EthiFinance Ratings

Sovereign Long-Term Rating Methodology

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1. Executive summary

This document describes the methodological process by which EthiFinance Ratings assigns a sovereign credit rating. It captures both financial and extra-financial risks that determine a sovereign's credit quality defined as the issuer´s ability and willingness to honour its financial commitments fully and in a timely fashion (for more details, please see the EthiFinance Credit Rating Scales & Definitions document[1]).

Ratings assigned by EthiFinance to sovereigns are based on the analysis of a mix of qualitative and quantitative factors through a concise three-step process designed to deliver precise and nuanced credit ratings:

- Model-Driven Anchor Rating: The foundation of our ratings lies in the calculation of an anchor rating, employing a partial least square combined with variable importance projection (PLS-VIP) model. This model has been calibrated using the creditworthiness of the country as a dependent variable and a set of 38 key performance indicators (KPIs), spanning across macroeconomic performance (making up 30% of the anchor rating), public finances (20% of the anchor rating), and ESG factors (50% of the anchor rating), as explanatory variables.

- Qualitative Adjustments: Building upon the quantitative anchor rating, we apply qualitative adjustments to encapsulate risk factors, future trends, and qualitative aspects not fully captured by the initial model. This step enriches the rating with a deeper layer of analysis, ensuring that it accurately reflects the sovereign's credit landscape.

- Modifiers: The process concludes with the application of modifiers when appropriate to address extraordinary events or to reflect special features such as having a reserve currency, adding a final layer of refinement to the rating.

Data integrity is paramount in our analysis. EthiFinance Ratings uses a broad array of data, including economic, social, and environmental metrics, primarily from public sources like national statistical offices and international organizations, to determine sovereign credit ratings. We incorporate historical data and forecasts. For solicited ratings, additional private information from governments can be used.

[1] https://www.ethifinance.com/es/calificaciones/ratingScale

2. Scope

This methodology applies to debt issued by sovereign governments both in local and foreign currency, subject either to local or international law.

Sovereign governments are understood to control states recognized by the United Nations through their authority to manage the state's own resources without depending on other governments at the same political level and/or external control. In fact, they are the highest authority in the country, and they have the power to establish the country's institutional framework, including the capacity to make their own fiscal, monetary, and/or political decisions independently. We use this methodology also to rate national central banks. In the case of economic and monetary unions (in which countries cede their monetary policy to a supranational organization) we consider as sovereigns each of the members if they fulfil the other aspects of our definition.

To avoid any doubt, we exclude in the scope of this methodology local and regional governments (for more detail please see EthiFinance Ratings' Sub-Sovereign Methodology document) and other government-related entities (GREs).

The rating assigned by EthiFinance Ratings measures the ability and willingness of a sovereign issuer to honour its financial obligations with commercial creditors fully and in a timely fashion. Therefore, defaults on obligations to creditors that are other governments, supranationals, local and regional governments and government-related entities are excluded from our definition of default. For further considerations on sovereign defaults and their definition see Annex D.

3. Source of data

We use macroeconomic, social, financial, political, environmental and any other data that we consider necessary for the issuance of a rating.

For unsolicited ratings, we use public information always from national statistical offices as the main source of information, followed by national central banks and other national authorities or institutions of recognized prestige, such as World Bank, OECD, IMF, Eurostat, and Bank for International Settlements, among others. All figures are converted to a hard currency (usually euros and US dollars).

We rely on the information that the government publishes. EthiFinance Ratings does not audit the data used.

With exceptions, most of the data used is on an annual basis and it is calculated from averages (4 years of historical information (three historical years plus the current year) plus one year of forecasts (next year when it is available). Mainly we use our own forecasts but, in their absence, we use third-party forecasts (from national and international agencies). Those forecasts are based on macroeconomic projections that, if not met, could result in a downgrade.

However, the number of years included in the quantitative analysis may vary in order to obtain a more realistic picture of a sovereign's credit profile. In exceptional cases, a certain year may even be excluded from our assessment if extraordinary circumstances (for example, a pandemic) occurred during that year that we believe are not representative of the sovereign's creditworthiness and that if considered would lead to an unwarranted lowering of its credit rating.

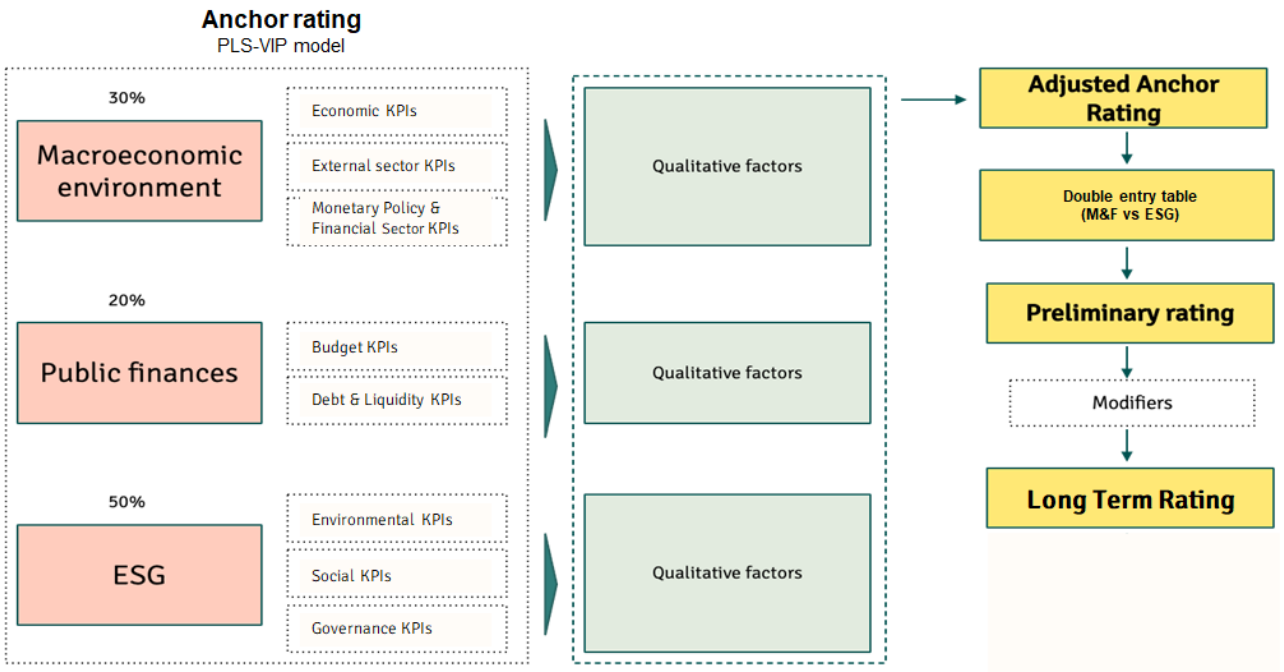
For solicited ratings, we use the same information as well as any non-public information provided by the sovereign, which allows us to perform a more thorough evaluation of the analytical factors included in this methodology.

In all cases, if we do not have adequate information, the sovereign government will not be rated or, if we already rate it, the rating will be withdrawn.

4. Analytical approach

A summary of EthiFinance's analytical approach to rating a Sovereign has been explained in the Executive Summary of this document and is illustrated in Table 1.

Table 1 – EthiFinance Sovereign Rating Methodology[2]



4.1. Deriving the Anchor Rating – the PLS-VIP model -

The first stage in rating a Sovereign is to establish its Anchor Rating. To do this, we use a PLS-VIP model, which is an expert-based regression that uses different levels of data. The process by which the model estimates anchor scores is illustrated in Figure 2 and comprise the following steps.

Step 1. Prior to using the model, the macro, fiscal and ESG quantitative KPIs (also referred to as the explanatory variables) are selected through an expert analysis (based on economic theory and our own expertise) combined with different statistical tests (significance analysis and VIP). These quantitative variables are grouped according to their nature into two large categories -Macro-Fiscal (22 KPIs) and ESG (16 KPIs) (See Tables 7,11 and 14), which in turn are subdivided into three pillars[3] with their corresponding weights as follows:

1) **Macroeconomic Environment Pillar:** which encompasses the analysis of the socioeconomic situation, monetary policy, the financial system, and the external sector sub-pillars.

[2] We use three decimal places, but for illustrative purposes we have rounded up to the nearest whole number.

[3] See Section 4 for more information.

2) **Public Finances Pillar:** which encompasses the analysis of the fiscal sub-pillar, debt sub-pillar, and sovereign government liquidity sub-pillar.
3) **Environmental, Social & Governance -ESG- Pillar:** which encompasses the analysis of the environmental sub-pillar, the social sub-pillar, and the governance sub-pillar.

Step 2. Before feeding the KPIs into the PLS-VIP model the variables must be normalised to avoid the problems associated with the different units in which they are expressed (monetary units, percentages, number of years, etc.). To normalise each variable, we used data available for 193 countries provided by the World Bank database. The observed data, for a given KPI, was plotted onto the most appropriate theoretical distribution function choosing the one with the lowest Root Mean Square Error (Annex B indicates the distributions used for each KPI). In some cases, the distribution is inverted in order that all variables respect the same logic, namely, that the higher the value the better the assessment. In exceptional situations, normalization adopts specific distributions to respect the economic sense of the variable. For example, in the case of consumer prices we take into account the distance from a central value (central bank mandate) and for this reason the distribution is curvilinear. For each KPI, and to consider trends rather than point-in-time data, the data used for normalisation consisted of the average over a 5-year period (4 years with historical information plus 1 year of forecasts, when available). In cases where there is not enough information - for example, in the case of certain environmental variables - we used data from the latest year available.

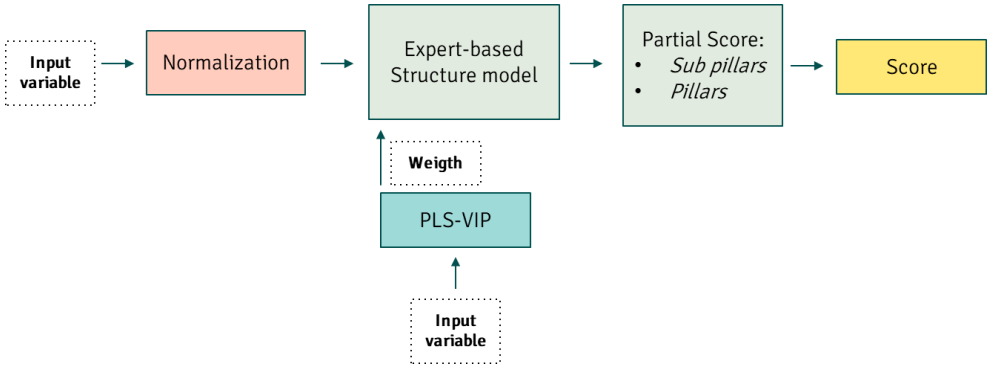
The result of normalisation is that any KPI value of a sovereign can be converted into a score of between 0 and 1.

Step 3. The normalized values of each KPI for the 193 countries which complied with our sovereign definition are introduced in the PLS-VIP[4] model which estimates the relative importance of the variables by assigning weights to each variable, sub-pillar, and pillar. To ensure that the model optimises the weights of each of the KPIs in such a way that the resulting final score is the best assessment of a sovereign's creditworthiness, the PLS-VIP model is fitted, using as the target variable the creditworthiness of the government, and as the explanatory variable each of the 38 KPIs mentioned before (In Annex A we have included a detailed explanation of the model). As a result of this process, the model distributes the weights amongst the three pillars, then it estimates the weights of the sub pillars belonging to each of the pillars, and finally it assigns weights to the KPIs belonging to each of the sub-pillars.

Step 4. The PLS-VIP model is now prepared to generate an anchor score for any sovereign. The analyst will feed the 38 normalised variables for a given sovereign into the model and it will assign the anchor score by multiplying each KPI score by their corresponding weights calculated in Step 3.

[4] Grömping, U. (2015). Variable importance in regression models. Wiley interdisciplinary reviews: Computational statistics, 7(2), 137-152.

Figure 2 – PLS-VIP model estimation process



The weights over the total score assigned by our model to each of the pillars and sub-pillars are shown in Table 2 below:

Table 2: Final weights[5] for pillar and sub-pillars over total score

Macroeconomic Environment (30%)			Public finances (20%)		ESG (50%)		
Socio-economic (10.69%)	External sector (10.22%)	Financial Sector and monetary (9.48%)	Budget (10.09%)	Debt & Liquidity (9.50%)	Environmental (4.74%)	Social (21.98%)	Governance (23.28%)

4.1.1. Anchor rating

Using the weights estimated through the PLS-VIP model explained before (Table 2) and the value taken for each of the normalized variables, we obtain the scores for each of the variables.

Since these are normalized variables, these scores are within the range [0,1] and should be understood as continuous cut-off points, which allows us to maximize the discriminating power of each of the KPIs used. Aggregating the scores of the sub-pillars and pillars, we obtain the final score of the model. This raw score is inverted, so, in this case, higher values correspond to worse situations, and are rescaled between 0 and 10. For more detail, please see the Annex D.

Finally, the score is converted into the anchor rating using our EthiFinance Ratings scale conversion table (Table 3). The boundaries of all ratings are established through linear interpolation to the nearest third of a whole number. For example, an Anchor rating score between 3.0 and 3.33 translates into an 'A+', whereas an Anchor score between 3.34 and 3.67 would translate into an 'A' rating.

[5] We use three decimal places, but for illustrative purposes we have rounded up to the nearest whole number. In this table we have only shown weights for pillars and sub-pillars, the weights for each explanatory variable are shown in the following epigraphs and in Annex 2.

The PLS-VIP model is calibrated to yield a minimum rating of CCC-. However, EthiFinance's scale also includes CC, C and D rating categories. A sovereign will be assigned a CC or a C if EthiFinance believes that the sovereign is very close to default and/or for subordinated debt of issuers that may be linked to the sovereign, such as GREs. Sovereigns rated D are in default under our definition[6].

The complete long-term rating scale and the definition of each of the rating categories can be found in the "Credit Rating Scale & Definitions" document that appears on the EthiFinance Ratings website[7].

Table 3 - Alphanumeric mapping for the Anchor rating

AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-
1	2			3			4		

BB+	BB	BB-	B+	B	B-	CCC
5			6			7 – 8[

4.2. Deriving the Issuer Credit Rating

To arrive at the Issuer credit rating, EthiFinance may adjust the Anchor Rating up or down with the use of the following three tools that complement the anchor rating calculate by the model:

- Qualitative analysis
- ESG double-entry table cap.
- Modifiers

4.2.1. Qualitative adjustments

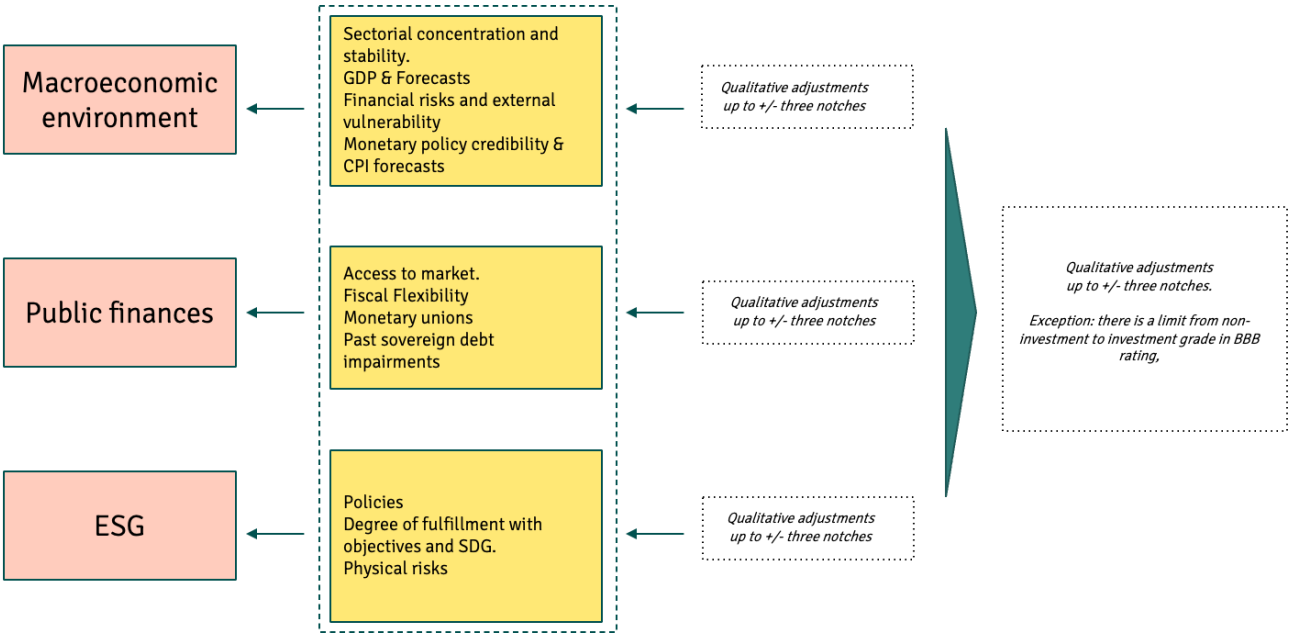
Once the anchor rating has been established, the process continues with the qualitative analysis. In this part we seek to incorporate into the analysis, qualitative factors and future trends that cannot be considered in the determination of the anchor rating due to the intrinsic limitations of the model. The qualitative analysis is done sub-pillar by sub-pillar and the impact on the overall anchor rating is limited by the weight of each sub-pillar.

In summary, the qualitative analysis is performed taking into consideration a series of nominal or qualitative variables -for example, central bank independence- or quantitative variables for which we do not have sufficient historical information and/or a relevant sample that otherwise would have allowed us to incorporate them into the PLS-VIP model. In the case of ESG KPIs, they are policy assessments, which are also difficult to incorporate into the model.

[6] https://www.ethifinance.com/es/calificaciones/ratingScale

For further information, Table 4 shows a summary of the categories of these adjustments, which are described in greater detail in Section 5 of this methodology.

Table 4 - Qualitative analysis



This qualitative process can upgrade or downgrade the rating assigned by the PLS-VIP model in each of the pillars by up to +/- 3 notches.

To determine the number of notches, we perform a two-step exercise:

- First: we analyse the factors defined in Section 5 of this methodology, sub-pillar by sub-pillar, assessing each of them as either Positive, Negative or Neutral to the sovereign's creditworthiness.
- Second: we translate these assessments into adjustment notches using the conversion table (Table 5).

Although the analysis is done sub-pillar by sub-pillar, the upgrade or downgrade of the anchor rating is also limited to +/- 3 notches (See the 4.2.3 Modifiers section to understand our view for countries with a reserve currency).

Table 5 - From qualitative adjustments to anchor rating impacts

Impact	Fundamentals
+ Three notches	All qualitative aspects affecting sub-pillars must be assessed as Positive.
+ Two notches	Half plus 1 of the qualitative aspects must be assessed as positive and the negative assessments do not exceed the neutral ones.
+ One notch	Half plus 1 of the qualitative aspects must be assessed as positive.
Neutral	Positive assessments are not the majority.
- One notch	Negative assessments outnumber the positive ones.
- Two notches	Negative assessments are the majority, and the positive assessments outnumber the neutral ones.
- Three notches	All qualitative aspects affecting sub-pillars must be assessed as negative or if the negatives are the majority, neutral assessments outnumber positive ones.

After applying qualitative adjustments, we obtain the **adjusted anchor rating**.

4.2.2. ESG-Double entry table cap

In extreme cases where the adjusted score of the ESG pillar is very high and the adjusted macro-fiscal score is very low, or vice a versa, calculating the weighted average of the scores of the blocks can give inconsistent rating outcomes that are too high. To solve this problem of overrating, we use a double-entry table that essentially caps the adjusted anchor rating at the extremes. The double-entry table is skewed in favour of the Macro and Fiscal pillars because we understand that a sovereign could face problems to honour its financial debt maturities despite having a strong ESG profile much more so than if the sovereign has a strong Macro and Fiscal profile and a weak ESG profile (see Table 6).

Table 6 – Double Entry Table – Preliminary Rating

	Environmental, Social & Governance Pillar							
	Cat (*)	**AAA**	**AA**	**A**	**BBB**	**BB**	**B**	**CCC**
Macroeconomic & Fiscal Pillar	**AAA**	*AAA*	*AAA*	*AA*	*AA*	*A*	*BBB*	*BBB*
	AA	*AAA*	*AA*	*AA*	*A*	*BBB*	*BBB*	*BB*
	A	*AA*	*AA*	*A*	*A*	*BBB*	*BB*	*BB*
	BBB	*A*	*A*	*BBB*	*BBB*	*BB*	*BB*	*BB*
	BB	*BBB*	*BBB*	*BB*	*BB*	*BB*	*B*	*B*
	B	*BB*	*BB*	*B*	*B*	*B*	*B*	*CCC*
	CCC	*B*	*B*	*B*	*CCC*	*CCC*	*CCC*	*CCC*

(*) The table above shows only the distribution by rating categories. Further granularity within the categories will be provided by the rating committee according to an expanded table constructed following the same logic.

The result obtained from applying the double-entry table is the final **Preliminary Rating**.

4.2.3. Modifiers

EthiFinance Ratings distinguishes three major circumstances where our preliminary rating can be adjusted:

- **Extraordinary events**: There are events of an extraordinary nature (wars, major natural catastrophes, epidemics, cyber-attacks, ...) that are captured neither by the PLS-VIP model nor by the qualitative adjustments discussed above. However, they can influence the sovereign government's ability and willingness to pay its obligations.

  In this sense, we understand that, for example, countries that are close to war or any other type of armed conflict will likely experience shortfalls in external financing that would impact negatively the balance of payments and, ultimately, the public finances of the country.

  For this reason, in this phase, we analyse the risk of occurrence of any of these events and, if appropriate, we adjust the Preliminary Rating. To do this, first, we estimate the impact of the event on public finances to identify if the government maintains the ability to service its debt maturities in the short-term. Secondly, we estimate the new financing needs following the event.

  Our methodology limits to a maximum of six notches the negative adjustment of the preliminary rating. However, and under very rare circumstances, the analyst can propose to the rating committee a larger adjustment, applying the definitions established in our Scales and Definitions document.

- **Reserve currency:** in the case of a government that issues a reserve currency, the cap imposed to the qualitative adjustment (see section 4.2.1) is not applied because we believe that its capacity to carry debt is high. In this sense, several studies have demonstrated that in stress moments investors look for non-risk investments to allocate their resources, and only countries issuing reserve currencies[7] can become public issuers of safe assets (Bogołębska, J. et al, 2019)[8]. Therefore, we understand that they won't face difficulties to raise debt to repay their maturities.

- **Adjustment for statistical distortions:** in very rare situations, some of the statistical indicators used by the PLS-VIP model may not accurately reflect the situation and/or structure of the economy of the country being analysed (for example, GDP in the case of Ireland). In such cases, the analyst may suggest to the rating committee an adjustment in the preliminary rating to correctly reflect the country's solvency in accordance with the definitions established in our Scales and Definitions document. After this process, we obtain the **Long-Term Rating** (Long-Term).

[7] Considered as those included by the IMF in the Special Drawing Rights (SDR).

[8] Bogołębska, J., Feder-Sempach, E., & Stawasz-Grabowska, E. (2019). Reserve Currency Status as a Safe Asset Determinant. Empirical Evidence from Main Public Issuers in the Period 2005–2017. Comparative Economic Research. Central and Eastern Europe, 22(3), 65-81.

5. The analytical process: the PLS-VIP model and the qualitative adjustments

In this Section we describe in more details 1) the rationale behind the quantitative KPIs that are used to arrive to our anchor rating and their corresponding weights (See tables 7,11 and 14). These KPIs and weights are used to calculate the scores of the three pillars: macroeconomic, public finances and ESG; and 2) the qualitative factors that lead to the adjusted anchor rating (See tables 8, 9, 10, 12,13 and 15) as we explained before in section 4.2.1.

5.1. Macroeconomic Environment Pillar

We consider that a dynamic and productive economy is a driver of employment and wealth. These provide a solid source of income for the sovereign government to tax, as well as a wide margin of manoeuvre to deal with future stress situations.

Moreover, it is important to consider the vulnerabilities (or opportunities) that can derive from the external sector, monetary policy, and the financial sector.

Thus, in this pillar we analyse the three sub-pillars and the KPIs illustrated in the Table 7 below.

Table 7: Macroeconomic environment: sub-pillars & KPIs. Weights[9].

Macroeconomic Environment Pillar								
Socioeconomic (35.2%)			**External Sector (33.6%)**			**Monetary Policy & Financial Sector (31.2%)**		
KPI	**Weight**	**Corre-lation**	**KPI**	**Weight**	**Corre-lation**	**KPI**	**Weight**	**Corre-lation**
GDP Evolution	8.95	Positive	*Current Account Balance*	24.57	Positive	*NPL*	27.01	Negative
GDP s volatility	10.82	Negative	*NIIP*	28.12	Positive	*ROA*	17.82	Positive
GDP Size	18.85	Positive	*Importance of currency*	29.06	Positive	*Solvency*	15.48	Positive

[9] We use three decimal places, but for illustrative purposes we have rounded up to the nearest whole number.

Age dependency ratio	10.29	Negative	*Currency Reserves*	18.23	Positive	*CPI average*	23.54	Negative
Unemployment average	12.90	Negative				*CPI volatility*	16.13	Negative
Unemployment evolution	13.16	Negative						
GDP pc	24.99	Positive						

Regarding the **Socioeconomic sub-pillar**, our analytical process focuses on the analysis of the sovereign's macroeconomic situation.

To evaluate the macroeconomic environment of an economy our PLS-VIP model will use, among others, the following indicators:

- **Real GDP Evolution**, we believe that the capacity of sovereigns to generate the necessary resources to finance programs and services, as well as to fulfil their financial obligations, is conditioned, among other aspects, by economic growth. In fact, we consider that low growth amplifies the challenges of debt repayment capacity and can make a high debt burden unsustainable. We analyse historical data and trend rates to determine the real growth that can be maintained without inflationary pressures, or other economic imbalances.
- **Real GDP Volatility**, we are interested in the volatility (measured through standard deviation), because greater volatility can be associated with a more uncertain or unstable economy, which can affect government revenues and expenditures.
- **GDP Size**, we analyse the size of the economy, in relation to global GDP because we believe that a large and diversified economy has a greater capacity to generate resources to meet its financial obligations compared to small and less diversified economies. In fact, smaller countries (even with high levels of wealth) may also have less capacity to face extraordinary events, such as natural disasters.
- **Age Dependency ratio** we study demographic trends because we understand that fast demographic growth may require better and larger infrastructures to ensure access to public services. These can increase the need for investments and, ultimately, consume financial resources. On the contrary, an ageing population could also negatively affect economic development through lower productivity (because of a decreasing productivity as the population ages), an increase in social expenses, and structural changes to the economy. Therefore, we positively value countries that have a sustained population growth rate over time, either through favourable fertility levels or through immigration. We evaluate the shape of the population pyramid, because it is expected that older populations require higher social expenses than those that are more balanced. Similarly, the evolution of the child population is relevant since its rapid growth may necessitate an increase in spending for education and health. We value positively a low share of dependent population (people below 16 years old and over 65 years old) in relation to the labour force.

- **Unemployment (average & evolution)**. We consider that economies with high unemployment rates could face limited tax collection capacity due to lower disposable income of citizens pressing down over the tax collection capacity of the sovereign, who might also increase it expenses in social assistance. We use the current unemployment rate and its forecast (when available), with particular attention to peer analysis.
- **GDP per capita.** First, we analyse wealth through GDP per capita (GDPpc), which is measured as the GDP (defined in previous section) over the number of inhabitants. We believe that the GDPpc is a good indicator of national wealth because it allows us to measure tax collection capacity as well as the relative level of social benefits enjoyed by citizens. We believe that a high GDPpc provides a greater margin of manoeuvre to collect taxes than a reduced GDPpc.

As indicated in Section 4 of this methodology, the score assigned by the PLS-VIP model to each of the sub-pillars can be adjusted up or down depending on a series of qualitative factors. Specifically, the qualitative analysis of this sub-pillar is calculated taking into account the following qualitative factors (Table 8).

Table 8: Socioeconomic qualitative adjustments.

	Positive	Neutral	Negative
GDP	The GDP growth forecast for the next three years exceed potential GDP and is not the result of an extraordinary event.	The GDP growth forecast for the next 3 years is in line with potential GDP.	The GDP growth forecast is below potential GDP.
	It is a major economy (G20) at a global level due to its level of influence.	Although its global presence is limited, it is relevant within its area of influence.	It is an economy with little or no influence at the global level or within its area of influence.
Sectoral concentration and vulnerabilities	Each productive sub sector does not represent more than 20% of GDP and/or employment, and the principal subsector does not present a highly volatile evolution.	There is at least one productive sub sector that represents more than 20% of GDP but presents low volatility or is a subsector considered not highly vulnerable.	There is at least one subsector that represents more than 30% of GDP and/or employment, or even though it does not reach this level, it is a sector that is a source of vulnerability for the economy.

With regard to the **External Sector sub-pillar,** we evaluate the economic and financial interactions with the rest of the world. Past events have shown that some sovereign debt crises have been motivated by imbalances in the balance of payments, such as Russia in 1998 or some newly industrialized Asian countries in the late nineties.

Net current account transactions are balanced by net surpluses in the financial account transactions (including changes in reserves). Imbalances, adjust through currency movements, which affect a country's external competitiveness. The current account behaviour can be considered an early indicator of economic crises, in the sense that economies with high current account deficits also depend on external financing.

To evaluate the external behaviour of an economy our PLS-VIP model will use, among others, the following indicators:

- **Current account balance (% GDP):** measures the transactions of goods and services (imports and exports) with the rest of the world, as well as transfers, capital, and labour income. Countries in surplus are less dependent on external financing and, therefore, more isolated from external shocks that may limit its financing capacity. In the case of the existence of a current account deficit (imports are higher than exports), we are interested in evaluating not only its size compared to GDP (high levels are considered as predecessors of economic crises), but also the trajectory of the components of the financial account, in order to determine the existence of equilibrium of the balance of payments.
- **Net International Investment Position (% GDP)**: measures the difference in the stocks of external financial assets and external financial liabilities of an economy at a given moment in time. We consider this a useful indicator for measuring the integration of a country in the international financial markets. These balances are the result of past transactions with foreign countries at market prices and prevailing exchange rates, in addition to other factors such as valuation adjustments. We favourably value an economy presenting a net positive international investment position, as it means that the volume of financial assets held is higher than external financial liabilities, reflecting a lower dependence on external financing. On the contrary, countries with a negative international investment position are more dependent on external financing.
- **Currency reserves (in months)**. We believe that economies highly dependent on imports, but with a high level of foreign exchange reserves, are less sensitive to sudden stops in international capital flows than economies with less international reserves. This is because central banks can sell their reserves to finance the capital outflow. The assessment of foreign exchange reserves is calculated in relation to the volume of imports of goods and services. We consider that they should cover at least three months of imports to be considered minimally acceptable. This is mainly for countries without a currency that is considered a reserve currency[10].
- **Importance of currency**, as a measure of the liquidity of a currency. We understand that sovereigns that issue a currency that is widely used in international transactions, will benefit from greater liquidity than those with a currency that is only used in local transactions. To measure the importance of the currency, we use data from the Bank for International

[10] Considered as those included by the IMF in the Special Drawing Rights (SDR).

Settlements, to establish the volume of foreign currency in international transactions (foreign exchange turnover by currency). The greater the use of the currency, the greater its liquidity and, therefore, the greater access to external financing of the country.

As indicated in Section 4 of this methodology, the score assigned by the PLS-VIP model to each of the sub-pillars can be adjusted up or down depending on a series of qualitative factors. Specifically, the qualitative analysis of this pillar is performed looking at the following qualitative factors (Table 9).

Table 9: External Sector qualitative adjustments.

	Positive	Neutral	Negative
External sector	The country has a flexible exchange rate and allows exchange rate fluctuations.	The country has a flexible exchange rate, although its fluctuation is within a narrow band.	The country has a fixed exchange rate.
	The export structure is diversified (no single good exceeds 25% of total exports), more insulated from possible shocks in international trade.	The structure of its exports is slightly concentrated (between 25% and 50%), but exports do not have a relevant weight in GDP (less than 25%).	Its exports are highly concentrated (>50% of the total) and have a high weight in GDP (>25%).
	It presents a sustained surplus in its current account.	It presents deficits in its current account, but they are financed through foreign direct investment (FDI).	It presents deficits in its current account on a permanent basis and are financed by portfolio flows or similar.

Finally, and with regards to the **Monetary Policy and Financial System sub-pillar** we evaluate the banking sector risks because we believe that financial crises constitute one of the main mechanisms that amplify economic crises. This is both due to the restriction of credit (that in the end could lead to a period of deflation), and the high amount of fiscal resources that are necessary to rescue problematic financial institutions.

In this sense, the economic crisis of 2008 showed that sovereign governments could be forced to allocate tax revenues in order to recapitalize unsound financial institutions. This is in addition to potentially guaranteeing obligations issued by banks that, in the end, could threaten the government's ability to pay its own financial obligations.

We believe that a country with a stable financial system, whose size is moderate in relation to GDP, with good levels of profitability and liquidity, capital adequacy and credit quality, is more resilient than a country with a vulnerable financial system. A stable financial system has, in the end, positive effects over the country's economic performance.

In this sub-pillar we also evaluate the adequacy of the monetary policy to meet the objective of price stability, since we believe that prolonged periods of high inflation are inversely related to the economic growth rate. This was the historic case with Germany in early 1920s and, although to a lesser extent, both the United States and Great Britain in the mid-70's.

Therefore, we consider that a sound monetary policy that delivers price stability and a solvent financial system has positive effects on economic growth, the exchange rate, the level of employment, and social cohesion.

Finally, we analyse the institutional framework in which the monetary policy operates to identify the factors that affect price mechanisms. We also consider the credibility of the objective of price stability, and the degree of independence of the central bank from political interference.

In this sense we consider that the credibility of the central bank is a key element to maintaining the financial and economic stability of a country.

For this analysis, our PLS-VIP model considers the following KPIs:

- **Non-performing loans (NPL)**. It was shown that one of the main factors that explain banking crises is credit portfolio quality, measured through the ratio of non-performing loans to gross loans, because this directly impacts a bank's capitalization. We believe a large volume of non-performing loans could trigger a bank's insolvency. This could lead to the need of assistance from the sovereign government.
- **Return on assets (ROA)**. Profitability is directly related to bank capitalization, in the sense that the lower the profitability, the lower the bank's capacity to retain earnings and to allocate funds to loan loss reserves. This could lead to regulatory capital ratios being breached and require assistance from the sovereign government in the event private capital cannot be raised. We use the Return on Assets ratio (ROA), calculated as the sectorial consolidated result to total assets. We consider that the higher the ratio, the lower the risk of extraordinary support.
- **Solvency: Common Equity TIER 1.** A bank's solvency is directly related to its ability to absorb losses in times of stress. To measure solvency, EthiFinance rating looks at the quality of the bank's eligible capital as a function of risk-weighted assets.
- **Consumer Price Index (CPI)**. The CPI reflects the effectiveness of monetary policy during an economic cycle. We believe that high levels of inflation negatively affect the efficient allocation of resources, slowing down investments and, thus, economic growth. In this sense, we consider that inflationary periods tend to be precursors for economic and political instability, favouring capital flight, currency crises, and the deterioration of the balance of payments. Therefore, we assign worse scores to those sovereigns with high inflation, or to those experiencing deflation, which can lead to increases in unemployment and delayed consumption. On the contrary, we believe that a moderate (below the central bank's inflation mandate) and sustained level of inflation is positive for economic development, job creation, and capital investment, thus boosting economies.
- **CPI volatility** as a signal of price stability. We measure it through standard deviation (the lower the volatility, the lower the score).

As indicated in Section 4 of this methodology, the score assigned by the PLS-VIP model to each of the sub-pillars can be adjusted up or down depending on a series of qualitative factors. Specifically, the qualitative analysis of this pillar is performed using the following qualitative factors (Table 10).

Table 10: Monetary policy and financial sector qualitative adjustments.

	Positive	Neutral	Negative
Monetary policy and inflation	The Central Bank's policy is independent of the government, clearly established and conveys credibility and confidence in its decisions.	The Central Bank's policy is independent of the government but is not clearly established or there is a lack of credibility from the economic agents.	The Central Bank's policy is not clearly defined or is not independent from the government or there is a lack of credibility.
	Inflation outlook for the next three years is in line with the Central Bank's mandate.	The inflation outlook for the next three years is close to the Central Bank's mandate.	The inflation outlook for the next three years is far from the Central Bank's mandate, or the country is in a situation of deflation.
Financial System	The size of the banking sector total assets does not exceed 200% of the country's GDP, or if it does, 75% or more of consolidated banking assets correspond to systemic banks. In addition, supervision by a regulatory body is established and effective, with well-designed macroprudential[11] measures.	The size of the banking sector total assets does not exceed 200% of the country's GDP, or if it does, 50% or more of consolidated banking assets correspond to systemic banks. In addition, supervision by a regulatory body is established, as are macroprudential measures, although they have not been entirely effective at certain instances.	The size of banking sector total assets exceeds 200% of the country's GDP, or if it does not, 25% or less of consolidated banking assets correspond to systemic banks. In addition, there are no supervisory mechanisms or macroprudential measures in place.
	Private sector credit and house prices increase at a lower rate than nominal GDP growth or, if they exceed it, consumer and/or real estate credit grows at a lower rate than nominal GDP.	Private sector credit and house prices increase at a rate similar to that of nominal GDP growth or, if it exceeds it, consumer or real estate credit grows at a lower rate than nominal GDP.	Private sector credit and house prices increase at a faster rate than nominal GDP growth, or consumer and/or real estate credit grows at a rate that exceeds that of nominal GDP.

[11] Malovana, Janku & Hodula (2023) affirms that macroprudential policy can reduce income inequality and mitigate the redistributive effects of financial crises, which are known to hit the poor harder.

	The outlook for the evolution of nonperforming loans follows a downward trend.	The outlook for the evolution of nonperforming loans is similar to its historical trend.	The outlook for the evolution of non-performing loans is at a pace above its historical trend.

5.2. Public Finances Pillar

The main components of the analysis of the public finance pillar are the sovereign's flexibility to face budgetary imbalances, and its financial autonomy.

We consider that a government that has demonstrated excellent sustainability and adequacy of public finances by controlling budget imbalances and having access to sufficient sources of liquidity, will obtain a higher rating in this factor (or lower score). For this measurement, we have focused especially on general government (meaning central, regional, and municipal governments combined), as it provides a more comprehensive overview of the sovereign's public finances.

To carry out this analysis we have differentiated the two sub-pillars illustrated in Table 11 below.

Table 11: Public Finances: sub-pillars & KPIs. Weights[12].

Public Finances Pillar					
Budget (51.50%)			**Debt & Liquidity (48.5%)**		
KPI	**Weight**	**Correlation**	**KPI**	**Weight**	**Correlation**
Net lending/ borrowing	68.72	Positive	*Gross Debt to GDP*	24.69	Negative
Operating expenses evolution	31.27	Negative	*Evolution of Gross Debt to GDP*	24.62	Negative
			Interests to Operating Revenues	33.16	Negative
			Debt maturity	17.52	Negative

Regarding the **Budget sub-pillar,** we evaluate budget sustainability, i.e., the budget balance, because we consider that the existence of budgetary surplus in the general balance is essential to finance investments and fulfil financial obligations. In fact, it has been demonstrated that many sovereign defaults have been preceded by fiscal imbalances.

[12] We use three decimal places, but for illustrative purposes we have rounded up to the nearest whole number.

If a sovereign is running a budget deficit, we analyse its nature (cyclical or structural), the path towards a balanced position, and, if any, the legal consequences of failing to do so.

We are interested in knowing the structure of public expenses and their evolution in recent years, particularly in relation to the income structure, analysing its flexibility to face imbalances. In this sense, we seek evidence that the proportion of structural expenses over total expenses is not excessive or that these do not represent a high share of total income.

Finally, we evaluate the flexibility of public finances to face imbalances that may arise from economic cycles. Flexibility can come from the sovereign government's ability to increase tax revenues or transfers received at the supranational level (i.e. fiscal unions or international organizations) to finance certain investments, or from the government's ability to manage necessary spending.

We understand that a sovereign government that shows a high capacity to adjust its income and expenses can withstand budgetary pressures better than a sovereign government that lacks such flexibility.

Regarding the budget independence, we especially take into consideration monetary unions (or any other type of unions) where governments give up monetary or fiscal powers in favour of a supranational body, or sovereigns with a manifest dependence on international aid.

To assess the budgetary sustainability of a sovereign government, we use the following indicators:

- **Net lending / borrowing (%GDP):** measures the capacity of the sovereign government to generate sufficient resources to finance public investments and meet financial obligations. We analyse both the current situation and the historical evolution, in the context of the sovereign's macroeconomic and social situation.
- **Operating expenses (growth)**. We analyse the evolution of current expenses and their compliance with legal limits (spending rule, if any). While we recognize governments might conduct counter-cyclical fiscal policies, increasing expenditures in crisis years, we would expect that they do it prudently. We would also expect that their policy actions are symmetrical, running surpluses in growth years.

As indicated in Section 4 of this methodology, the score assigned by the PLS-VIP model to each of the sub-pillars can be adjusted up or down depending on a series of qualitative factors. Specifically, the qualitative analysis of this pillar is performed considering the following qualitative factors (Table 12).

Table 12: Budgetary pillar qualitative adjustments.

	Positive	Neutral	Negative
Budget stability	There are fiscal rules that limit the fiscal deficit, and the government complies with them, or, in case of non-compliance, there are established and real medium-term fiscal correction paths, so compliance is expected before the next three years.	There are fiscal rules that limit the fiscal deficit, and the government complies with them, or, in case of non-compliance, there are established and real medium-term fiscal correction paths, so compliance is expected before the next five years.	There are no fiscal rules limiting the fiscal deficit or the government does not comply with them and there are no mechanisms for their correction, so compliance is not expected before the next five years.
	In the medium term (approx. next three to four years) public spending is projected to increase at a rate similar to nominal GDP or there is a fiscal rule that limits the growth of public spending, and the government complies with it.	In the medium term (approximately the next three to four years), public spending is projected to increase more than nominal GDP, but this does not represent a source of vulnerability for public finances as it is non-structural spending.	In the medium term (approximately the next three to four years), public spending is projected to increase by more than nominal GDP, and this structural spending will be a source of vulnerability for public finances.
	The country has a recurrent primary surplus or the government has defined a credible policy for its achievement in the medium term (approx. next three or four years).	Although it does not present a recurrent primary surplus, the government has defined a credible policy for its achievement in the medium term (approx. next three to four years).	It does not present a recurrent primary surplus and the government has not defined a credible policy to achieve it or is not expected to achieve it in the medium term (approx. next three or four years).
	The sovereign government shows high flexibility to adapt its budget in stress situations. It does not show dependency on resources transferred from supranational organizations for meeting its financial obligations. Thus, the sovereign has limited budget rigidity and is able to increase its tax collection capacity or decrease spending if necessary.	The sovereign government shows moderate flexibility to adapt its budget in situations of stress. It shows a moderate dependency on resources transferred from supranational organizations for meeting its financial obligations. Thus, the sovereign has moderate budget rigidity and is able, with certain limitations, to increase its tax collection capacity -moderate fiscal burden- and cut back on	The sovereign government shows low flexibility to adapt its budget in situations of stress. It shows a high dependency on resources transferred from supranational organizations for meeting its financial obligations. Thus, the sovereign has a high degree of budget rigidity, with constraints its ability to increase its tax collection capacity -high fiscal burden- and to cut back on

		spending -slightly elevated structural expenditure-.	expenditures -high structural expenditure-.

Regarding the **Debt and Liquidity sub-pillar,** we take into consideration both sustainability (basically volume, evolution, and structure) and capacity to assume new debt.

Specifically, we use gross debt (as a percentage of GDP) without considering financial assets of the government or central bank.

To evaluate the capacity of a sovereign government to service debt, we also consider the cost of debt (as a percentage of operating revenues), as well as the foreseeable cost trend that it could present itself in a potential scenario of a rise in interest rates (debt sustainability).

Likewise, we consider the structure of the debt, especially if there is a concentration of foreign currency short-term maturities. This is because sovereign governments with a concentration on short-term foreign currency debt could be forced to refinance in periods of market turmoil.

We also analyse the contingent liabilities that are not part of the consolidated debt of the sovereign government. This is because, if crystalized, they could deteriorate the sovereign government's financial situation, as well as drain liquidity. We consider government-guaranteed debt and the debt of companies whose majority shareholder is the government if we consider that these contingent liabilities may materialize.

Regarding the assessment of liquidity, we focus on identifying available liquid assets (in %GDP) that could be used by sovereign governments to stabilize economic cycles. We also include free cash flow, when it is available, to service its debt.

To assess debt, our PLS-VIP model takes into account the following ratios:

- **Gross Debt to GDP and Evolution of Gross Debt**. We measure the sustainability of debt, in relation to the GDP. We positively value a low ratio, provided the sovereign's institutions are reliable and strong. We also analyse the debt trend (historical data and forecasts).
- **Interest to Operating revenues**. This ratio allows us to measure the resources that the government needs to cover its financial costs. The lower the ratio, the higher the government's ability to meet its obligations.
- **Debt maturity profile (12-month maturity over total debt)**. We are interested in the distribution of debt maturities. We understand that a sovereign government with highly concentrated maturities (or bullet amortizations), will likely present a higher risk of refinancing than a sovereign government with a more homogeneous distribution of maturities.

As indicated in Section 4 of this methodology, the score assigned by the PLS-VIP model to each of the sub-pillars can be adjusted up or down depending on a series of qualitative factors. Specifically, the qualitative analysis of this pillar is done considering the following qualitative factors (Table 13).

Table 13: Debt & Liquidity sub-pillar qualitative adjustments.

	Positive	Neutral	Negative
Debt sustainability	The Government exhibits adequate capacity to access international capital markets with its local currency debt issuance, improving average maturity and keeping the interest burden at levels that do not represent a source of vulnerability. Furthermore, the share of general government debt in foreign currency accounts for less than 6% of the total and short-term maturities in foreign debt are low.	The Government has access to international capital markets although it is forced to make placements in both local and foreign currency, with an increasing interest burden but not yet a source of vulnerability for government finances. Furthermore, the share of general government debt in foreign currency accounts for less than 10% of the total and short-term maturities in foreign debt are adequate.	The Government has limited access to international capital markets in local currency and is therefore obliged to issue most of its debt in foreign currency, which is a source of vulnerability to exchange rate and/or interest rate fluctuations. Furthermore, the share of general government debt foreign currency accounts for more than 10% of the total and short-term maturities in foreign debt are high.
	Public debt in nominal terms follows a downward trend, and this trend is expected to continue over the next five years.	Although public debt has remained stable or increasing, a downward trend is projected for the next five years.	Public debt has maintained an upward trend and is projected to continue to grow over the next five years.
	There are regulatory limits on debt levels and the government is in compliance or is projected to be in compliance within the next two years.	There are regulatory limits on debt levels and the government is in compliance or is projected to be in compliance within the next five years.	There are regulatory limits on debt levels and the government is not in compliance and is not projected to be in compliance for the next five years.
	Contingent liabilities exist, although they do not represent a source of vulnerability due to the limited probability of materialization.	Contingent liabilities exist but there is a very low probability and/or they do not represent a source of vulnerability.	There are contingent liabilities that are highly materializable and/or represent a source of high vulnerability for the government.
	The sovereign government has not defaulted in the past 50 years.	The sovereign government has defaulted in the past 50 years.	The sovereign government has defaulted in the past 50 years.

Liquidity	The difference between gross debt over GDP and net debt over GDP exceeds 10 percentage points of GDP.	The difference between gross debt over GDP and net debt over GDP exceeds 5 percentage points.	The difference between gross debt over GDP and net debt over GDP is less than 5 percentage points

5.3. Environmental, Social & Governance (ESG) Pillar

This methodology includes environmental, social and governance (ESG) criteria and its effects on sovereign governments' ability and willingness to fulfil their financial commitments.

Maplecroft (2012)[13] affirms that countries displaying poor ESG indicators are often more prone to shocks from social problems (i.e., poverty, illiteracy, ethnic and religious differences, and demographic factors), leading to greater sovereign risk. We can find the same conclusion in Capelle-Bancard et al. (2016)[14] or, more recently, in Pineau & Estran (2022)[15]. In this sense, Klusak et al. (2021)[16] affirms that possible transmission pathways are extreme weather events, consumer movements (as protests or other events resulting in reputational risks), transition risks[17] and litigation risks.

In this sense, the absence of regulation on the environment could lead to the depletion of a region's natural resources, with the consequent negative effects on future generations. In addition, the existence of subsidies, or any other type of aid for certain types of activity not considered environmentally sustainable is a negative factor to be considered. We are also concerned about natural disasters (earthquakes, floods ...), the government's ability to foresee and manage them, and the human and negative costs on the economy caused by the loss of industries, crops, and infrastructures.

Regarding social criteria, we value social stability, because economic development benefits from positive human capital management (unemployment, and wage policy), and also because the absence of social stability could entail social conflicts. These, in the worst case, could materialize in violence that could plunge the economy into recession.

Governmental institutions constitute the third criteria, since we believe that an adequate political stability enhances development. This contrasts to the existence of political struggles, which could cause instability in decision-making, and lead to macroeconomic scenarios that are not predictable.

For these reasons, EthiFinance considers that ESG has a high influence on economic development. This is not only due to the direct impact of environmental, social and governance policies, but also because

13

14 Capelle-Blancard, G., Crifo, P., Diaye, M. A., Scholtens, B., & Oueghlissi, R. (2016). Environmental, Social and Governance (ESG) performance and sovereign bond spreads: an empirical analysis of OECD countries. *Available at SSRN 2874262*.

15 Pineau, E., Le, P., & Estran, R. (2022). Importance of ESG factors in sovereign credit ratings. *Finance Research Letters*, *49*, 102966.

16 Klusak, P., Agarwala, M., Burke, M., Kraemer, M., & Mohaddes, K. (2021). Rising temperatures, falling ratings: The effect of climate change on sovereign creditworthiness. Australian National University, Crawford School of Public Policy, Centre for Applied Macroeconomic Analysis.

17 Associated to the pace and extent at which a country adapts to the reduction of greenhouse emission and transitions to renewable energies (e.g. new regulations or technological costs).v

governments could potentially issue new regulations that influence the fulfilment of ESG criteria by other economic actors.

To measure this, our methodology incorporates quantitative variables that are fed into the PLS-VIP model. As for qualitative characteristics, as in the macroeconomic and public finances blocks, these are considered in the qualitative analysis process to obtain the adjusted anchor rating.

Table 14: ESG: sub-pillars & KPIs. Weights[18].

ESG Pillar								
Environmental (9.48%)			**Social (43.95%)**			**Governance (46.56%)**		
KPI	**Weight**	**Correlation**	**KPI**	**Weight**	**Correlation**	**KPI**	**Weight**	**Correlation**
CO2 per inhabitant	31.84	Negative	*Vulnerable employment*	26.37	Negative	*Control of corruption*	16.42	Positive
Consumption Renewable Energy	21.19	Positive	*Human development index*	27.95	Positive	*Rule of law*	16.77	Positive
Protected areas	15.34	Positive	*Health expenditure pc*	27.44	Positive	*Voice and accountability*	15.44	Positive
Physical risks: Agriculture sector	16.69	Negative	*GINI index*	11.15	Negative	*Government effectiveness*	18.31	Positive
Physycak risks: natural hazard	14.93	Negative	*Female to male labour force*	7.08	Positive	*Political stability*	14.66	Positive
						Regulatory quality	18.40	Positive

Regarding the **Environmental sub-pillar**, our methodology analyses the way in which governments manage their natural resources. We do so to determine whether they constitute a source of risk, both for the country's economic performance and for the government's ability and willingness to repay its obligations. The latter could arise if the government is forced to allocate greater budgetary resources to deal with environmental disasters.

At EthiFinance Ratings we understand that the lower the score assigned to each indicator, the better the sovereign government's management of environmental risks, and it will be less likely to find itself in a situation of vulnerability that could compromise its ability and willingness to meet its obligations to third parties in the short term.

For the assessment of this sub-pillar, our PLS-VIP model takes into account the following KPIs:

[18] We use three decimal places, but for illustrative purposes we have rounded up to the nearest whole number.

- **Transition risks: CO2 per inhabitant (metric tons per capita).** Since the publication of Nordhaus (1977)[19] highlighted the relationship between economic growth and climate change, many studies have attempted to quantify the relationship between the two variables. In this sense, Cancelo & Vazquez (2020)[20] show that those countries with higher levels of per capita income are those with the highest CO2 emissions, basically because they are intensive in energy consumption.

  This situation is important, since a country's GDP is the result of capital and labour, and capital -technology- which needs energy to work. The problem is that if capital is inefficient in energy consumption, it will need more energy to continue producing.

  This situation is not trivial because the Kyoto commitments and the Paris Agreements oblige signatory governments to reduce greenhouse gas emissions. To achieve this, countries with the highest levels of CO2 per capita will need to increase investment in favour of a less polluting energy production mix, while promoting energy efficiency in the development of their economic activity.

  We cannot lose sight of the fact that these investments will need to be financed to a large extent with public resources (see Climate-developments financing needs in our qualitative approach), which will come from taxes or new public debt issues. In fact, Hannes (2020)[21] affirms that an increase in temperatures is directly related to the performance of sovereign bonds and, ultimately, to the risk premium associated with their issuance. In a similar way Kotz et al (2021)[22] affirm that increased temperature volatility reduces economic growth.

- **Energy: Consumption of Renewable Energy (% of total final energy consumption).** As a country increases its consumption of renewable energy, it can decrease its consumption of its most polluting sources of energy. Achieving a more favourable mix of energy production facilitates compliance with commitments agreed to in Kyoto and Paris. In fact, there is a direct relationship between renewable energy consumption and economic growth and, ultimately, the development of a country, as highlighted by Carballo & García (2017)[23] in their study applied to large European economies. The problem is that, in the short-term, using non-renewable energy generates growth, while, in the long-term, it leads to pollution and depletion of natural resources (Tillaguango & Loaiza, 2018)[24].

  Beyond the positive externalities on the environment, higher share of renewable energy in total energy consumed has a positive effect on the country's energy independence. This is particularly important in the face of fluctuations in prices of non-renewable energies. In this regard, we

[19] Nordhaus, W. D. (1977). Economic growth and climate: the carbon dioxide problem. The American Economic Review, 67(1), 341-346.

[20] CANCELO MÁRQUEZ, M., VÁZQUEZ, D., & del Rosario, M. (2002). Emisiones de CO2 y crecimiento económico en países de la UE. Estudios Económicos de Desarrollo Internacional. AEEADE, 1(2), 69-91.

[21] Böhm, H. (2020). Physical climate change risks and the sovereign creditworthiness of emerging economies (No. 8/2020). IWH Discussion Papers.

[22] Kotz, M., Wenz, L., Stechemesser, A., Kalkuhl, M., & Levermann, A. (2021). Day-to-day temperature variability reduces economic growth. Nature Climate Change, 11(4), 319-325.

[23] Caraballo Pou, M. Á., & García Simón, J. M. (2017). Energías renovables y desarrollo económico. Un análisis para España y las grandes economías europeas. El trimestre económico, 84(335), 571-609.

[24] Tillaguango, B., & Loaiza, V. (2019). Efecto causal de la energía sustentable y no sustentable en el crecimiento económico: nueva evidencia empírica global por grupos de países. ReVista Económica, 6(1), 37-48.

should not lose sight of the shocks experienced by major industrialized countries in the 1970s with the oil price shock, or more recently with the war in Ukraine and the imposition of sanctions on gas from Russia.

- **Forest: Protected areas (% of total land area).** The World Commission on Environment and Development (WCED) defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs", with the Sustainable Development Goals (SDGs) being the specific milestones established in 2015. Within this framework, SDG 15 focused on the protection of biodiversity, since as shown by Bertzky et al. (2012)[25] protected areas provide livelihoods for millions of people and maintain carbon stocks on earth, which helps to mitigate and regulate climate change. In fact, that protected areas could help reduce poverty, which in the long term could have a positive impact on the country's fiscal situation by improving its revenue-raising capacity and reducing fiscal resources allocated to social policies.
- **Physical Risks: Agriculture, forestry, and fishing (% of GDP).** Because of its own nature, the primary sector is one of the most vulnerable to climate risk, especially due to the increased frequency of extreme natural events[26]. Therefore, countries where this sector represents a larger share of their GDP will be more exposed to these events, which could impact production, employment, tax revenues, and foreign currency receipts, among others-.

  In addition, agricultural activity is recognized as one of the main contributors to global CO2 emissions and is, therefore, a source of vulnerability for the adequate control of greenhouse gas emissions into the atmosphere. In this sense, Appiah et al. (2018)[27] conducted a study with the objective of examining the causal relationship between agriculture production and carbon dioxide emissions in emerging economies from 1971 to 2013. They found that a 1% increase in economic growth, crop production index, and livestock production index generated increases in carbon dioxide emissions of 17%, 28%, and 28%, respectively.
- **Physical risks: Natural hazards.** To assess country-level vulnerability and coping capacity related to climate change we use INFORM Global Risk Index[28] published by the Joint Research Centre - JRC - European Commission. This index identifies countries at a high risk of humanitarian crisis that are more likely to require international assistance. It takes into account three big dimensions: hazard & exposure (earthquakes, tsunamis, floods), vulnerability, and lack of capacity to cope.

Regarding the **Social sub-pillar,** our methodology considers the efforts made by sovereign governments in favour of human development, both in their own country and in their contribution to global human

[25] Bertzky, B., Corrigan, C., Kemsey, J., Kenney, S., Ravilious, C., Besançon, C., & Burgess, N. (2012). Protected Planet Report 2012: tracking progress towards global targets for protected areas. Protected Planet Report 2012: tracking progress towards global targets for protected areas.

[26] Field, C.B., V.R. Barros, D.J. Dokken, et al., (2014), Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, IPCC, 2014: Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1132 pp.

[27] Appiah, K., Du, J. & Poku, J. Causal relationship between agricultural production and carbon dioxide emissions in selected emerging economies. Environ Sci Pollut Res 25, 24764–24777(2018)

[28] Joint Research Centre - JRC - European Commission. 2022. INFORM Global Risk Index 2019 Mid-Year, v0.3.7. Palisades, New York: NASA Socioeconomic Data and Applications Center (SEDAC). https://doi.org/10.7927/yzp7-sm30.

development. In this sense, at EthiFinance we believe that a country with a high score in this sub-pillar boasts a high level of human development, better social welfare, and improved revenue-raising capacity. This in turn reduces the need to commit a large share of the budget to address social inequalities, something than a country with a lower score in this sub-pillar might have to confront.

To measure this sub-pillar our PLS-VIP model considers the following KPIs:

- **Employment: Vulnerable employment (% total employment).** This metric focuses on the share of workers with little or no remuneration and limited access to social protection programs, leading to a greater risk of precariousness. This situation mainly affects developing countries where, according to the International Labour Organization, more than half of the employed population is vulnerable. Moreover, vulnerable employment is used as a useful indicator to measure the health of labour markets.

  Furthermore, it also has a significant impact on economic growth, as countries with highly vulnerable employment suffer from lower productivity, reduced potential growth, and higher poverty rate. This could potentially give rise to social unrest that can affect the sovereign government's ability and/or willingness to pay.

- **Human Capital: Human Development Index.** The UNDP uses the Human Development Index as a summary measure of average achievement in key dimensions of human development: a long and healthy life, literacy levels and having a decent standard of living. This indicator helps us understand if the economic development of a country is permeating the living conditions of its citizens or, on the contrary, if economic growth is not improving their standard of living. This situation is not trivial, since, as Bundala (2013)[29] states, countries with better HDI and lower unemployment have a lower risk of default and, therefore, a lower cost of debt.
- **Health: Health Expenditure per inhabitant:** Closely related to life expectancy, this indicator measures health spending (public and private) per capita, on the understanding that the higher this spending, the better the living conditions of the country's inhabitants.
- **Inequality: GINI index.** This indicator measures the degree of deviation of the income distribution compared to a perfect distribution with 0 representing no deviation and 100 representing complete deviation. Although there is not a perfect linear relationship between inequality and economic growth, various empirical studies show that inequality hinders growth and, therefore, the development of a country.
- **Gender: Female to male labour force.** SDG 15 focuses on the eradication of all forms of discrimination against women and girls. In order to achieve this goal, it is essential to favour their economic independence, as this is associated with higher literacy rates and a reduction in poverty rates.

Finally, and regarding the **Governance sub-pillar**, we evaluate the strength and stability of the institutional frameworks. These shape the performance and structure of the sovereign government, since we understand that situations of instability negatively affect willingness to pay.

[29] Bundala N.N., (2013), Do Economic Growth, Human Development and Political Stability favour sovereign creditworthiness of a Country? A Cross Country Survey on Developed and Developing Countries, International Journal of Advances in Management and Economics, 2: 32-46

To do so, we use a series of six indicators published by the World Bank (their definitions are shown below), in combination with other qualitative aspects.

- **Institutional framework: Rule of law**., This indicator captures perceptions of the extent to which agents have confidence in and abide by the rules of society. This refers to the quality of contract enforcement, property rights, police, and the courts, as well as the likelihood of crime and violence.
- **Institutional framework: Regulatory quality**., This indicator captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.
- **Institutional framework: Voice & Accounting**., This indicator captures perceptions to the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and freedom of media.
- **Government: Government Effectiveness**., This indicator captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures. It also includes the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.
- **Government: Political Stability.,** This indicator measures the likelihood that the government will be destabilized by unconstitutional or violent means, including terrorism.
- **Government: Level of corruption.**, This indicator captures endemic corruption in a country's public sector. For its valuation we calculate the percentiles and evaluate the position of the sovereign government in relation to its peers.

As indicated in Section 4 of this methodology, the score assigned by the PLS-VIP model to each of the sub-pillars can be adjusted up or down depending on a series of qualitative factors. Specifically, the qualitative analysis of this pillar is calculated considering the following qualitative factors (Table 15).

Table 15: ESG: qualitative adjustments

	Positive	Neutral	Negative
Environmental	The country has emissions targets, which are credible and accompanied by policies to achieve them. They are part of an international treaty (e.g. Paris Agreement).	The country has emissions targets, which are credible, although it has not yet implemented policies to achieve them.	The country has no emissions targets, nor has it stated its intention to do so. The country has suffered an extreme natural disaster that could compromise its future growth and spending potential.
	When the data is available, Climate-Development financing needs[30] to GDP represent less than 5% of GDP	When the data is available Climate-Development financing needs to GDP represent less than 8% of GDP	When the data is available Climate-Development financing needs to GDP represent more than 8% of GDP
Social	The Government has defined a national agenda for the achievement of SDGs 1, 2, 3, 4, 5, 8 and 10, with a positive evolution in all indicators and a tendency to continue in the medium term.	The Government has defined a national agenda for the achievement of SDGs 1, 2, 3, 4, 5, 8 and 10 but so far it has not shown a positive evolution in all indicators, or the medium-term trend does not reflect an improvement.	The Government has not defined a national agenda for the achievement of SDGs 1, 2, 3, 4, 5, 8 and 10 or so far has not shown a positive evolution in all indicators or the medium-term trend does not reflect an improvement.
Governance	The government is stable, thanks to a majority or to across-the-board support from other parties, which guarantee approval and execution of budget plans. Government officials are experienced and have demonstrated sustained budgetary compliance.	The government is stable, although it does not hold a majority. Support from other parties is ad-hoc and not across the board, so there is a risk of budget roll-overs or non-compliance. Government officials are experienced although there is volatility in budget compliance, sometimes resulting in a slight increase in	The government is unstable. There is no support from other parties, so there are risks of a vote of no confidence and non-compliance. Government officials have limited experience, or there is sustained budgetary instability.

[30] Since 2021 the World Bank Group publishes a core diagnostic report, called Country Climate and Development Report (CCDRs) to analyse how each country's development goals can be achieved in the context of mitigating and adapting to climate change.

		instability.	
	The government has a comprehensive and credible long-term investment plan, coherent with the economic and social circumstances.	The government presents a long-term investment plan, although not very plausible and not entirely in line with the economic reality and social circumstances of the country. Government's investment plan does not fit reality.	The government does not present a long-term investment plan, or it is not adjusted to the economic and social reality of the country. If it is available, the investment plan is not adjusted to the economic and social reality.
	The government has demonstrated a high willingness to make structural changes, i.e., by implementing policies regarding youth unemployment, population aging or to increase the weight of high value-added sectors in the economy.	The government has demonstrated a moderate willingness to make structural changes.	The government has demonstrated a low willingness to make structural changes.

Annexes

Annex A: Partial Least Square regression and Variable Importance in Projection (PLS-VIP)[31]

The numerous indicators used in the EthiFinance Ratings sovereign rating methodology cover a wide range of aspects and may present strong correlations. Therefore, it is difficult to use classical regression techniques such as the Ordinary Least Square regression, which can be strongly impacted by these multicollinearity issues, potentially leading to biased results. To overcome these aspects, we decided to use a regression type where the multicollinearity is less of an issue, the Partial Least Square (PLS) regression (Wold, 1966; Wegelin 2000; Tenenhaus, 1998[32]). This method is not used to directly assess the final rating but rather to determine the weight of the different variables, sub-pillars, pillars, and categories within a fixed structure model. This model avoids the multicollinearity issue by using orthogonal components, such as is done with a Principal Component Analysis (PCA).

The difference with a PCA approach combined with a linear model is that in the PCA approach, the input variables are transformed to maximize their variance (cf. equation 1) while in the PLS-VIP model, the input and target variables are transformed to maximize the covariance between inputs and target (cf. equation 2). This means, from equation 3 and 4, that it is also indirectly maximizing the explanation of the input and target variables.

$t_a = X_a p_a$ with t_a such as the variance $({t'}_a t_a)$ is maximized and with ${p_a}' p_a = 1$ (1)

$t_a = X_a w_a$ and $u_a = Y_a c_a$ with ${w_a}' w_a = 1$ and ${c_a}' c_a = 1$ such as $Cov(t_a, u_a)$ is maximized. (2)

$$Cov(t_a, u_a) = correlation(t_a, u_a) * \sqrt{var(t_a)} * \sqrt{var(u_a)} \quad (3)$$

$$Cov(t_a, u_a) = correlation(t_a, u_a) * \sqrt{{t'}_a t_a} * \sqrt{{u'}_a u_a} \quad (4)$$

The PLS regression is performed using PLSRegression from the Python sklearn.cross_decomposition library. The aim is not to predict directly Y but rather to find the optimal weights of each indicator in SRM. Therefore, the weights are estimated using a Variable Important in Projection method.

[31] For more details about this methodology, please see Pineau, E.; Le, P.; & Estran, R. (2022). Importance of ESG factors in sovereign credit ratings, Finance Research Letters, Volume 49, 2022, 102966, ISSN 1544-6123, https://doi.org/10.1016/j.frl.2022.102966.

[32] Wold, H., (1966), "Estimation of principal components and related models by iterative least squares", in P.R. Krishnaiaah (Ed.), Multivariate analysis, pp.391-420.
Jacob A. Wegelin. (2000), A survey of Partial Least Squares (PLS) methods, with emphasis on the two-block case. Technical Report 371, Department of Statistics, University of Washington, Seattle.
Tenenhaus, M., (1998). La régression PLS: théorie et pratique. Paris: Editions Technic.

Annex B: Variable normalization

Variable	Distribution	VIP	Weight (Over total Score)	Data Source
GDP Evolution average	Burr	0.45	0.958	World Bank
GDP Evolution volatility	Burr	0.62	1.158	World Bank
GDP Size	Beta	0.99	2.017	World Bank
Age dependency ratio	Cauchy	0.51	1.102	World Bank
Unemployment average	Burr	0.76	1.381	World Bank
Unemployment evolution	Cauchy	0.73	1.409	World Bank
GDP pc	Log-normal	1.34	2.674	World Bank
Current Account Balance	Cauchy	0.94	2.513	World Bank
NIIP	Cauchy	1.06	2.875	International Monetary Fund
Importance of currency	Beta	1.07	2.972	Bank for International Settlements
Currency Reserves	Burr	0.65	1.865	World Bank
NPL	Log-normal	1.38	2.561	World Bank
ROA	Burr	0.93	1.691	World Bank
Tier 1	Beta	0.76	1.468	World Bank
CPI average	Burr	0.94	2.233	World Bank
CPI volatility	Burr	0.82	1.530	World Bank
Net lending/Borrowing	Cauchy	0.86	6.935	World Bank

Operating expenses evolution	Burr	0.39	3.157	World Bank
Gross Debt / GDP	Burr	0.68	2.346	International Monetary Fund
Gross Debt / GDP – evolution	Burr	0.66	2.339	International Monetary Fund
Interest / Operating Expenses	Burr	0.95	3.151	World Bank
Debt Maturity	Burr	0.50	1.665	Fiscal Space database - World Bank
CO2pc	Burr	1.18	1.510	World Development Indicators - World Bank
Consumption Renewable Energy	Power law	0.69	1.005	World Development Indicators - World Bank
Protected Areas	Exponential	0.59	0.727	World Development Indicators - World Bank
Physical Risks: Agriculture sector	Gamma	1.24	0.792	UN
Physical Risks: Natural hazards	Normal	1.16	0.708	UN
Vulnerable Employment	Beta	1.23	5.795	World Development Indicators - World Bank
HDI	Beta	1.31	6.145	World Development Indicators - World Bank
Health expenditure pc	Log-normal	1.29	6.031	World Development Indicators - World Bank
Gini index	Log-normal	0.83	2.451	World Development Indicators - World Bank
Female to male labour force	Log-normal	0.52	1.556	World Governance Indicators - World Bank
Control of corruption	Gamma	1.32	3.823	World Governance Indicators - World Bank
Rule of law	Chi-squared	1.34	3.904	World Governance Indicators - World Bank
Voice and accountability	Burr	1.26	3.595	World Governance Indicators - World Bank
Government effectiveness	Chi-squared	1.42	4.263	World Governance Indicators - World Bank

Political stability	Burr	1.13	3.412	World Governance Indicators - World Bank
Regulatory quality	Chi-squared	1.45	4.284	World Governance Indicators - World Bank

Annex C: From raw data to normalized values and continuous cut-off points.

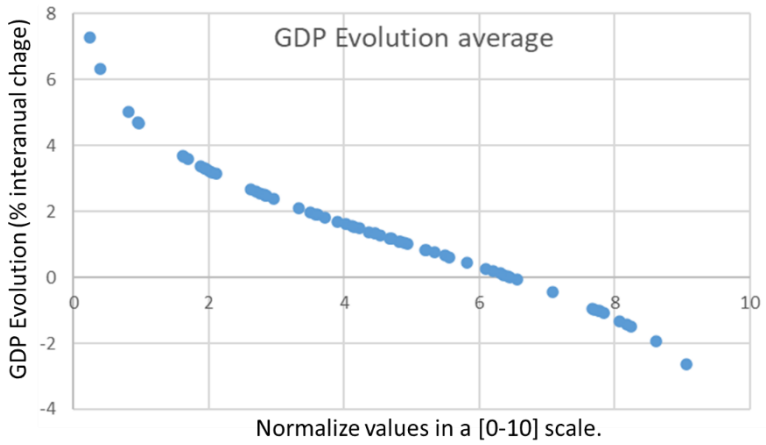
The estimation of the PLS-VIP model requires that the variables have been previously normalised to avoid the problems associated with the different scales in which they are expressed.

The normalisation process consists of re-expressing all the variables on a scale [0,1]. Various techniques are available for this purpose, and the one with the lowest Root Mean Square Error has been selected (see Annex B for more details).

But beyond their usefulness for estimating the weights of the PLS-VIP model, these normalised values - rescaled to [0 (best)-10 (worst)] - are what we use to calculate the scores of the sup-pillars, pillars, and categories (see Annex A for more details).

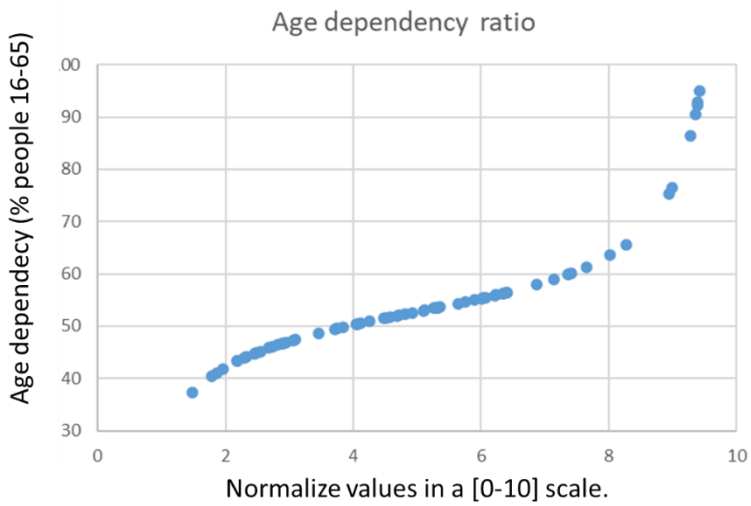
In this sense the normalised distribution of each variable should be understood as a distribution of continuous cut-off points that, comparing with the raw data distribution (before normalization), respects its economic sense, as explained in the following two examples:

Example 1: GDP Evolution.



The graph above shows the distribution of the normalised values of the GDP Evolution KPI (X-axis) versus its non-normalised value (Y-axis) for each of the countries in our sample. It shows, firstly, the negative sign of the distribution, i.e. the worse the GDP growth, the higher the normalised value assigned to that country. As this normalised value is the one we take into account to calculate the model's score, in the end a worse GDP growth figure implies a worse score for the country analysed.

Example 2:



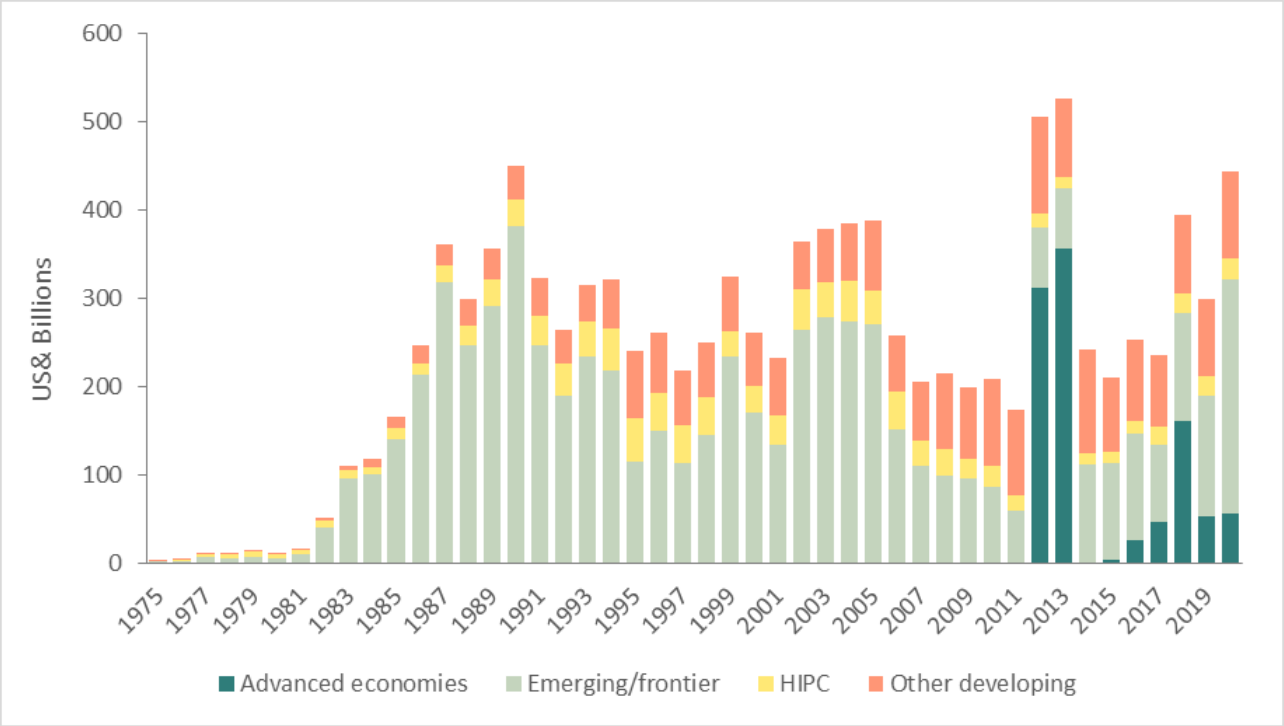
In the previous graph we have plotted the distribution of the value taken by the dependency ratio (Y-axis) against the normalised value of the same ratio (X-axis). In this case it can be seen that the trend of the distribution is increasing, i.e. the higher the dependency ratio, the higher the normalised value, which means a worse score from our PLS-VIP model.

Annex D: Sovereign defaults

Sovereign defaults are not as common as corporate defaults because they have at their disposal fiscal tools (tax increases, issuance of new debt…) and other powers (control of the domestic financial system, expropriation…) that make it easier for them to meet their financial obligations. However, as we show in Figure 1, there have been several cases of sovereign defaults since 1975 that are not related exclusively with the level of wealth of the country. In this sense, the majority of sovereign defaults involve developing countries although in the years following the 2008 financial crisis, the number of defaults involving developed countries increased, highlighting that wealthy countries are also liable to defaults.

Sovereign defaults, in addition to restricting access to new funding, have significant consequences on both the business and household sectors, by either making access to credit more difficult or by reducing the attraction of capital from abroad, among others. In addition, defaults affect the levels of poverty, nutrition, energy consumption, and health with the most vulnerable people often suffering the greatest impact[33].

Figure 1 – Sovereign defaults since 1975



Source: Beers, D. et al (2020)[34]

We consider that a sovereign government is in default if one of the following events occur:

[33] Farah-Yacoub, J. P., Graf von Luckner, C., Ramalho, R., & Reinhart, C. (2022). The Social Costs of Sovereign Default.

[34] https://www.bankofcanada.ca/2020/06/technical-report-117/

- If upon maturity of any financial instrument (direct or irrevocably guaranteed by the sovereign government) the government does not pay the principal and / or interest / coupon payment accrued after a standard 30-day grace period. In this definition we see both soft-defaults (defined as negotiated defaults where payments are missed) and hard-defaults (defined as unilateral defaults).

- If the refinancing / restructuring of any financial instrument occurs in conditions that EthiFinance considers were coerced. In other words, creditors accepted conditions worse than what prevailed in the market up to that moment only to avoid an imminent default.

The failure to meet financial obligations with other governments or supranational entities (such as the European Central Bank or the International Monetary Fund) is not considered in our definition of default. However, we do evaluate the relationship between the sovereign and these entities (see Section 5.1 Monetary Policy).