate the largest estimates regarding Public Debt and Public Debt to GDP ratio for Peru, which in this case is from 1822 to 2022,
- 2) Analyze the relationship between Wars and Earthquakes on the debt-to-GDP ratio in Peru and other variables.

To fulfill its objectives, this article has the following structure: Section 1 provides the introduction; in Section 2, we discuss the sources and our nominal estimates in USD of the External and Internal Debt which together account for the total Debt. After this, using the latest estimates of Seminario et al. (2020), we estimate long-term Debt to GDP ratios; in section 3, we provide the empirical strategy considering time series analysis; in section 4 we show the results; in section 5 we summarize the main conclusions and recommendations; finally, section 6 lists the References.

## 2. Data

In this article, we use a wide variety of sources to estimate public finance-related variables such as foreign debt, internal debt, contingent liabilities, and current assets. Up until today, all the Annals of the Treasury of Peru were revised for this document. Data from the 20<sup>th</sup> Century could improve in quality even more if we process the tables in the Statistical Abstracts of Peru, which we now have digitalized in PDFs. Additional discussion is also provided on key regressors such as catastrophes later. Finally, a discussion on corruption, stability, growth, inflation, depreciation, and interest rates is provided.

Table 1. Peru's Monetary Units' equivalence

From/To	Peso (Feble)	Sol (oro/plata)	Libra Peruana	Inti	Nuevo Sol
Peso (Feble)	x 1	÷ 1.25	÷ 12.5	÷ 1,250	÷ 1,250 MM
Sol (oro/plata)	x 1.25	x 1	÷ 10	÷ 1,000	÷ 1,000 MM
Libra Peruana	x 12.5	x 10	x 1	÷ 100	÷ 100 MM
Inti	x 1,250	x 1,000	x 100	x 1	÷ 1 MM
Nuevo Sol	x 1,250 MM	x 1,000 MM	x 100 MM	x 1 MM	x 1

Source: Own preparation based on BCRP (2023b); Decreto-Ley N° 7126 de La Junta Nacional de Gobierno. Estableciendo Como Unidad Monetaria de La República El Sol de Oro Sin Acuña (1931) ; Ley de 14 de Diciembre de 1901. Estableciendo Disposiciones Aplicables a La Unidad Monetaria de La República (1901) y Ley de 14 de Febrero de 1863. Amonedación Conforme al Sistema Métrico Decimal (1863). MM=million

We use a wide variety of Exchange Rates. Pound Sterling to Dollar, which is expressed in Dollars per Pound Sterling, comes from Officer (2023) and currencies from Argentina, France, Switzerland, and Germany from Officer (2018) where data is expressed in each currency unit per Dollar. Researchers should be careful when using this source because the data from the Pound Sterling is not expressed as someone would expect. The exchange rate between the dollar and the sol was built over Seminario (2015) in tables VI-51 on pages 840-842, which has information on exchange rates from 1824 to 1896, where the exchange rate between 1821 and 1823 is assumed to be the same as the one in 1824, and VII-90, which has data available from 1896 to 2012. The rest of the timespan, 2013-2022, can be found in BCRP (2023) in which we considered the average bid-ask exchange rates yearly.

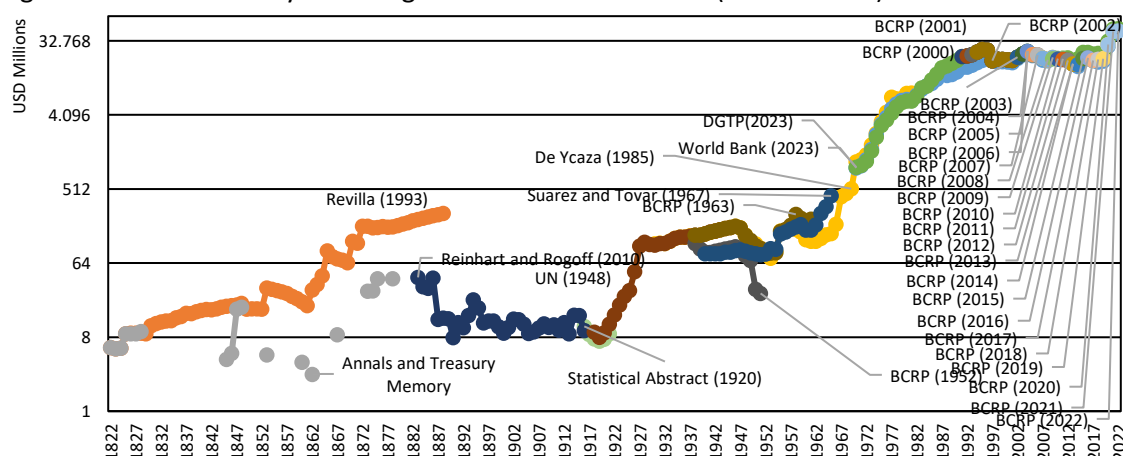
The first difficulty is linking Peru's different currencies throughout its history. When it began its Republic History, it used the currency Peso, which had a fraction of the amount divided into eights. Then, we had to deal with the Bolivian Peso Feble issue. Later, Sol was born. Then we got the Peruvian Pound (Libra Peruana) and returned to the Sol. After that, the Sol would become the Inti; then the Inti would transform into the Nuevo Sol, and finally, the Nuevo Sol would be relabeled Sol. That is why we provide a conversion table for all these currencies in Table 1.

## 2.1 Foreign Debt

Regarding Foreign Debt, this essay continues with the efforts of Leiva (2019), who worked with a timespan that began in 1824 and ended in 2016. In Table 2 we can see all sources with information regarding total foreign public debt identified. There are 68 references. These sources allow us to avoid interpolations for foreign debt, which is an improvement compared with Leiva (2019), where there were some interpolations. Figure 2 portrays the available information in USD millions and the vertical axis is in logarithms. It shows that after 1952 there is not a wide discrepancy between all the available sources. From 1916 to 1952, the sources don't coincide always, but the differences are minor. The debt estimated using Reinhart and Rogoff's (2010) data is problematic because in that time, particularly from 1890 to 1900, the Ministers of the Treasury argued that Peru did not have Foreign Debt, so it should have been zero. However, Reinhart and Rogoff (2010) show that Peru was paying somehow its debt, so it should have been more than zero.

The same happens with the data that the Annals provide. The Annals record debts to many countries such as Venezuela, Ecuador, Chile, USA, and others in the 19<sup>th</sup> century. However, if we compare the total amounts that are in the Annals, they are by far less than the debt that Revilla (1993), who also cites Wynne (1951) and McQueen (1926) as his sources. He argues that Peru issued Debt with UK private agents to pay the foreign debt to other countries. Therefore, even after revising the Annals and the Memories of some Treasury Ministers, Revilla (1993) remains the primary data source for the 19th Century Public Debt. We should also say that the data sources are inconsistent, even from the same institution. This may be because some reports were made in a specific month and others at the end of the year or maybe just because the Peruvian Government did not know how much it owed, especially during the 19th Century. If we think about it, if that is the case, in a pessimistic scenario, the most significant estimate would be the one at the end of the year. Therefore, what we do is to get the maximum estimate of debt. In this document, we repeat the same exercise.

Figure 2. Data availability on Foreign Public Debt 1822-2022 (USD Millions)



Source: Own preparation. See Table 2 for more details.

Table 2. Data sources for Peru's Foreign Public Debt

Source	Years	Currency Denomination
Annals of the Public Treasury of Peru. (Dancuart, 1903a, 1903b, 1903c, 1904, 1905b, 1905a, 1906b, 1907, 1908; Rodríguez, 1919)		Volume and years in parenthesis, page is next to the hyphen: I (1822-222, 1825-222, 1828-226); III (1845-49); IV(1846-42, 1847-43, 1848-43); V (1853-20); VI (1860-57); VII (1862-161); VIII (1867-138); IX(1873-44); X (1874-95,1875-96,1878-96); XX(1890-93)
Treasury Memory by Almenara (1901)		Internal debt only exists due to negotiations with foreign creditors. Therefore, foreign debt was 0 in 1889-1900 (page 54).
Revilla (1993)	1830-1888	Pound Sterling. Debt to the UK.
United Nations (1948)	1918-1945	Pound Sterling, US. Dollar and French Franc
BCRP (1962)	1938-1961	Pound Sterling, US. Dollars, Swiss Franc, Argentinean Peso, and German Mark.
Peru's Statistical Abstract (Ministerio de Fomento, 1922)	1916-1921	They separate debt into internal debt and other kinds of debt. This essay assumes that the rest is Foreign Debt, but this could not be the case. This could be revised.
DGTP (2023)	1970-2022	Total estimates and disaggregation for Latin America, Socialist countries and others.
World Bank (2023)	1970-2021	This reference improves Leiva (2019) because it does not focus on the currency of debt but on the country, institution, or instrument holder.
De Ycaza Clerc (1985)	1930-1981	Consolidated (no disaggregation).
BCRP (1952)	1938-1950	Consolidated (no disaggregation)
Memories of the Central Bank 1966-1969 (BCRP, 1966, 1967, 1968, 1969)		Consolidated (no disaggregation). Information for the years 1940-1966 comes from the memory of 1966. Memories of 1967, 1968, and 1969 provide information on the same years.
Memories of the Central Bank 2000-2022 (BCRP, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022)		Consolidated in groups: International Organizations, Paris Club, Bondholders, Suppliers, International Banks, Latin America, and Communist Countries →2000 (1991-2000), 2001 (1992-2001), 2002 (1993-2002), 2003 (1994-2003), 2004 (2002-2004), 2005 (2003-2005), 2006 (2004-2006), 2007 (2005-2007), 2008 (2006-2008), 2009 (2007-2009), 2010 (2007-2010), 2011 (2009-2011), 2012 (2010-2012), 2013 (2011-2013), 2014 (2012-2014), 2015 (2013-2015), 2016 (2014-2016), 2017 (2015-2017), 2018 (2016-2018), 2019 (2017-2019), 2020 (2018-2020), 2021(2019-2021), 2022 (2020-2022).
Reinhart & Rogoff (2011)		These authors have estimates of the foreign debt to Exports ratio from 1883 to 1916. We multiply those ratios by Seminario et al.'s (2020) exports estimate.
In the following list we put the data availability in parenthesis next to each volume year:		
League of Nations (1930, 1932, 1933, 1935, 1937, 1938, 1939, 1940)		<i>International Statistical Yearbook 1929</i> : 1930 (1926-1928), <i>Statistical Yearbook of the League of Nations</i> : 1932 (1927-1929), 1933 (1929-1931), 1935 (1932-1934), 1937 (1933-1936), 1938 (1935-1937), 1939 (1936-1938), 1940 (1936-1939)
Epstein (1928, 1930, 1932, 1934, 1935, 1936, 1937, 1939) and Keltie & Epstein, (1920, 1921, 1922, 1924, 1925, 1926)		<i>The Statesman's Yearbook</i> . 1920 (1918), 1921 (1920), 1922 (1921), 1924 (1923), 1925 (1924), 1926 (1925), 1928 (1926), 1930 (1929), 1932 (1930), 1934 (1931,1932), 1935(1933), 1936 (1935), 1937 (1936), 1939 (1937).

## 2.2 Internal Debt

Before 1916, we had a more difficult task regarding internal debt because we didn't have data for many years. The primary source is the Annals of Public Finance. Sometimes, particularly at the beginning of the Republic, we only have some estimates of specific debts and sometimes estimates of total Public Internal Debt. Therefore, after the discussion on interpolation, we divide the section into two subsections. Subsection 2.2.1 discusses the sources of Internal Debt for 1916-2022, and Subsection 2.2.2 discusses the sources for 1821-1916.

Table 3. Data sources for Peru's Internal Public Debt: 1916-2022

Source	Years	Currency Denomination of Foreign Public Debt
Peru's Statistical Abstract (Ministerio de Fomento, 1922)	1916-1921	Here, they separate debt into internal debt and other kinds of debt. The present working paper assumes that the rest is foreign debt, but this could not be the case. Therefore, this source could be revised.
United Nations (1948)	1918-1945	Consolidated and disaggregated by funded and floating debt.
Memories of the Central Bank (BCRP, 1963)	1938-1961	Total estimates disaggregated by consolidated internal, floating, and short-term and administrative debt.
DGTP (2023)	1990-2022	Total Estimates and disaggregation in Social Security credits, bonds, and bonds.
Guardia (2007)	1994-1998	Consolidated (no disaggregation).
De Ycaza Clerc (1985)	1930-1981	Consolidated (no disaggregation). Based on reports by the General Comptroller of the Republic.
Contaduría Pública de la Nación (1992, 1993)	1992-1993	Consolidated (no disaggregation)
In the following list of the years of these periodical publications, we put the data availability in parenthesis:		
League of Nations (1930, 1932, 1933, 1935, 1937, 1938, 1939, 1940)	League of Nations. Consolidated and disaggregated by funded and floating debt. 1930 (1926-1928), 1932 (1927-1929), 1933 (1929-1931), 1935 (1932-1934), 1937 (1933-1935), 1938 (1935-1937), 1939 (1936-1938), 1940 (1936-1939)	
Memories of the Central Bank 2004-2022 (BCRP, 2004-2022)	Disaggregated in the short term and long term: 2004 (2002-2004), 2005 (2003-2005), 2006 (2004-2006), 2007 (2005-2007), 2008 (2006-2008), 2009 (2007-2009), 2010 (2007-2010), 2011 (2009-2011), 2012 (2010-2012), 2013 (2011-2013), 2014 (2012-2014), 2015 (2013-2015), 2016 (2014-2016), 2017(2015-2017), 2018(2016-2018), 2019(2017-2019), 2020(2018-2020), 2021(2019-2021), 2022(2020-2022)	
Instituto Cuánto (1992, 1993)	It was consolidated with no disaggregation between 1982 and 1990.	

Splines are interpolations that consider all the information contained in the available data. In contrast to regressions that estimate a line between the original dots, splines pass through the original dots. This means that splines evaluated in the year where there is data show the actual data and only interpolate where there is no data. Only in the domain, without information regarding the function range, do they show their estimates. Splines do not estimate one unique equation for all the data but different equations between two dots for which data is available. We use the tool provided by SRS1 Software, LLC (2018) which is a freely available add-in for Excel

to interpolate using nonmonotonic splines. There are other possibilities of cubic interpolation and even multivariate cubic splines (Press et al., 2007) that could be explored in future studies. Some researchers also try Random Forest Methods, which could be more helpful.

Table 3 provides information for 1916-2022. It is important to note that there is no need to interpolate anything for this part. This is an improvement compared to Leiva (2019), who did not have data for 1916 or 1917. Data from Statistical Abstracts are also available in PDF versions, and foreign debt data is available there. We will mine those data sources in a future project.

The timespan 1821-1916 requires its own treatment because it is mainly based on the data available from the Annals of Public Finance, where, for the first years of the Republic, there are no consolidated estimates of Internal Public Debt. We will write down in paragraphs all the information we have identified if necessary because the 19<sup>th</sup> Century Internal puzzle is very complicated. Indeed, this puzzle is so complex that it is the primary source of corruption but also the main source of conflicts and political instability, as can be seen in the study on corruption by Quiroz (Quiroz, 2013).

The first Debt we can identify is the one of 30,000 pesos of General San Martin, which was covered totally (Dancuart, 1905a, p. 223). We assume this is in 1821 and that it was paid in total in 1823. Then, in November 1823, a new Debt emerged with the Lima Chamber of Commerce, which would be 200,000 pesos, which would cost the end 300,000 pesos when the State paid back (Dancuart, 1905a, p. 223). Later, a new Debt would be recognized with particulars that had economic relations with the Vice Royalty of Peru. This Debt was estimated at 12,246,812 pesos and two and  $\frac{1}{2}$  reales and was not paid totally until 1865. We assume that this amount was the recognized Debt and that it was paid yearly until 1865 when it was totally paid (therefore, we have estimates of minimum debt from 1825 to 1865). However, because we don't want to make unnecessary assumptions when there is no data available, in this case, we don't provide estimates of Internal Public Debt from 1821 to 1825. Finally, up to 1826, the State had recognized owing money to internal creditors, suppliers, unpaid salaries, and others up to 7,069,000 pesos, of which it had paid 1,809,000 pesos. Therefore, the State owed to these people 5,260,000 pesos in 1826 (Dancuart, 1905a, p. 226).

It was not until 1830 that we can find a table with consolidated debt in the Annals as in Dancuart (1906a, p: 42). However, as Dancuart (1906a, p: 40) explains, this did not include the debt related to the Vice Royalty of Peru during the Spanish regime we mentioned before, nor the debt associated with Tagle and Unanue which would require another legislation themselves. We distribute this information from 3,008,385 and 4/8 yearly from 1827 to 1830 and the same with the amortization but from 1828 to 1830. The 2,332,012.06 that were issued until 1930 were distributed from 1821 to 1930. Then we have an estimate of total Internal Debt in 1845 of 6 million pesos (Dancuart, 1903a) It's important to note that between 1830 and 1845, we have a gap that could be filled with our projection of the Spanish Debt. However, it's obvious that those 6 million estimated contain more kinds of debt than it, even though our projection and their projection are very close (6,272,757.53 pesos is what we estimate for that year).

For 1846, we have the information in Volume IV, page 46 (Dancuart, 1903b) giving 6,846,344.5 pesos. It is vital to notice that President Castilla stated that Internal Debt with a Decree on December 28th, 1848, that there was a limit to which no other debt would be recognized. Those with that specific kind of debt that was out of the country would only have 18 months to exchange the debt for money. Therefore, after this consolidation of internal debt, in 1849, internal public debt would be 3,472,284.375 pesos (Volume IV, page 48 of the Annals of Public Finance (Dancuart, 1903b). But then, from 1850 to 1854, according to Dancuart (1903c) in Volume V, Peru lived an illusion. All the order that was achieved during the previous regime got into chaos again. The guano era was, by far, the most problematic of the Public Finance in Peru.

In Volume V, page 20 of the Annals of Public Finance we can see that in 1853, Internal Public Debt was 23,211,400 pesos.

Table 4. Data sources for Peru's Internal Public Debt: 1821-1915

Year	Source	Page	Amount	Currency
Annals of the Public Treasury of Peru (Volumes and references)				
1826	I (Dancuart, 1905a)	226	5,260,000	Pesos
1830	II (Dancuart, 1906a)	42	3,524,558	
1845	III (Dancuart, 1903a)	50	6,000,000	
1846	IV (Dancuart, 1903b)	46	6,846,344.5	
1849		48	3,472,284	
1853	V (Dancuart, 1903c)	20	23,211,400	
1854		20	14,140,400	
1860	VI (Dancuart, 1904)	65	7,324,479	
1861		243	7,789,654	
1862	VII (Dancuart, 1905b)	162	6,015,100	
1867		105	8,645,511	
1868		106	6,210,634	
1870	VIII (Dancuart, 1906b)	59	7,716,536	Soles
1871	IX (Dancuart, 1907)	48	12,814,048	
1872		44	15,831,314	
1874	X (Dancuart, 1908)	95	14,108,609	
1875		96	17,465,025	
1876	XII (Rodríguez, 1913)	68A	24,723,582	
1879	XX (Rodríguez, 1919)	6	20,633,950	
1888		7	38,798,190	
1890	XXII (Rodríguez, 1924)	11	39,387,500	
1891		13	35,365,545	
1889		71A	48,599,924	
1892	XXIV (Rodríguez, 1926)	45	26,282,553	
1893		47	31,572,500	
1894		52	36,232,600	
Memories of the Ministers of Finance				
1897	Memory 1897 (Rey, 1897)	23	47,591,761	Soles
1901	Memory 1900 (Belaúnde, 1900)	55	3,257,747	Peruvian pound
1902	Memory 1902 (Ward, 1902)	27	683,455	
1903	Memory 1903 (Sarria, 1903)	27	842,495	
1904	Memory 1904 (Reinoso, 1904)	53	965,885	
1908	Memory 1908 (Schreiber, 1908)	62	1,760,620	
1910	Memory 1910 (Schreiber, 1910)	69	1,287,330	
1912	Memory 1912 (Plácido Jiménez, 1912)	19	1,012,855	
1915	Laws, Decrees, and Governmental Resolutions (Ministerio de Hacienda, 1929)	76	702,648	

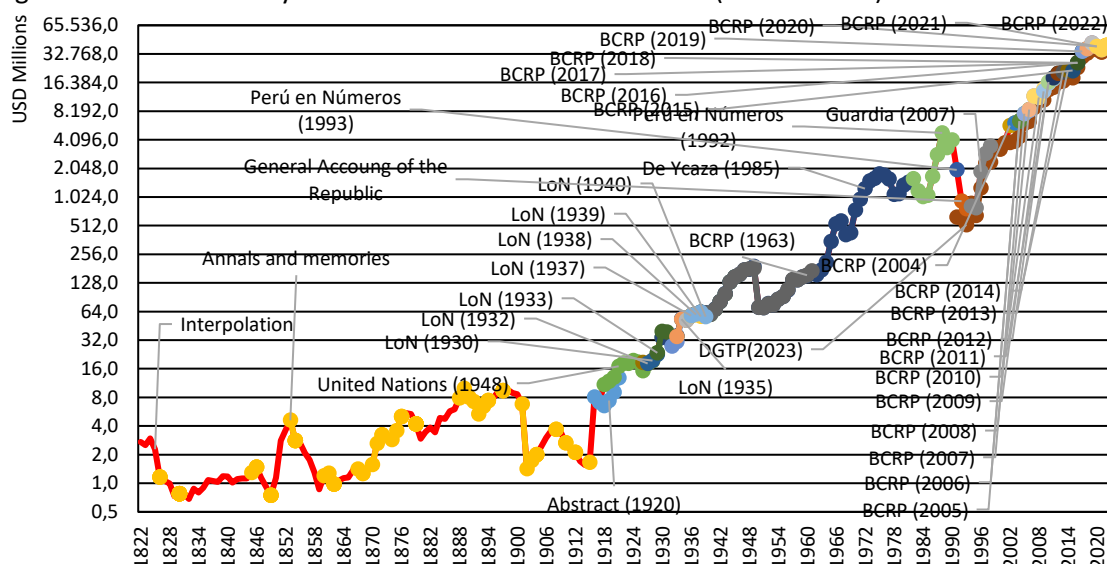
Source: Own preparation. All sources are inside the table.

After seeing this massive amount of debt, the government transformed part of it into foreign debt through the Urribarren and Montané negotiations. Therefore, we have another estimate for Internal Debt in 1854: 23,211,400-9,071,000, which is 14,140,400 pesos. In 1860, some of the debt was either converted into external debt or paid and a stock of 7,324,479.44 pesos was the result (See Volume VI, page 65 of the Annals of Public Finance (Dancuart, 1904)).

In the 1861-1862 budget, we have information about the Internal Public Debt in 1861 (Dancuart, 1904, p. 243-244). In 1861, consolidation debt was 7,123,461.688 pesos, but then 600,000 pesos were amortized, the debt to pay for the freedom of slaves (manumission) was 414,000 pesos then, the census was 464,024.375 pesos, the one to Capellanías was 351,509.625 pesos. Making the summation and resting the amortization, we get 7,789,654.19 pesos as an estimate for 1861. See p. 243-244 in Dancuart (1904) for more details. In 1862, Minister Pedro Galvez, in his Memory of the Congress, said the debt was 6,015,100 pesos (Dancuart, 1905b, p. 161).

This essay has gone into detail to show the calculations made before 1862. This is necessary for transparency and replication. However, the rest of the information sources are explained in Table 4. Now that all the available data is used, we shall interpolate for the years without data. In total, there are 142 observations for 201 years. However, we should point out that there are also estimates of nominal GDP in dollars and exchange rates. We estimate the internal debt to GDP ratio for the years in which there is data and then use a one-way spline with it to fill in the gaps and extrapolate until 1822. Then, those interpolations are multiplied by the GDP and, finally, we reach the estimates in Figure 3.

Figure 3. Data availability on Internal Public Debt 1822-2022 (USD Millions)



Source: Own preparation.

Note: All references are inside the figure signaling where they are used. Interpolation in red.

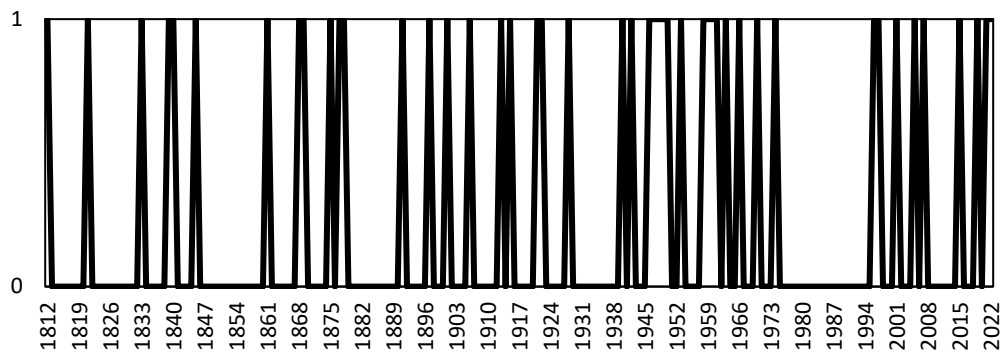
## 2.3 Catastrophes

Catastrophes are adverse shocks. In general, there are catastrophes whose origin is natural and others whose origin is human. In this essay, we explore the case of earthquakes as an example from a natural disaster and wars as an example of human origin disaster.

### 2.3.1. Earthquakes

Regarding the earthquake data, the information is not uniform, and after the International Geophysical Year (1956) the number of observations has increased dramatically (Ferro, 1978) And yet curation is required. It is important to notice that data after 2000 is even more regular, which could make the entire dataset not comparable (Instituto Geofísico del Perú (IGP), 2024). Now, the Geophysical Institute of Peru (IGP) provides access to two datasets: the historical before 1960 and the instrumental after 1959. Because seismology is a science that requires time and effort, this essay builds upon the efforts of different scientists compiled by the IGP. Therefore, the number of earthquakes cannot be used as an indicator.

Figure 4. Dummy for a big earthquake



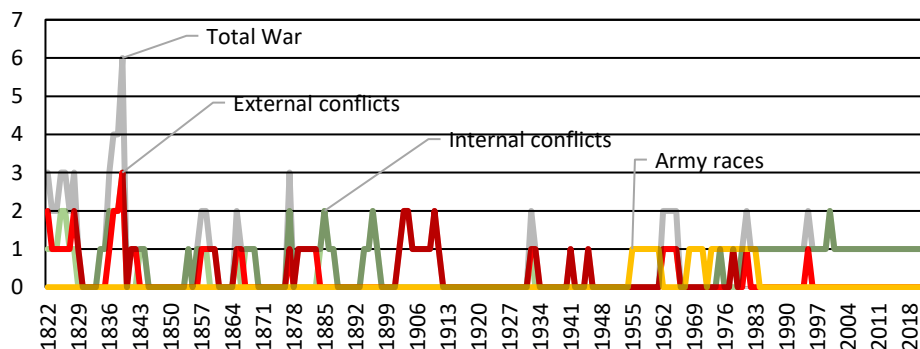
Source: Own preparation based on IGP (2024)

We cannot use the magnitude simply because the magnitudes in which the earthquakes are measured change over time. If we count the number of earthquakes recorded in the IGP dataset, we will find that before 1921, there were only one or two and only three in 1913. However, it was after 1900 that more observations became available. The maximum in each kind of measurement in each year was found. After this, from 1901 onwards, only the P75 higher earthquakes remain. This is transformed into a dummy variable, which can be seen in Figure 4.

### 2.3.2. Wars

The list of wars is still a work in progress. Yet, in this working paper, information is not only reduced to the wars that came into reality, but we also include armaments races since they increase debt levels due to many reasons: 1) purchases of guns are usually made on credit, 2) it's a stable equilibrium in which all buyers try to buy the highest amount of guns and ammo available 3) once the war explodes, fixed demand for ammo is determined by the number of guns and how much of it was already used. In Figure 5 we can see the number of wars or arms races from 1822 until these days.

Figure 5. Internal, External, Arms Races and Total War



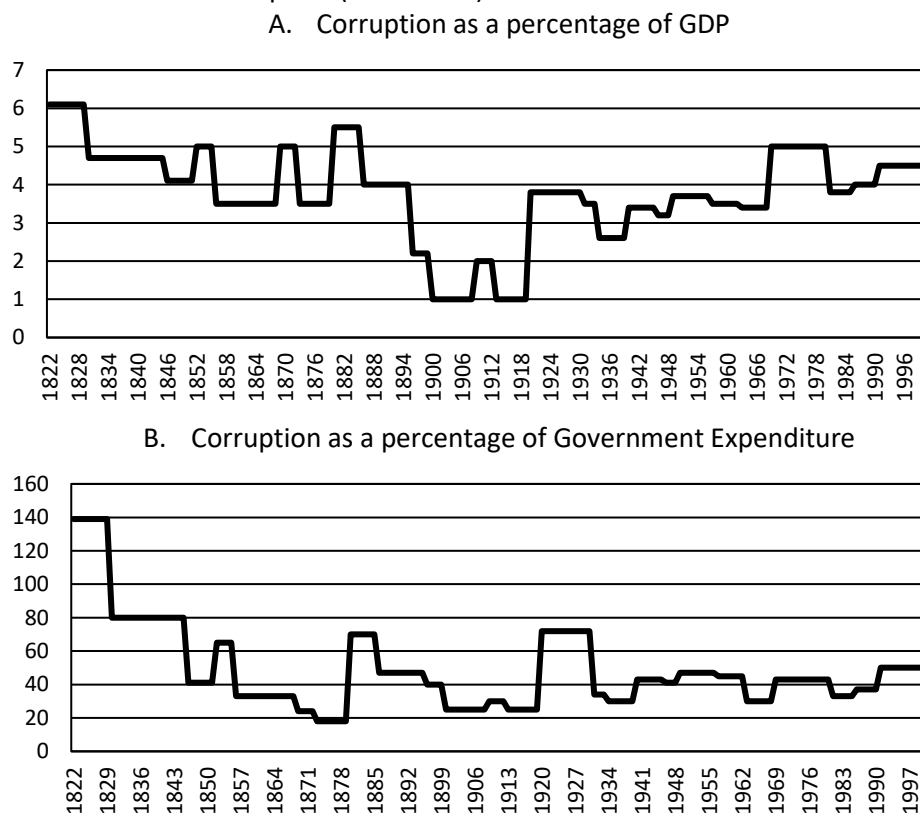
Source: Own preparation. See the GitHub repository documentation for details.

### 2.4 Corruption

Estimates of corruption are available in the famous study by Alfonso Quiroz (Quiroz, 2013, pp. 551–553) in table A.7. In this essay, the years have been fixed so that the beginning and end of the government estimates match without gaps. In particular, the author does not provide information on the Peru-Bolivia Confederation when Santa Cruz was in power. We work assuming that it is the same as Gamarra and La Fuente's regime estimates. The main problem is that there is only data until 2000. Future essays can complete the information until the current year. As can be seen in Figure 6, the ranking shifts depend on the denominator. The most corrupt years would change if we used the GDP or the total expenses. In any case, the most corrupt years

happened at the beginning of Independence. In the first scenario, the pre-war with Chile era was the second most corrupt time, followed by the Revolutionary Government of the Armed Forces in the 1970's. In the second case, it would be the 11 years of government of Leguía around the 1920's followed by the Pacific War.

Figure 6. Relative cost of corruption (1822-2000)



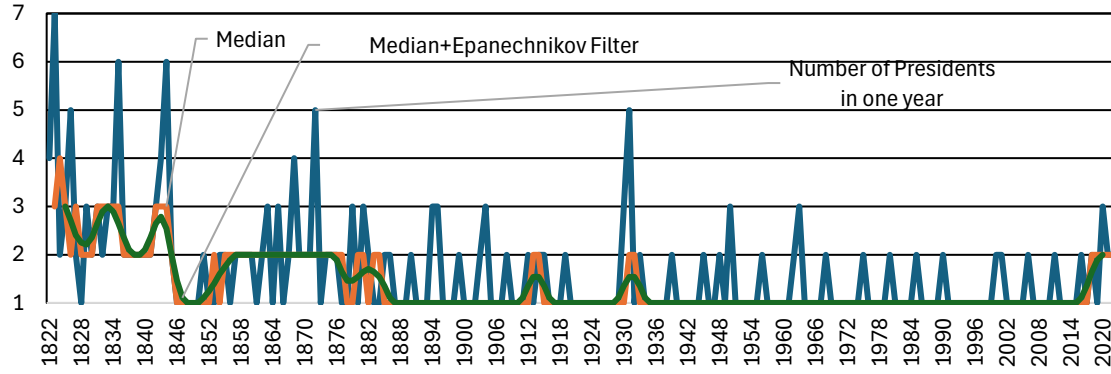
Source: Own preparation based on Quiroz (2013).

## 2.5 Political instability

The number of presidents comes directly from the information compiled by the Library of the Congress of the Republic of Peru (Biblioteca del Congreso de la República, 2023). In this approach, we only consider the shifts in government. If a President was reelected or only changed the status of their presidency but remained in charge, we assumed that the government remained equal. This allows us to identify that Leguía (11 years), Fujimori (10 years), Odría (8 years) (not considering the interruption with Zenón Noriega), Velasco and Mariano Ignacio Prado (both with 7 years) were the presidents that ruled the most continuously. In the context of Public Debt, our working hypothesis is that political instability in the form of government shifts may correlate with Public Debt due to the classic motives explained by the Public Choice Theory (Buchanan, 1988; Puviani, 1903). The analysis can be improved in the future.

In Figure 7, we see the political shifts. There are three kinds of states. In state one, one President governs; in state 2, there is a change in which there would be 2 Presidents in those specific years. We could expect instability because there have been many military regimes, but that was not the case. If we apply a median with a 5-year window and over it, we use an Epanechnikov kernel. If that can be seen, it is because those years were volatile. This happens primarily right after the Independence and before the war with Chile. Other eras of high instability were during the Billinghurst Regime and the clash between the Congress and Executive, right after the coup d'état from Sánchez Cerro and, finally, during the latest political crisis that started during the government of Pedro Pablo Kuczynski and lasted until these days.

Figure 7. Number of presidents by year



Source: Own preparation based on the list by the Congress of the Republic of Peru

### 2.6 Growth, inflation, depreciation and interest rate

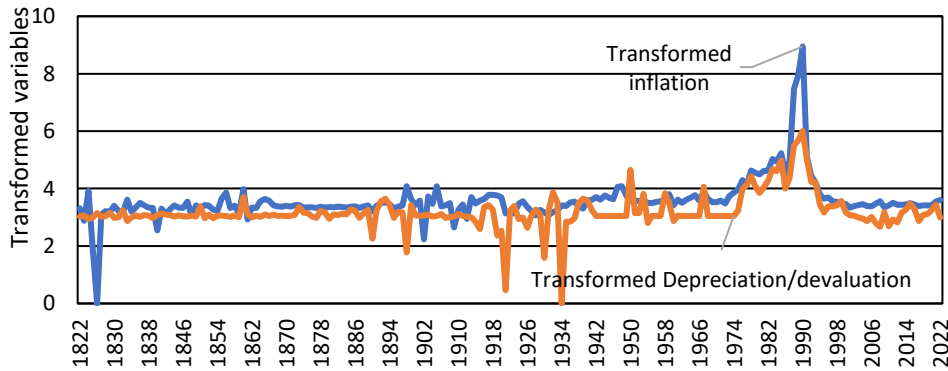
The primary sources for GDP growth, inflation and depreciation/devaluation are the important studies in which Professor Seminario was involved (Seminario, 2015; Seminario et al., 2020) with the data reported by the Central Bank until today (BCRP, 2023b). Interest rate is understood as a long-term interest rate and is the minimum between USA and UK expressed as consistent by Officer (2024). This procedure will guarantee we extract a proxy for the risk-free nominal interest rate. Inflation and depreciation were transformed with the following formulas:

$$Inflation_{ttransformed,t} = \ln(Inflation_t - \min(Inflation) + 1) \dots (1)$$

$$Depreciation_{ttransformed,t} = \ln(Depreciation_t - \min(Depreciation) + 1) \dots (2)$$

With this, we can represent in the same figure each of these variables and appreciate fluctuations (Figure 8). Interest rate in Peru should be higher than this due to the risk premium.

Figure 8. Transformed inflation and depreciation/devaluation



Source: Own preparation based on Seminario (2015) and BCRP (2024)

### 3. Methodology and empirical strategy

To understand the relation between natural disasters, human disasters and Public Debt, we can start with a basic budget function in terms of percentage of GDP (Blanchard, 1990):

$$b_t = -s_t + \left( \frac{1 + i_t}{1 + \gamma_t} \right) b_{t-1} \dots (3)$$

Where:

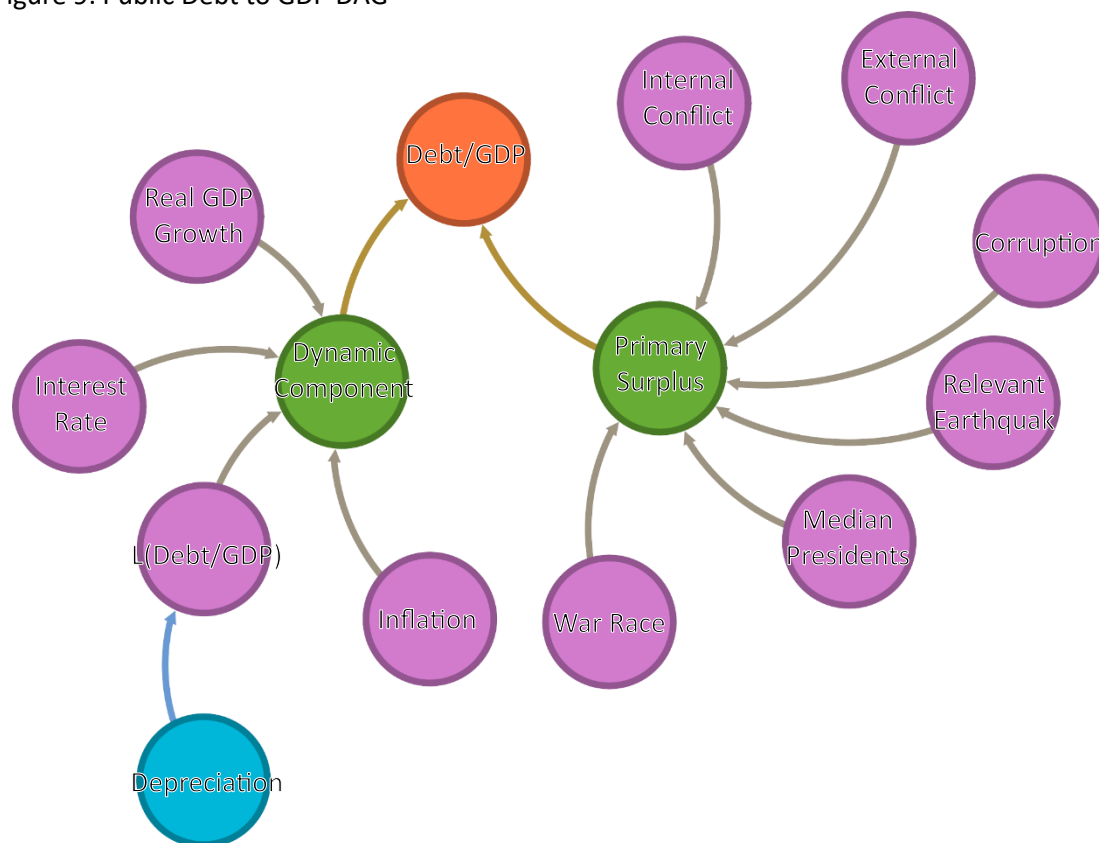
$b_t$  is the stock of Total Public Debt,  $s_t$  is the primary surplus in year t,  $i_t$  is the nominal interest rate in year t and  $\gamma_t$  is the nominal growth rate of GDP.

Now, let us discuss the Primary Surplus  $s$ . This is the theoretical link between Debt and Natural Disasters, Corruption, Instability, and War. We can define it as:

In general, we would expect  $s_t$  to decrease with the occurrence of a disaster, however the relation may not be necessarily immediate. There could be lags or even contrary effects in the short run: maybe expenditure is reduced because the government is not able to spend as planned or just could be the case that the government is slow to react to the disaster.

Based on the previous discussion, we can build a theoretical Directed Acyclic Graph (DAG) which will be the base of our regressions in Figure 9. We still have a missing variable which is the Primary Surplus. However, we argue that, from an exploratory perspective, we can assume the Debt to GDP ratio is dependent on a reduced form on the purple and blue variables. To control for the Lag of Debt as a Percentage of GDP, we use Fourier Transformations. The hypothesis of this paper is that Internal Conflict, External Conflict and Earthquakes have a positive impact on the Debt to GDP ratio.

Figure 9. Public Debt to GDP DAG



#### 4. Diagnosis and Results

This section shows the diagnosis, statistics, and regression results. All of the estimates on which this section is based can be found in the following computational notebook: Earthquakes, wars and Debt: a computational notebook by Favio Leiva\_

##### 4.1 Diagnosis and Summary Statistics

Before performing any econometric analysis, we must find out if the assumptions of the OLS hold or not. In Table 5. Almost all the variables except for the Dummy created for earthquakes have heteroscedasticity problems, and 3 of them have stationarity issues: Gross Debt, Corruption and

Internal Conflict. Of these three, Gross Debt, which is Gross Debt as percentage of GDP, is our key dependent variable.

To address the issue of heteroscedasticity, robust standard errors are used. To tackle non-stationarity, two steps are followed. First, after taking the logarithm of the Debt-to-GDP ratio, Fourier transformations are applied to filter out the effects of cyclical events occurring every 100, 50, 25, 12, 6, and 3 years. Additionally, the approach of differencing the data is employed. This strategy generates seven dependent variables related to the Debt-to-GDP ratio, all of which are confirmed to be stationary according to the Augmented Dickey-Fuller (ADF) test. The issue of structural change is also examined in the computational notebook. Using the Zivot-Andrews test, only the variable derived from differencing is free of structural breaks. For simplicity, a single structural break is identified in each estimate, although the computational notebook allows for the identification of multiple breaks using the package ruptures in python (Truong et al., 2020). Similar results are found there when using the Partial Autocorrelation Function which shows that the issue of autocorrelation is only fixed when taking differences.

Table 5. Descriptive statistics of the variables used

Label	N	$\mu$	$\sigma$	min	25%	50%	75%	max	ADF	ARCH
<b>Year</b>	201	1922	58.17	1822	1872	1922	1972	2022	n.a.	n.a.
<b>Gross Debt<sup>a</sup></b>	201	41.915	47.07	2.24	14.73	31.91	45.96	266.70	N.S.	Het.
<b>Corruption<sup>a</sup></b>	179	3.78	1.23	1	3.45	3.8	4.7	6.1	N.S.	Het.
<b>Internal Conflict</b>	201	0.46	0.61	0	0	0	1	3	N.S.	Het.
<b>War Race</b>	201	0.11	0.31	0	0	0	0	1	N.S.	Het.
<b>Corruption<sup>b</sup></b>	179	48.97	26.14	18	33	43	57.5	139	Stat.	Het.
<b>Median Presidents</b>	200	1.37	0.61	1	1	1	2	4	Stat.	Het.
<b>External Conflict</b>	201	0.28	0.55	0	0	0	0	3	Stat.	Het.
<b>Total Wars</b>	201	0.74	0.91	0	0	1	1	6	Stat.	Het.
<b>Wars + Army Races</b>	201	0.85	0.91	0	0	1	1	6	Stat.	Het.
<b>Relevant Earthquake</b>	201	0.22	0.41	0	0	0	0	1	Stat.	Hom.
<b>GDP Growth</b>	201	2.98	7.73	-44.33	-0.80	4.27	7.21	25.84	Stat.	Het.
<b>Inflation<sup>c</sup></b>	201	3.58	0.75	0	3.34	3.45	3.63	8.95	Stat.	Het.
<b>Depreciation<sup>c</sup></b>	201	3.20	0.60	0	3.02	3.07	3.26	6.00	Stat.	Het.
<b>Interest rate</b>	201	4.06	2.14	0.82	2.85	3.15	4.37	13.200	Stat.	Het.

Note: The last two columns have information on ADF Test and ARCH test. Stat.=Stationary, N.S.=Non-Stationary, Het.= Heteroscedastic, Hom.= Homoscedastic. a. As percentage of GDP. b. As percentage of budget. c. Transformed using equation 1.

The structural changes are identified by setting Dynamic Programming with a normal cost function (Lavielle, 1999; Lavielle & Teyssi re, 2006). When we take differences, no algorithm identifies structural change anymore. Finally, we analyze the correlation of each dependent variable with 10 lags of the variables of interest, one at a time. All these regressions are expressed in Table 6.

Regarding earthquakes, we find a significant positive effect at a 10% significance level ( $\alpha = 0.1$ ) using the second lag when accounting for the effects of events recurring every six years. This does not necessarily imply that earthquakes have no impact on public debt. Two possibilities could explain this finding: (1) the effects of earthquakes might dissipate within months or quarters, as observed during the COVID-19 pandemic, or (2) the government's response may be

delayed, taking up to two years to see a relation with the budget allocated to addressing emergencies, resulting in less pronounced effects. For events recurring every 50 years or more, earthquakes exhibit a positive correlation with the debt-to-GDP ratio nine and ten years later, significant at the 5% level ( $\alpha = 0.05$ ).

Regarding the "wars and races" variable, we observe a significant positive effect at  $\alpha = 0.1$  with the 8th lag when accounting for the effects of events recurring every 12 years. Conversely, a significant negative effect is identified when using differences and the 9th lag at the same significance level. Wars alone are significant only when using differences with a 9th lag. Due to the inconsistency of these results, we will exclude this variable from our final regressions.

Focusing on internal wars, they show significant effects at  $\alpha = 0.1$  both contemporaneously and with a one-year lag after controlling for events recurring every 100 years. Additionally, internal wars remain significant at  $\alpha = 0.1$  for lags 5, 8, and 9 after controlling for events recurring every 12 years. These results suggest that internal wars strongly influence public debt in both the short and long term.

Table 6. Significant coefficients in lag models by different cleaning approaches.

Regressors	Debt to GDP ratio in logarithms					
	(1)	(2)	(3)	(4)	(5)	(6)
Earthquake						
L2						0.0311*
L9			0.1277**			
L10			0.1321**			
Wars/Army races						
L8					0.0195*	
L9	-0.0214*					
Wars						
L9	-0.0295**					
Internal wars						
L0		0.1447*				
L1		0.1470*				
L5					-0.0479*	
L8					0.0380*	
L9					0.0534**	
External wars						
L1				-0.0518*	-0.0350*	
L4	0.0575**		0.1188***	0.0577*		
L5			0.1528***	0.1030***	0.0628**	
L6			0.1210***	0.0849**		
L7			0.0805*			
L9	-0.0856**	-0.1579*			-0.0545*	
L10		-0.1994**	-0.0982*	-0.0721*	-0.0683**	
Army races						
L0		-0.3536***				
L1		-0.3278***				
L2		-0.2745**				
L3		-0.2611**				
L4		-0.2632**				
L5		-0.2690**				
L6		-0.2370*				

Note: Each coefficient comes from a regression. In total 420 regressions were estimated. Of this, only 36 hold significant coefficients. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ . Each of the models includes a constant. (1) Differences, (2) 100+ clean, (3) 50+ clean, (4) 25+ clean, (5) 12+ clean, (6) 6+ clean

Regarding external wars, we find a significant positive relationship with public debt at  $\alpha = 0.05$  when using differences, specifically with a 4th lag. External wars remain significant and positive in models controlling for events recurring every 50 years, particularly for lags 4, 5, 6, and 7. Finally, army races are significant across lags 0 to 6. However, the sign of the effect is contrary to expectations, which may be attributable to confounding factors not included in the model such as the interest rate or an increase of the guns supply in the world.

#### 4.2 Results

A series of regressions were performed and the ones in Table 7 show the expected signs and are significant. The strategy used was to choose the first lag in which the key variables have a significant effect in the previous section except for External Wars. The same was with the controls.

Table 7. Chosen regressions

	Gross Debt as Percentage of GDP in Logs					
	Filtered 50+			Filtered 25+		
	(1)	(2)	(3)	(4)	(5)	(6)
Earthquake L2	-0.024 (0.051)	-0.057 (0.052)	-0.082 (0.060)	0.003 (0.041)	-0.015 (0.043)	-0.031 (0.047)
Internal wars	0.020 (0.047)	0.024 (0.046)	0.031 (0.053)	0.060 (0.038)	0.084** (0.039)	0.062 (0.047)
External wars L4	0.135*** (0.044)	0.133*** (0.046)	0.147*** (0.050)	0.075* (0.039)	0.079** (0.040)	0.060 (0.043)
Army races	0.074 (0.076)	0.160** (0.075)	0.195** (0.084)	0.064 (0.066)	0.180*** (0.063)	0.178*** (0.062)
Inflation L1		-0.013 (0.031)	-0.012 (0.031)		0.024 (0.026)	0.038 (0.026)
Depreciation		-0.009 (0.060)	0.003 (0.065)		0.020 (0.045)	0.023 (0.046)
Risk free interest rate		-0.039*** (0.013)	-0.041** (0.020)		-0.037*** (0.012)	-0.040*** (0.013)
Real GDP growth		-0.006 (0.004)	-0.006 (0.004)		-0.003 (0.003)	-0.003 (0.003)
Corruption as percentage of budge in logs			-0.012 (0.056)			0.106** (0.050)
Median presidents			-0.035 (0.056)			0.046 (0.085)
Observations	197	197	175	197	197	175
R2	0.052	0.102	0.104	0.034	0.070	0.088
Adjusted R2	0.027	0.059	0.043	0.009	0.025	0.027
AIC	140.47	137.81	143.77	72.89	73.52	81.50
Residual Std. Error	0.340 (df=191)	0.335 (df=187)	0.353 (df=163)	0.287 (df=191)	0.284 (df=187)	0.295 (df=163)
F Statistic	2.165* (df=5; 191)	4.143*** (df=9; 187)	2.833*** (df=11; 163)	0.919 (df=5; 191)	1.847* (df=9; 187)	2.166** (df=11; 163)

Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01. Each of the models includes a constant and a dummy to control one structural change. Standard Errors in Parenthesis.

The table is divided into two parts. The first part runs regressions of the Debt to GDP as percentage of GDP in cleaned of the effects of events that happen each 50 years or more. The

other part cleans for events that happen each 25 years or more. In no regression the earthquake variable is significant. This supports the idea that there is no reaction of the government on time to the emergency nor does it have a significant coefficient related to debt, which is a proxy of the budget.

As for wars, in model 5 all regressors have the expected sign. Wars in general seem more robust to explain debt than earthquakes. It's important to notice that after adding additional controls, army races become significant. Even though we added corruption as a control, including that regressor reduces the number of observations because there is only data until the year 2000. Army races and external wars seem robust to adding additional controls. In any case, internal conflicts, external wars and army races seem more important than our proxy of earthquakes to explain Public Debt. An additional comment comes with the issue that external wars have a positive effect in Public Finance 4 years later, while army races and internal wars seem more contemporary.

The risk free interest rate reduces debt after cleaning for 50+ and 25+ regularity events. We used a proxy in this essay based on the interest rate the UK and the USA seem to offer and yet it is significant. In these chosen models, inflation is not relevant. Corruption is significant in the last regression. Future studies could compile information on the interest rate in Peru.

The issues of endogeneity, reverse causality and non-stationarity have been dealt here through the utilization of Fourier Series decomposition. On the other hand, if we pay attention to the Adjusted R2 and Akaike Information Criteria, the best model is model 2 for the first group of regressions. On the other hand, model 4 is the best for the second group of regressions according to the AIC, while the adjusted R2 expresses model 6 is the best. It's important to notice that the low values of R2 are expected because of cleaning the effects of time and the strong autoregressive components related to this from the formation of Debt as a stock.

The regressions include a dummy to control structural change in 1955 for the first group of regressions and another for 1894 for the second group of regressions. Additional structural changes are identified in the computational notebook. Corruption may also play a role in explaining high levels of debt. However, we don't go in depth on that discussion in this essay.

## **5. Conclusions and Recommendations**

In this document, the historical development of Public Debt, in many of its forms has been explored since Independence until 2022. This document makes public the longest estimates of Debt to GDP ratio for Peru and shows preliminary results on the relationship between Debt, Wars and Earthquakes. The moments of social crisis, including civil wars, external wars and natural disasters seem to have a correlation with Public Debt unsustainability. Even though, earthquakes don't seem to be so important and it takes time for the government to make a significant reaction to it. Exploring conflict, war and disasters is key to understanding Public Debt Sustainability. This is a first exercise of exploring disasters. Future studies could explore the role of El Niño phenomenon on Public Debt.

When not controlling for endogeneity, among all conflicts, internal conflicts had the highest correlation with the Debt to GDP ratio, therefore, compromising Sustainability. However, after cleaning the effects of time and taking the proper lags of the regressors, external wars become the most important, but with a lag of 4 years. Army races and Internal wars show a contemporary relation. Future studies could explore how to deal with the issue of identification the optimum lags. This essay shows that the coefficients are highly sensitive to econometric specifications. Using DAGs instead of equation is more useful to work in this scheme since we don't know, a priori, which is the lag that should be included in the regressions.

Beyond regressions, focusing on describing the results of the compilation, the worst moments for Public Debt in Peru were right after Independence in which Peru did not have a Public Budget and did not even know how much it owed to almost nobody. This was more serious for the case of internal debt for which many books have been written about. The appearance of guano and Public Finance irresponsibility seems to represent the worst impact in Public Finance. The idea that continuous deficit is sustainable in the long run existed in Peru even before Keynesian policy. This is what Basadre called Illusory Prosperity.

The variables studied in this essay have certain problems that shall be addressed to avoid bias in the estimators. The issue of endogeneity in time series analysis is well known. Public Debt as percentage of GDP is nonstationary. This is mainly because there have been waves of unsustainability which were related to irresponsibility in Public Finances and because there are subjacent processes that impact the long-term generating long-term debt cycles. Recently Public Debt does not show explosive patterns. It is important to point out that Debt does not occur in abstract but in the real world where there is corruption, war and disasters. Even though this essay was not focused on the issue of corruption nor stability, these variables seem important to understand why Peru may have had higher debts in the past. Also considering additional classic controls such as interest rate, growth rate, depreciation/devaluation rate and inflation are key. However, there is still space to complete the time series on corruption that ends in 2000.

From the perspective of policy recommendation, the necessity of having institutions ready to act during catastrophic events and to reduce the time policy responds to those crises is key. It's also important to point out that diplomacy has also value since, despite its costs, it could avoid wars if countries understand each other and work together to reach a sustainable peace where security is not compromised. Coordinated disarmament or coordinated purchases of weapons could guarantee a strategic equilibrium in which countries can protect themselves and avoid army races. On the future, even joint disarmament could be a diplomacy objective. But just as Peru shall have positive relations with her neighbors, Peru shall have a positive relation with itself. Dialogue and mutual understanding should be promoted among all Peruvians, respecting their cultures and identities and doing the best efforts to avoid war.

Corruption should be fought everywhere and whenever possible because it has a negative effect in Public Finances and, through that, in the wellbeing of all Peruvians. Corruption seems like a robust regressor. Therefore, fighting corruption should be a common day activity if reaching Public Debt Sustainability is our objective. Transparency with conflicts of interests, honesty and diligence are key requirements of it. Future studies could go in depth in war related variables such as deaths, expenditures and others. Other kinds of disasters, such as El Niño phenomenon could be incorporated in the future. Of course, adding classical regressors such as internal and external actual interest rates (instead of our proxy), taxation, public investment and others remain research opportunities for the future. Economic growth remains a key explanatory variable for the Debt to GDP ratio.

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