Autoridad Independiente de Responsabilidad Fiscal

Macroeconomic projections and debt sustainability analysis

World Bank Conference

Fiscal Rules and Fiscal Councils in the Western Balkans

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Macroeconomic projections: Philosophy of the modelling framework

1 **To endorse by legal mandate**

AIReF Organic Law 6/2013

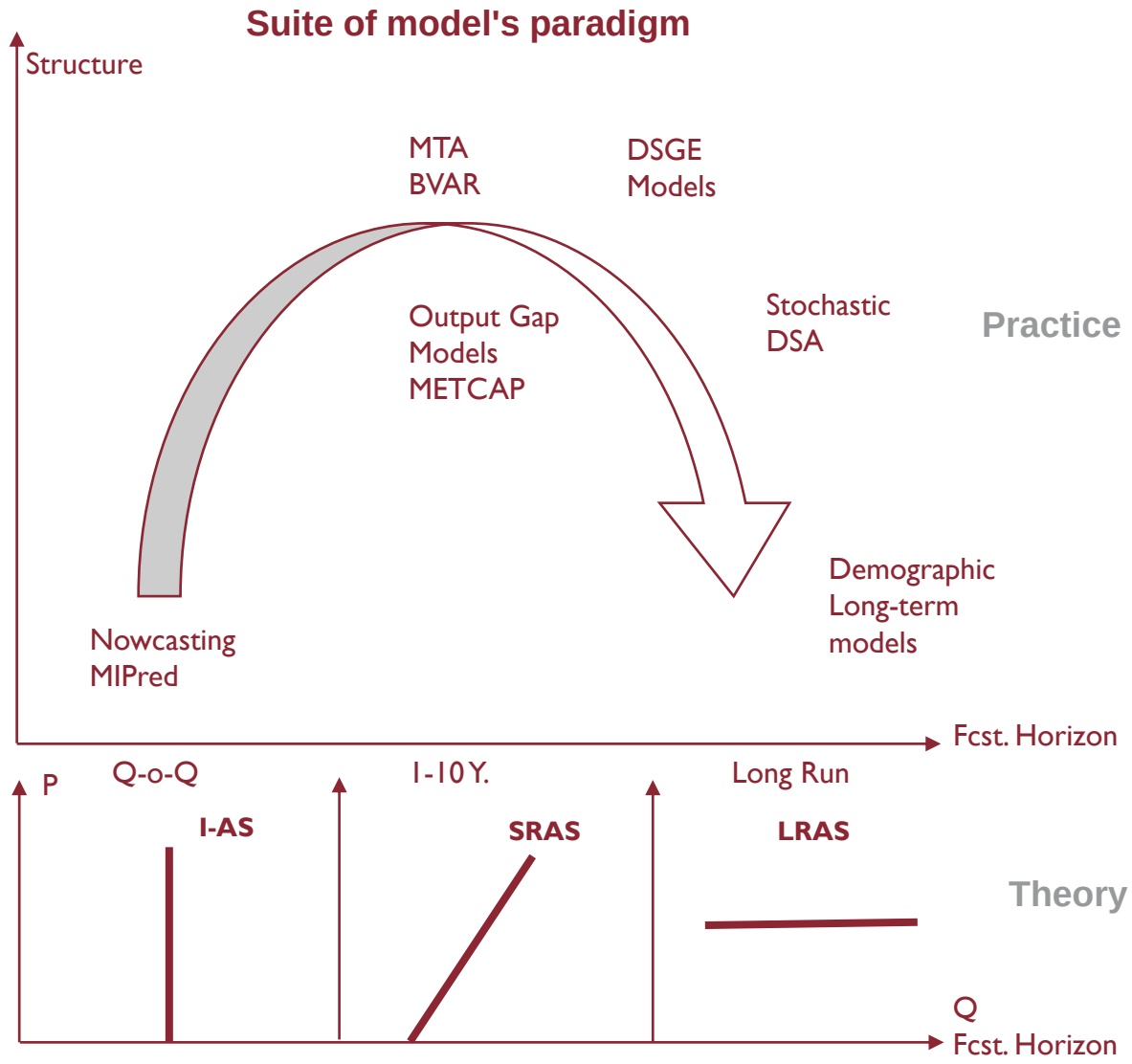
Art.14 Macroeconomic forecasts incorporated in the draft budgets of all public administrations […] shall be subject to a report by AIReF and indicate whether they have been endorsed by AIReF.

2 **From point forecast to confidence interval**

Point forecasts are not analyzed as isolated objects. They are examined with respect to a confidence interval

3 **From the very short to the long run**

AIReF often recommends multiannual economic and fiscal plans. Setting the bar high AIReF produces and publishes forecasts from the very short (Q-o-Q) to the very long (+50 Years)



Nowcasting as a central analytical piece

Forecasting

Short-term economic outlook based on GDP projections and medium-term anchor

Real time monitoring

Interpretation of high-frequency signals along “surprise events”

Integrated vision

Fully-fledged economic outlook, including all demand-side components

AIReF’s MIPred Model

MIPred (2015) was the very first model of its kind in the Spanish forecasting ecosystem. A fully transparent nowcast tool which is updated each time a new data point is released and whose results are published. It serves as a thermometer for the T+0 developments and systemically reviews the economic situation. On the other hand, it poses some major communication challenges.

Nowcasting with MIPred

1 Dynamic Factor Model: Why?

Common info about the cycle
Stock and Watson (2002) tradition
Extended use in institutions
- Transparent
- Replicable: public data
- Use of high-frequency data

2 Which variables?

Statistical selection process
Parsimonious version
Add if correlation with GDP increases

3 Parsimonuous model

Variable & (Publication lag -in months-)
Social security system: registered workers (t-1)
Index of Industrial Production (t-2)
Large companies. Real sales and Compensation of employees (t-2)
Services PMI (t-1)
Real Merchandise Imports (t-2)
Electricity Consumption (t-1)

Release of new indicator

↓

How does it compare with the **model estimates**?

↔

No surprise

GDP qoq forecast **is not revised**

Deviation/surprise: positive (negative) if observation is larger (smaller) than forecast

↔

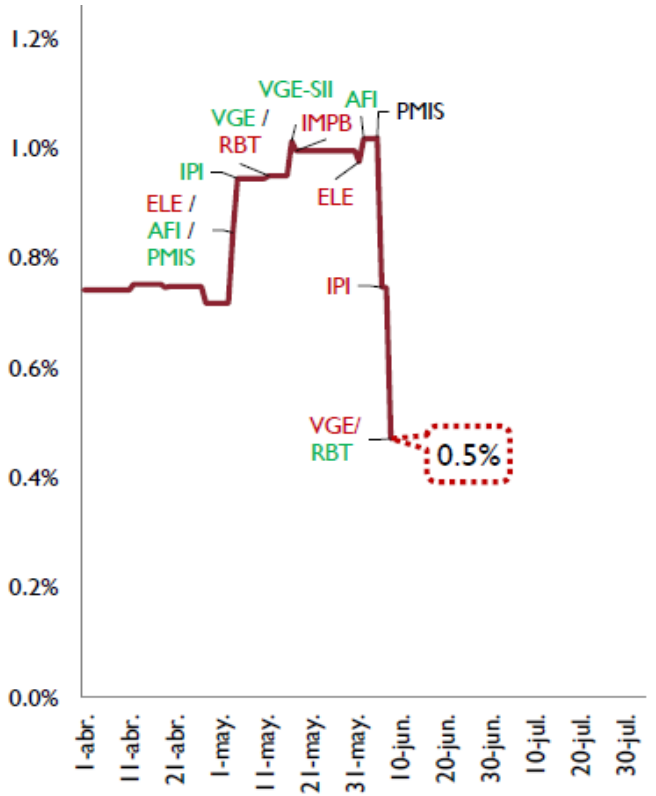
Upward (downward) GDP revision accompanying positive (negative) surprises

How does it compare with the Upward (downward) revision of the indicators accompanying positive (negative) surprises?

Release on the same day of the publication of the indicator in a reusable format

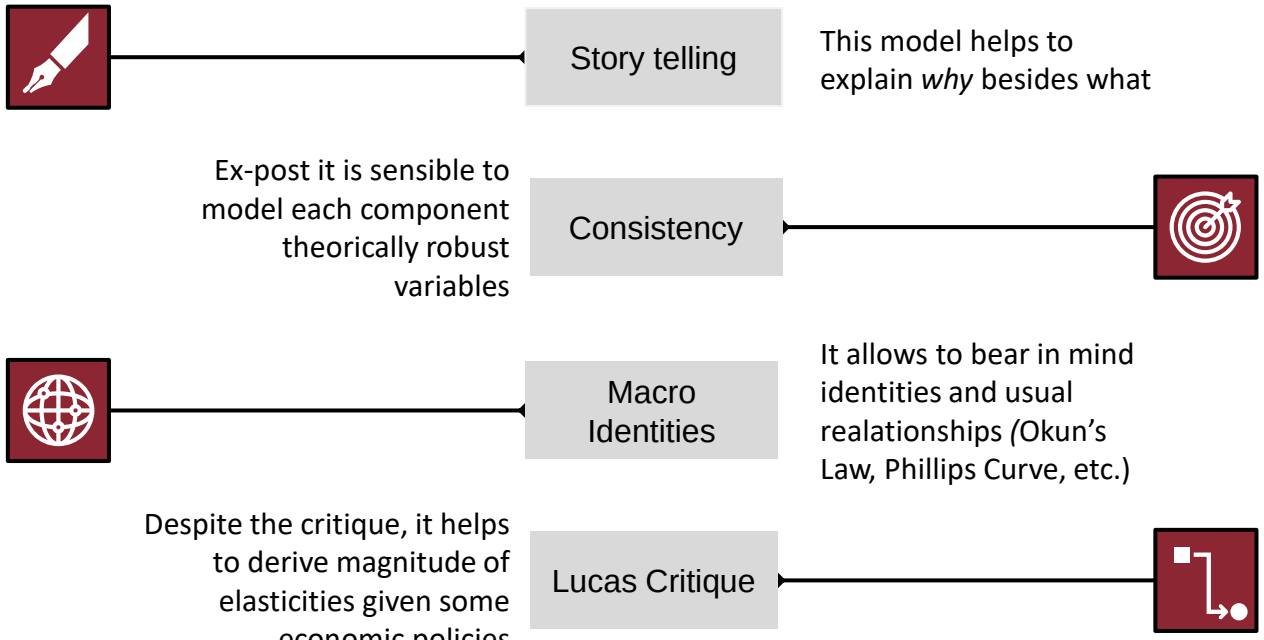
Example of MIPred Updates

GDP Q-o-Q growth Spain 2022:Q2



In **green** positive surprises, in **red** negative surprises

Medium Term AIReF Model: writing narratives



A simple error correction equation

$$\Delta y_t = \beta_0 + \beta_1 \Delta x_{1,t} + \cdots + \beta_i \Delta x_{i,t} + \gamma \left(y_{t-1} - \left(\alpha_1 x_{1,t-1} + \cdots + \alpha_i x_{i,t-1} \right) \right) + v_t$$

Pros:
(1) Exploits cointegration relationships
(2) Allow to set fixed parameters for impact
(3) It creates some narrative on the *whys & hows*

Cons:
(1) For forecasting a t+h path for exogenous variables is needed.
(2) Some mean reversion otherwise

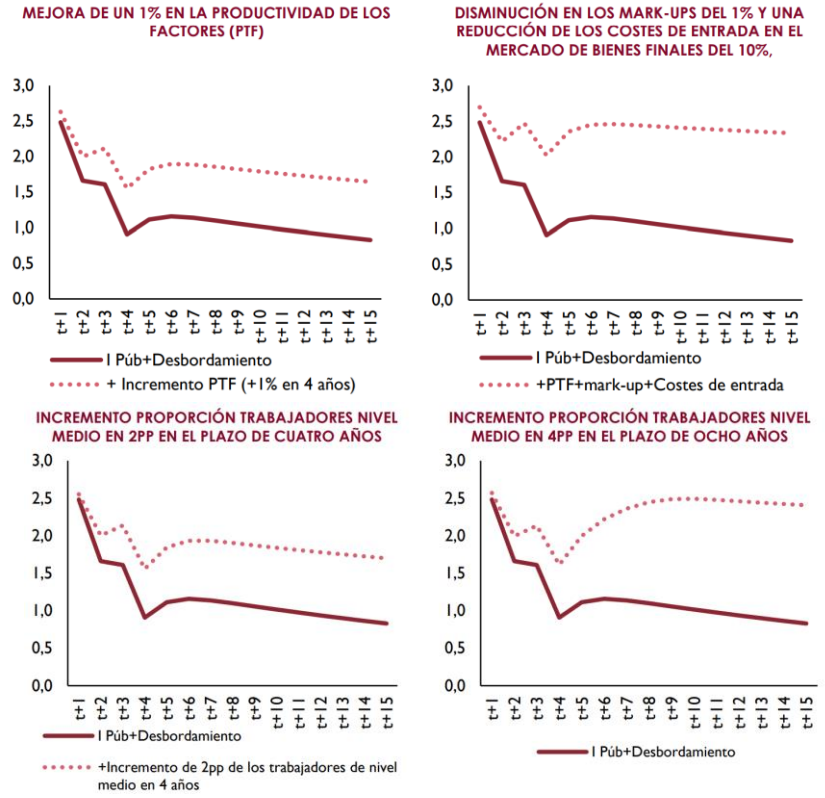
AIReF's MTA Model

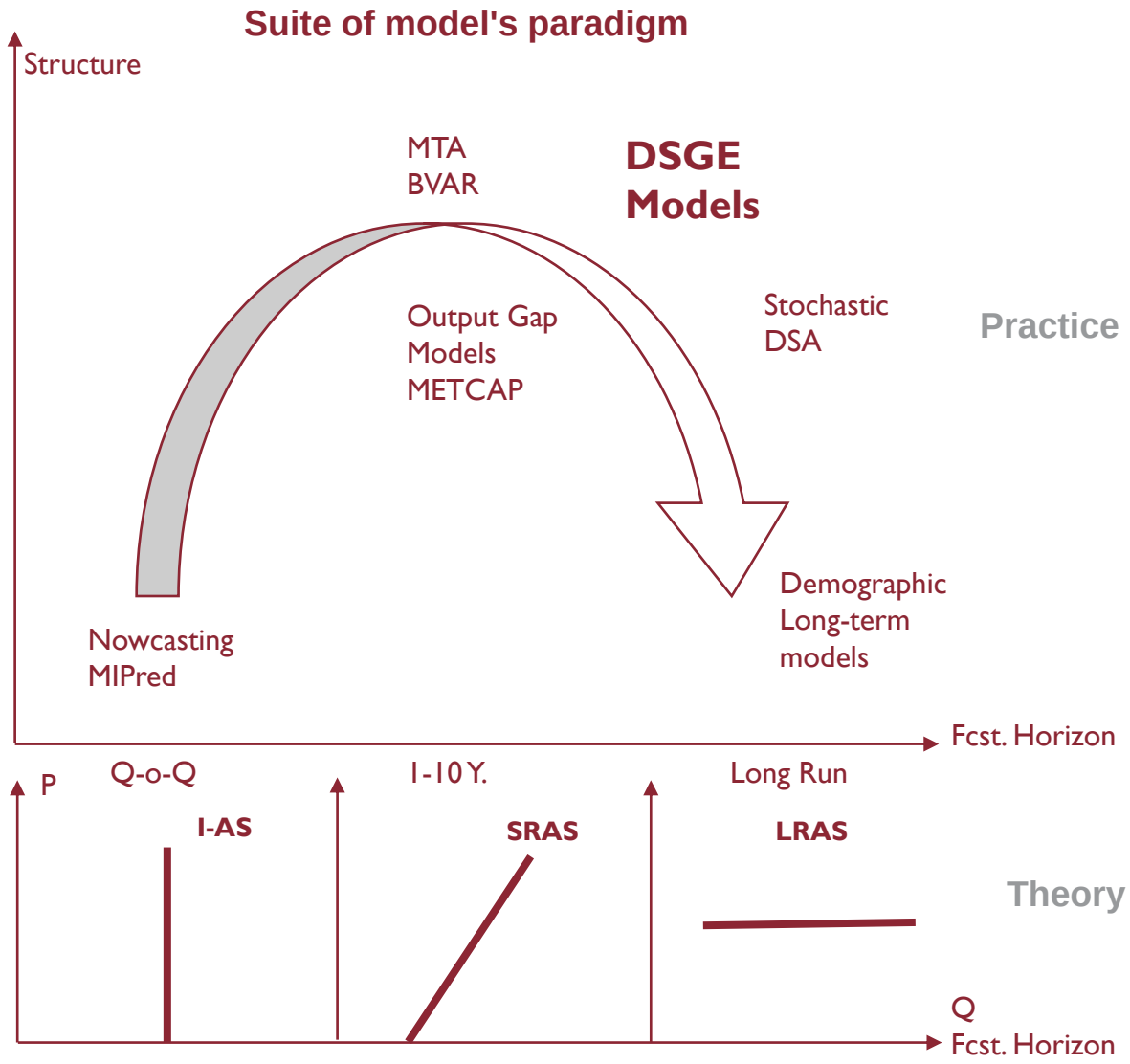
AIReF developed a medium-term model based on a system of error correction equations in the tradition of Granger and Weiss (1983). In the MTA (Quarterly Model from AIReF) each demand component has an equation that exploits the cointegration relationship of the endogenous variable and a set of exogenous variables. This may be derived further. For instance, besides a consumption equation it is possible to add an equation describing disposable income.

Policy and forecasting simulations in a general equilibrium framework

1 DSGE Models

AIReF takes advantage of DSGE models from EC (QUEST). The long goal is to develop in-house DSGE model tailored for fiscal analysis. These models allow to simulate policies and shocks encompassing all dynamics of an open economy.





2 Approaching uncertainty

To endorse or not endorse, that is the question

1 Fancharts as communication tool

In the tradition of Bank of England (1996), we use fancharts as the standard method to visualize uncertainty surrounding government forecasts.

Instead of comparing point forecasts our approach is to understand whether government forecasts may fit our probability distribution of the future economy realization.

2 Uncertainity in our medium term models (MTA)

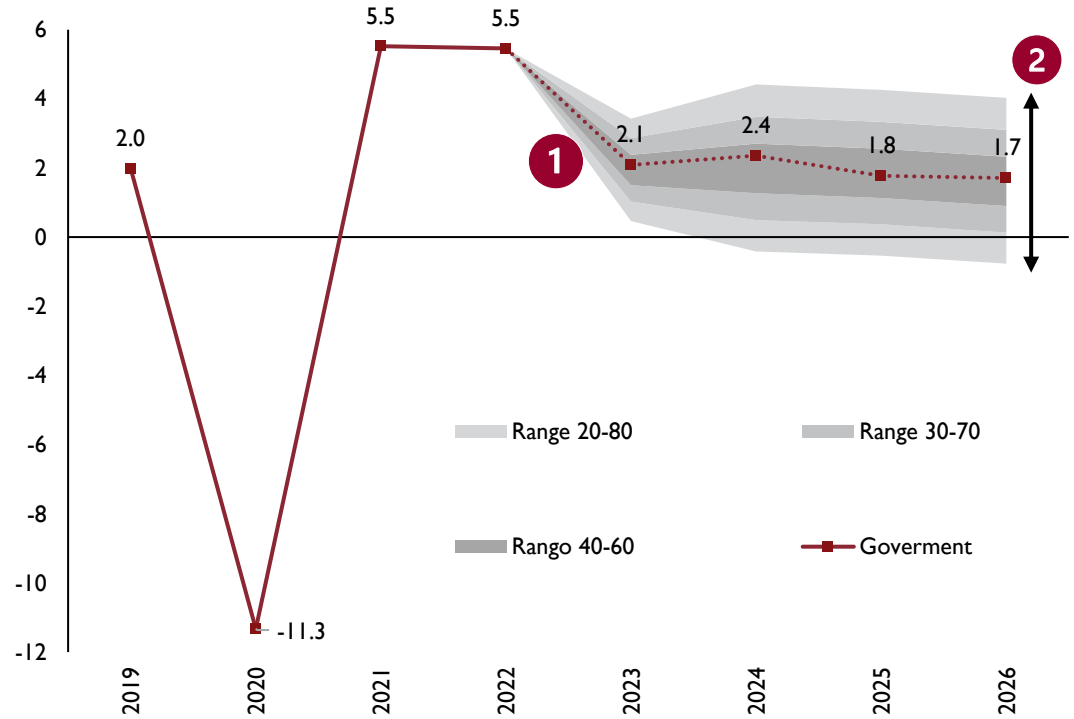
Our medium-term framework is the most balanced tool. It is able to reconcile the events with the standard economic relationships (Okun's Law, Phillips Curve, Output Gap) and, therefore, it is the tool used to derive the fancharts.

It has a practical advantage. Using an OLS estimator is straightforward to derive confidence intervals using:

$$\hat{y}_{t+1} \pm t_{n-p,1-\frac{\alpha}{2}} \cdot \hat{\sigma} \sqrt{1 + X'_{t+1}(X'X)^{-1}X_{t+1}}$$

Therefore we obtain symmetrical fancharts. Asymmetrical distributions may adhere better to observed data but there is a greater communication challenge. Upward and downward risks might be better communicated using other tools.

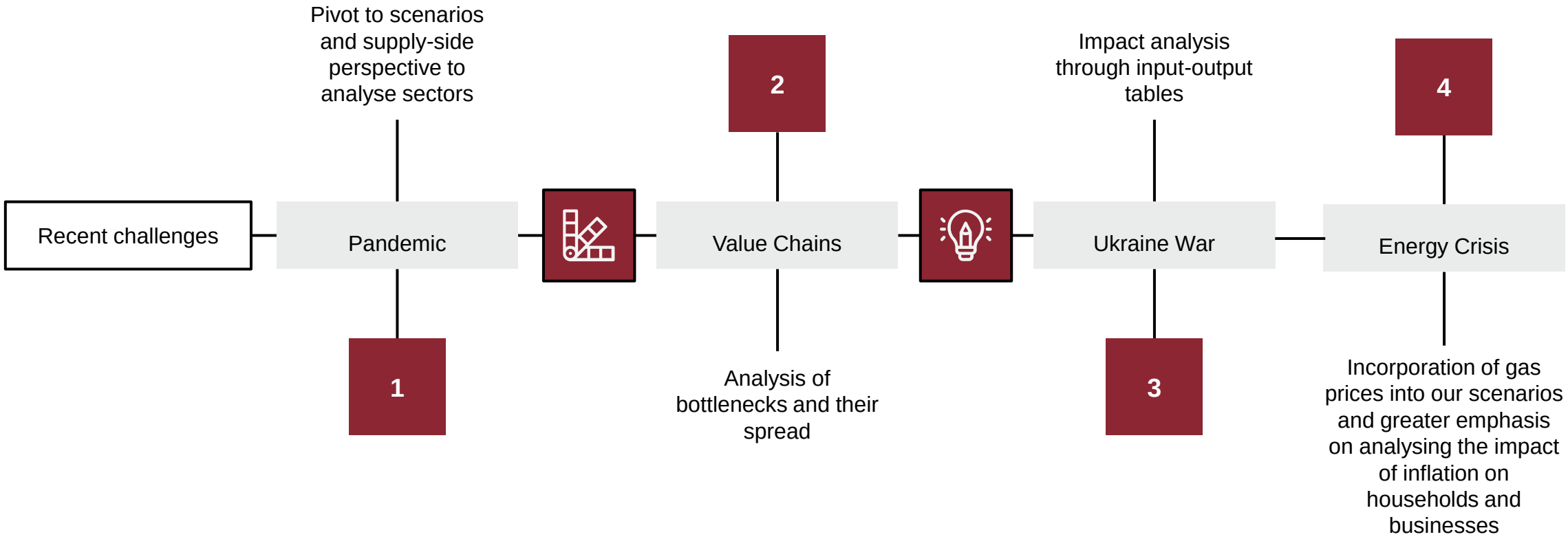
Real GDP Projections and AIReF's Interval
Spain Stability Program Endorsement



1 **Central path:** Represents the most likely path.

2 **Uncertainty Level:** Amplitude of the Fan Chart

Black swans have made forecasting a tougher job



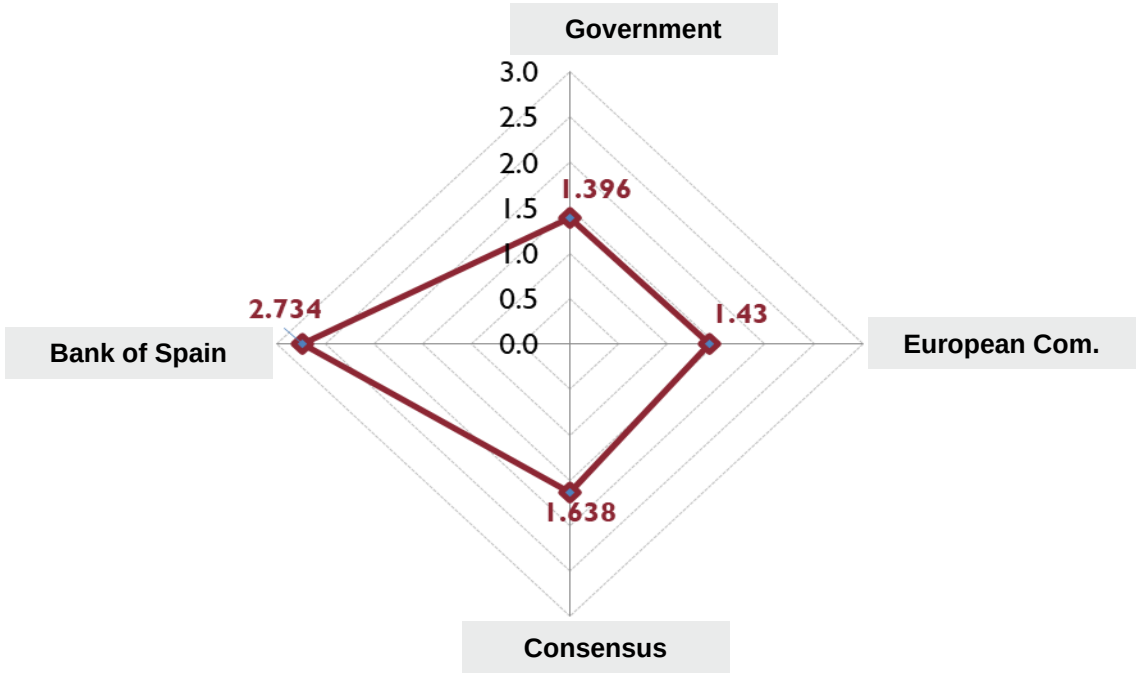
How AIReF was able to deal with this issues?

It has been necessary to continuously adapt our forecasting exercises to these shocks and to be extremely transparent with forecasting assumptions, and methods. On a practical level we have often resort to either input-output framework or to SVAR. In particular, to gauge the impact of energy shock or monetary policy SVARs are very practical and quick to use as analytical tools.

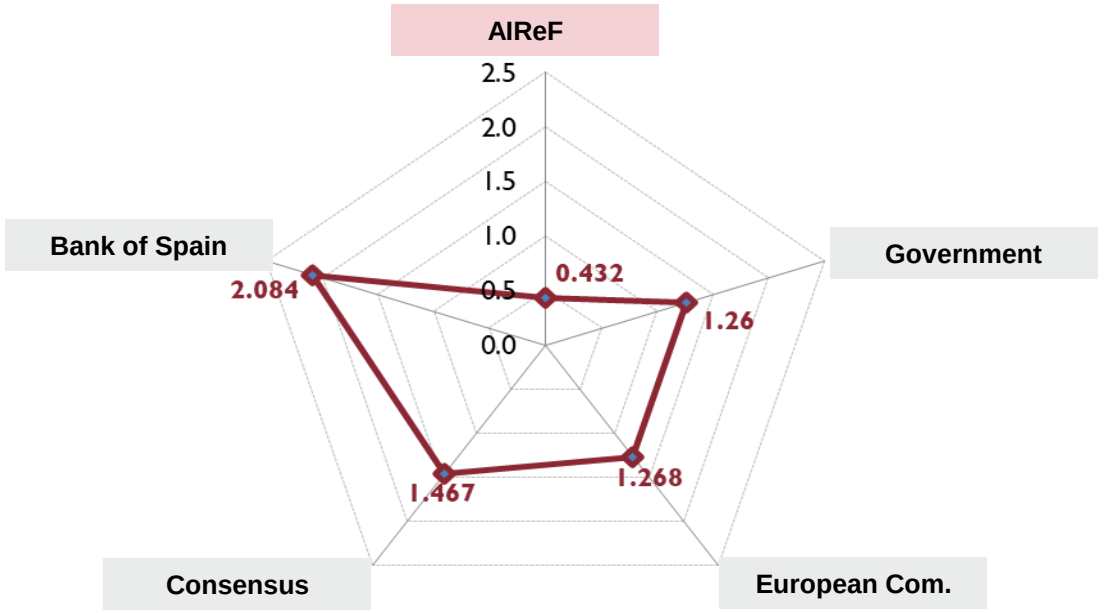
Ex-post analysis of government and AIReF forecasts

Accuracy in forecasting GDP growth in volume terms (RMSE)

Before the creation of AIReF (1999-2014)



After the creation of AIReF (2014-2019)



OECD Recommendation: Following the OECD's recommendation, AIReF began in 2022 the publication of the assessment of its own forecasts to improve its own models and try to shed light on the degree of goodness of its forecasts.

Good news: AIReF achieved a smaller MSE than other official forecasters and, more importantly, the Government reduced its error too.

Future tasks: In the case of AIReF's forecasts, it is found that the accuracy of the variables related to the **foreign sector** and **employment** is lower compared to other institutions, which makes it advisable to review our in-house models.

3 Special Modules

Special Modules (I): The very long-run

1

AIReF's mission is to ensure effective compliance with the principle of financial sustainability by the General Government

There is a need for a comprehensive approach and a move away from fragmentation of the problem. Attention to the long run

Focused on demographics, which from 2030 onwards have a strong impact on sustainability: consensus on a prolonged and certain effect

Inhouse demographic projections include methodologies for fertility, mortality and migration

Besides demographics the economic model built on top is a simple production function approach with effective labour. The exercise includes baseline, alternatives and sensitivity analysis.

2

Some example results from the baseline scenario: pressure of ageing and interest expenditure

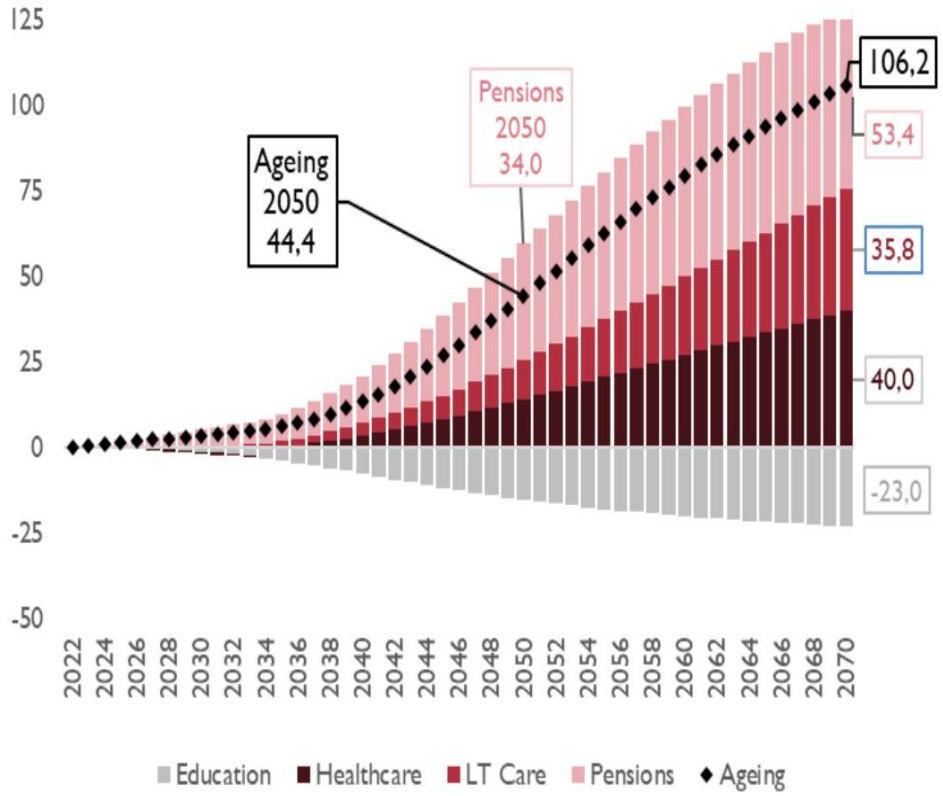
After the present relatively favourable decade, the decade of the 2030s marks a turning point giving way to an accelerating upward path. The debt ratio would reach 147% of GDP in 2050 (186% in 2070)

From the 2030s, AIReF's projections show a deterioration of the primary balance as a result of the ageing of the population that pushes up debt

Growing pension expenditure is the single largest contributor to the increase in debt associated with ageing.

The contribution of spending on healthcare and long-term care follows an upward path, with their contribution gradually increasing

Impact of Ageing on public debt
Contributions of different components



Special Modules (II): The regional dimension

1

A regional mandate

- AIReF must oversee regional budgets and their macroeconomic forecasts.
- To do so a regional quarterly economic model for the autonomous regions was envisaged.
- It allows consistency with the national and the aggregate of regional GDPs.

2

Sources of information

- The METCAP model uses three data sources:
- (1) Regional accounting, (2) National Quarterly Accounts, and (3) Regional economic indicators.

3

It is a 3-sept process

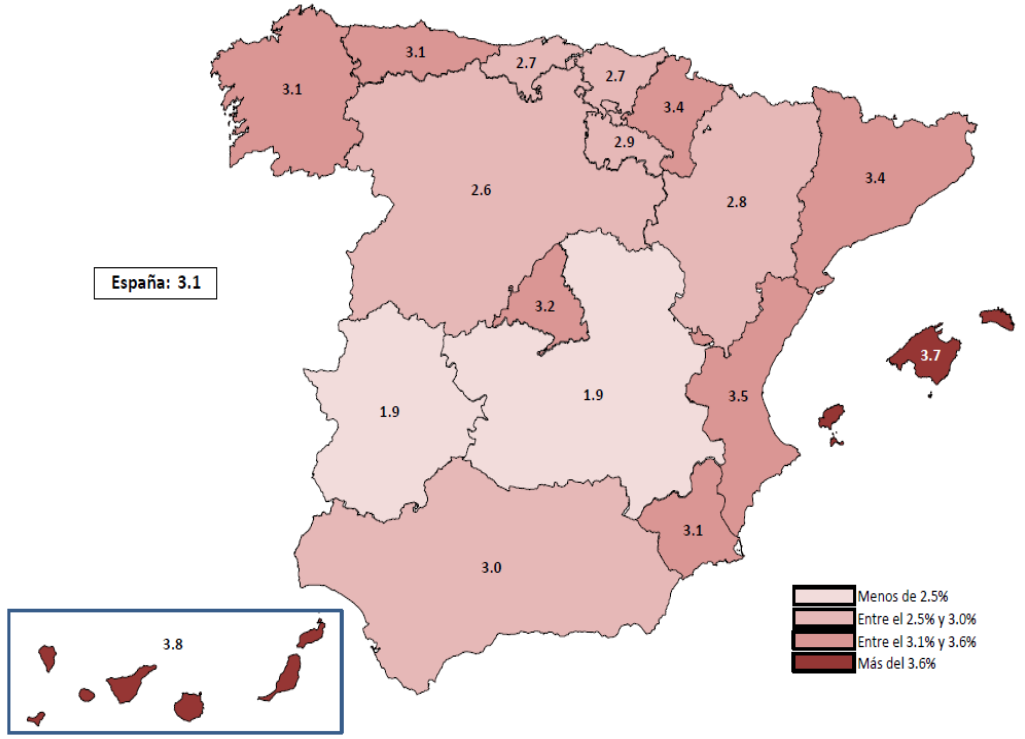
- First, using seasonally and calendar corrected regional economic indicators, synthetic indexes for each autonomous region are constructed
- Second, a quarterly GDP for each autonomous regions is computed, which
- Is reconciled with the official national quarterly GDP and the regional annual GDP.

4

Ensure consistency

- One of the main challenges is to ensure a cross-sectional and longitudinal consistency.
- This may create some friction meaning that is politically sensitive to forecasts region's growth below the average Spanish growth

Spain NUTS-2 economic growth estimation 2017:Q2
Source: AIReF METCAP model.



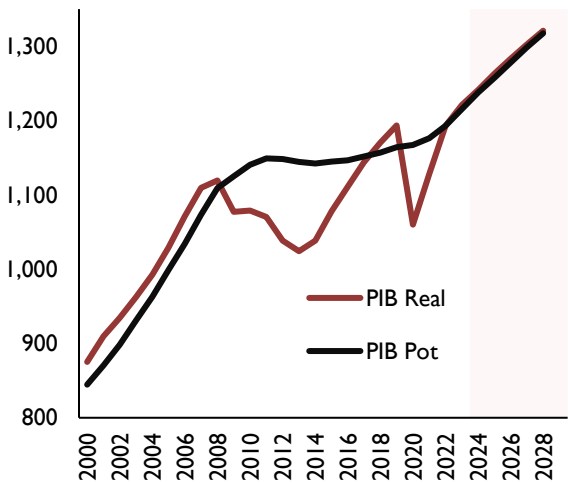
Special Modules (III): The cyclical position

The estimation of the output gap had a great importance within the structural balance framework. Highly indebted countries had to closely monitor these developments. The financial crisis and the Covid shock meant that may not be advisable to rely on only one model. AIReF's approach to modelling cyclical position relies in a suite of models to make sure the signal derived is comparable across methodologies. All have pros and cons and allow to offer some degree of confidence around the estimations.

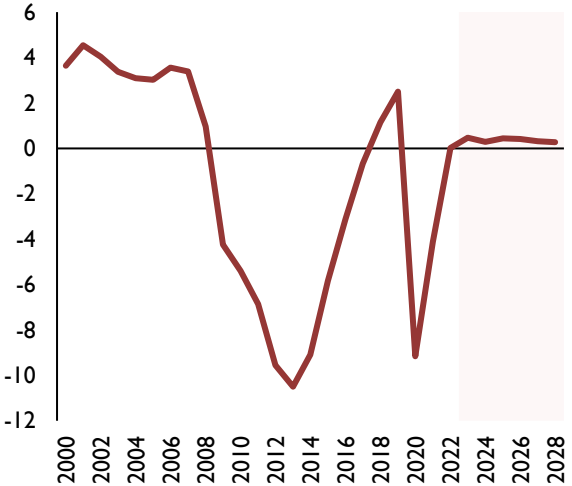
Data requirements a suite of OG models

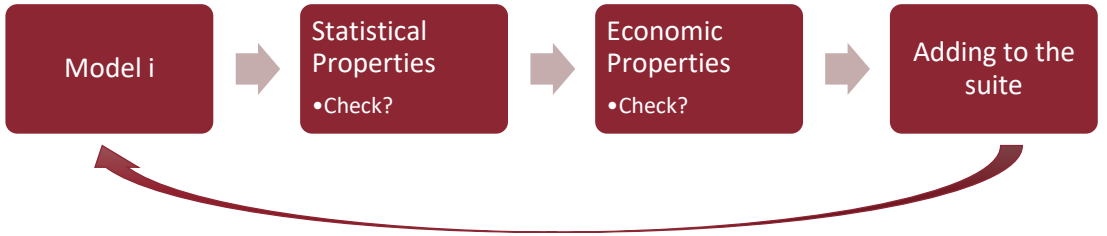
Serie	Provider	UV	PCA	MV	PF	Inhouse projections	Horizon
GDP	INE	x	x	x	x	x	T+4
Real Interest Rate	BdE			x			
Credit Growth	BdE			x			
Housing Prices	BdE			x			
Inflation	ECB			x	x	x	T+4
Wage Inflation	EC		x	x		x	T+4
Unemployment	INE			x	x	x	T+4
Short-Term Unemployment	EC		x	x			
Current account	BdE			x			
Money Supply	ECB			x			
National Savings	INE			x	x	x	T+4
Investment in equipment	INE			x	x	x	T+4
Investment in construction	INE			x		x	T+4
Stock de Capital	CE				x	x	T+4
Hours Worked	INE				x	x	T+4
Migration	INE				x	x	T+10
Business Surveys	EC						
Capacity Utilization	EC		x				
Car Registrations	INE		x	x			
Soft Indicators	Several		x				

Observed and Potential GDP B.E.



Output gap (% Potential GDP)





4 Debt Sustainability Analysis

(1) Dealing with decentralized debt sustainability analysis (I)

WHAT	WHERE	HOW
Supervisory role throughout the Budget cycle	Autonomous Regions Subsector (NUTS-3)	Analysis of budget documents
		Analysis of compliance with budgetary objectives
	Region 1	Sustainability analysis: debt projections
	Region 2	Macroeconomic forecasts and endorsement
	Region n	
On-demand evaluation function	Local Corporations Subsector	Public policy evaluation studies at the request of the regional governments
	24 Individuals	Several ACs have requested evaluations of cross-cutting policies such as health and education.

What's different?

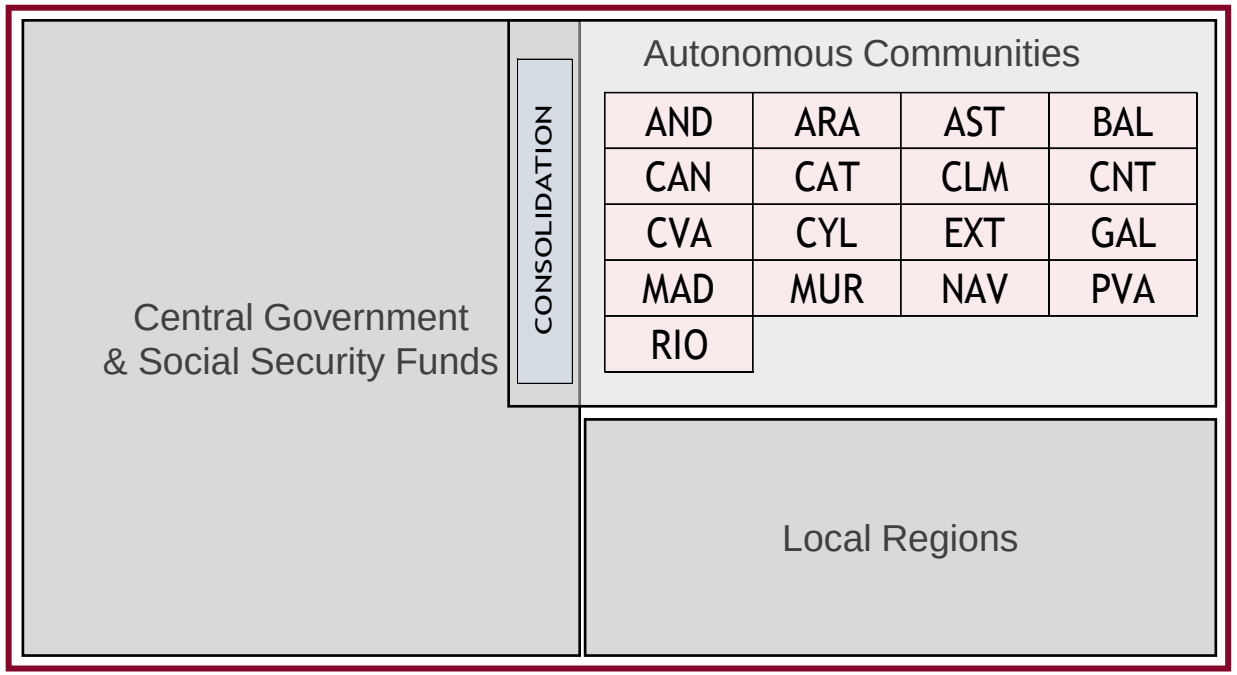
Comparative advantage over other agencies due to its access to **granular information** from all levels of government

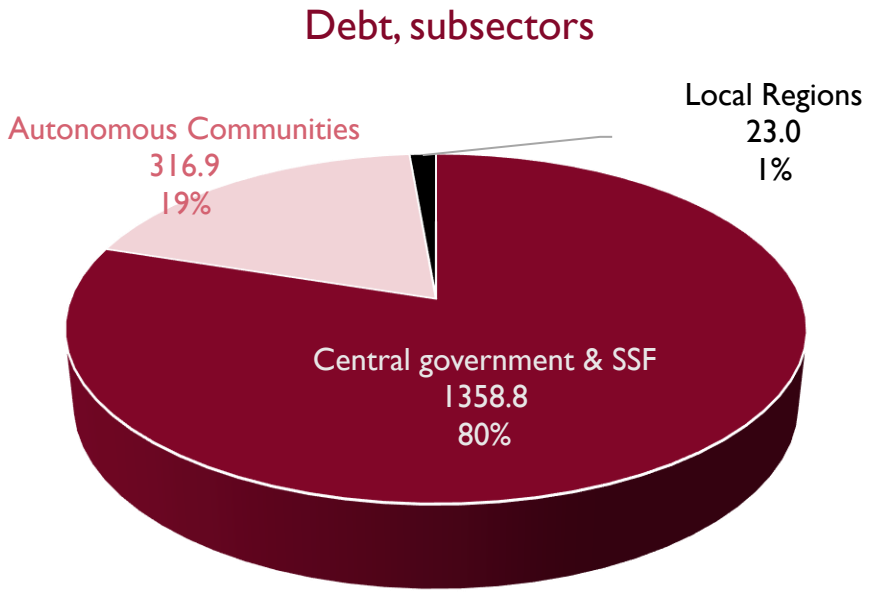
Differential characteristic with respect to other IFIs in having **supervisory powers** over all public administrations

Synergies between the supervision and evaluation to analyze key policies with competences across different levels of government

- **Duty to inform**
- **Comply or explain**

(1) Dealing with decentralized debt sustainability analysis (II)





Uncertainty Option 1: Stochastic Fiscal VAR

Debt dynamics: a stochastic analysis

Vector of shocks to public debt

Derived from the Variance Covariance Matrix	Simulated from a multivariate non-structural model
PROS	**PROS**
Good in short data samples Approach of EC and IMF	Either normality or use boots Consistent paths for macro var
CONS	**CONS**
Central scenario is given and not true stochastic nature	Needs longer data samples Not always a valid VAR model

Step 1: The unrestricted VAR(p) is estimated

(i) real public expenditure
(ii) real net revenues
(iii) public debt/GPD
(iv) real GDP
(v) GDP deflator
(vi) Ten-year gov. bond yields

$$X_t = \begin{bmatrix} e_t \\ r_t \\ d_t \\ y_t \\ p_t \\ i_t \end{bmatrix}$$

$$X_t = A + A_1 X_{t-1} + \cdots A_p X_{t-p} + u_t$$

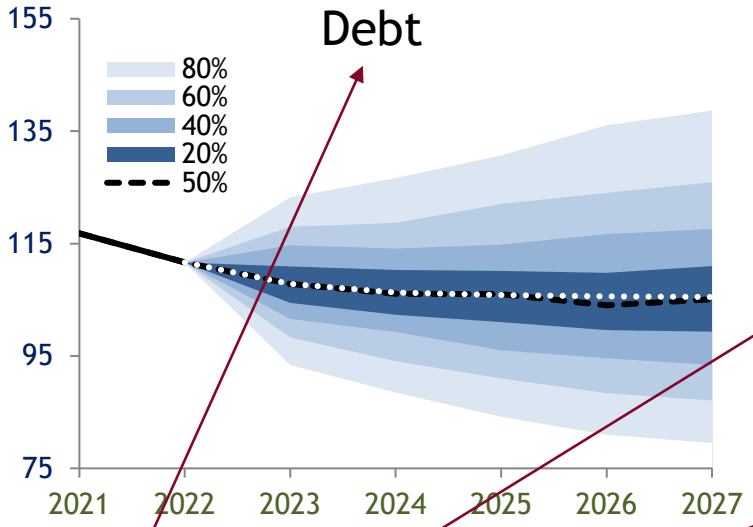
Step 2: Generate disturbances for the projection window

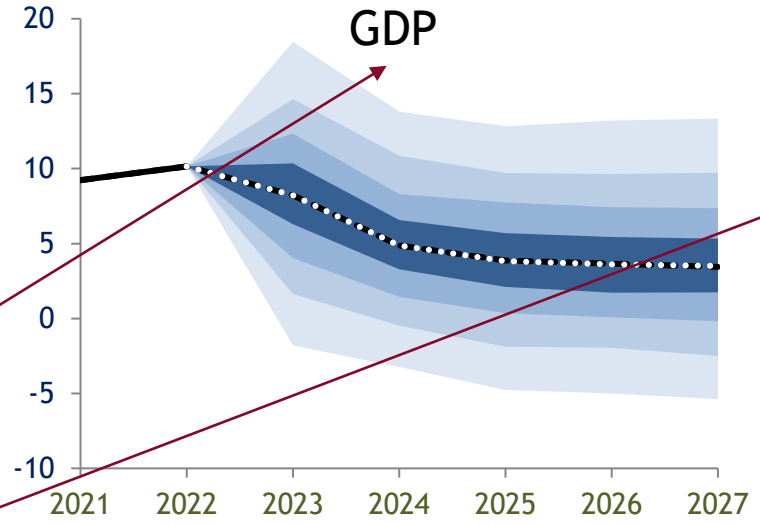
As joint normality was rejected, the stochastic simulations are obtained by bootstrapping procedures, resampling with replacement from the estimated error vector

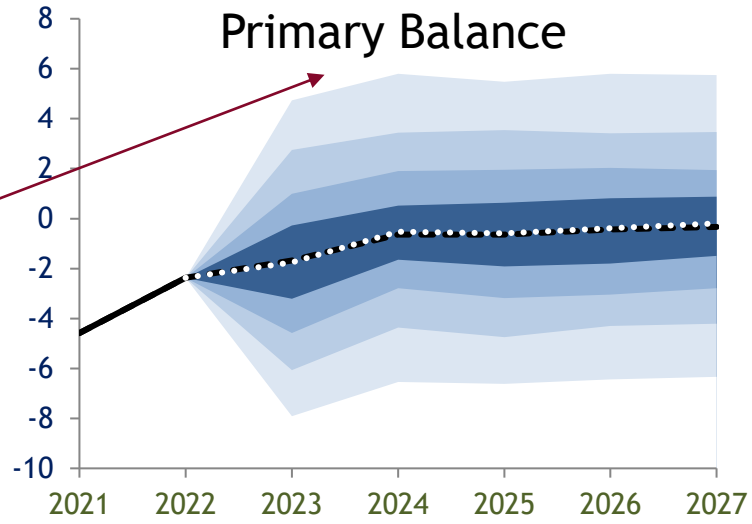
Step 3: Generation of the projected endogenous variables

The resampled residuals , and the estimated VAR coefficients, enable out of sample projections for the vector of endogenous variables , which are consistent with the simulated shocks

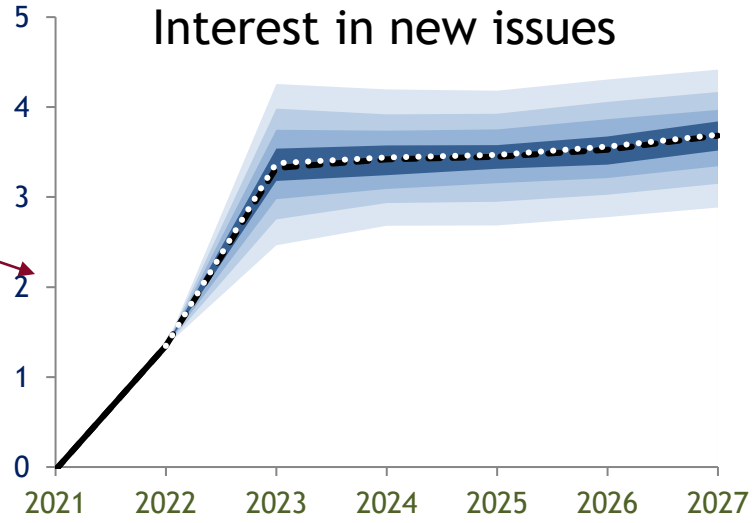
Uncertainty Option 2: VCV Matrix in COM style

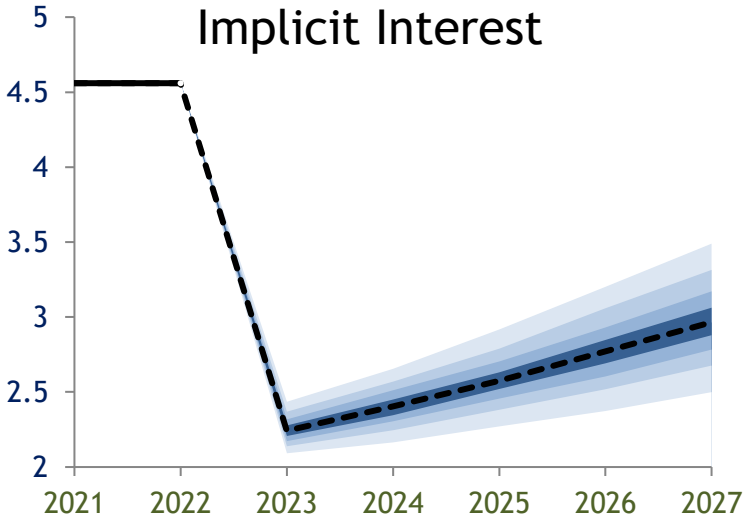






$$\Delta b_t = \underbrace{\frac{i_t - g_t}{1 + g_t}}_{(1)} b_{t-1} \underbrace{- pb_t}_{(2)} + \underbrace{dda_t}_{(3)}$$

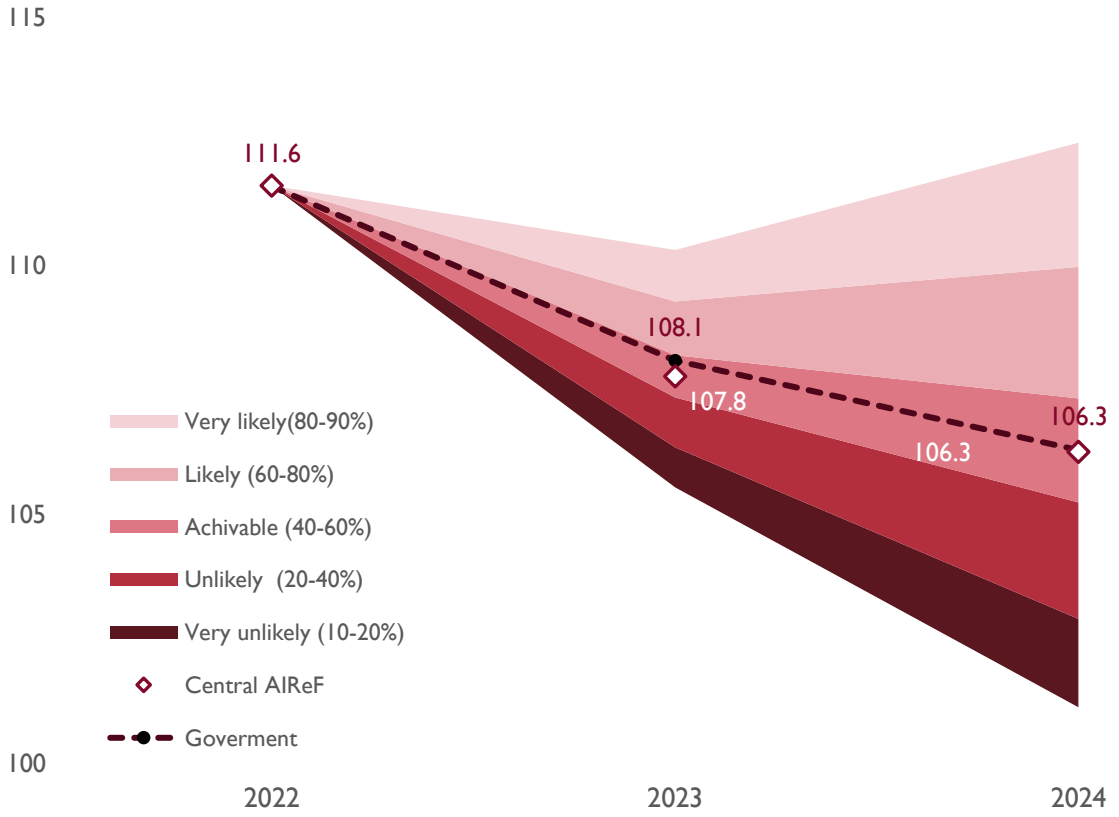




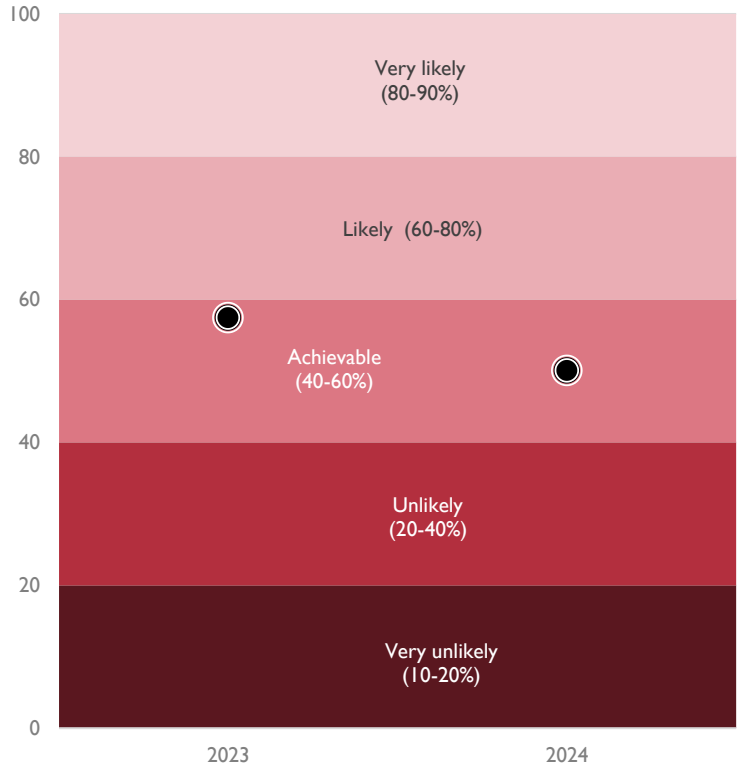
- 1,000 draws will be generated with shocks on the variables of the debt dynamics equation
- To obtain 1,000 alternative debt paths on the inertial path

Communicating the result: medium term

Debt to GDP Projections: Government and AIReF



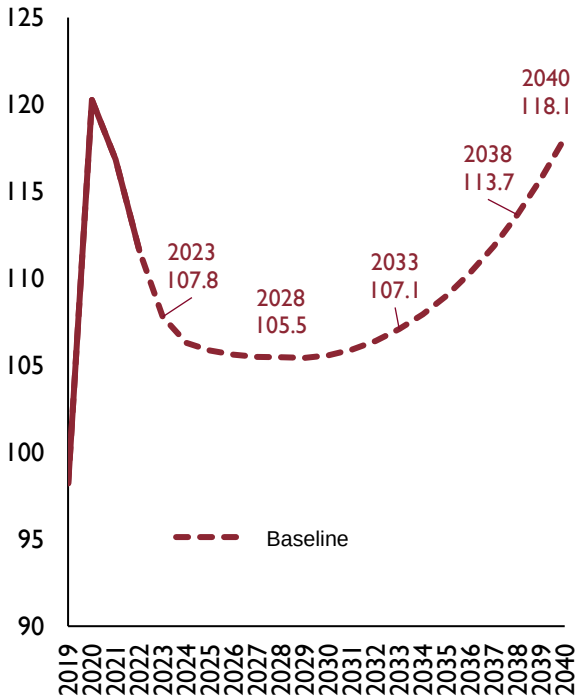
Probability of reaching a ratio below the Government's



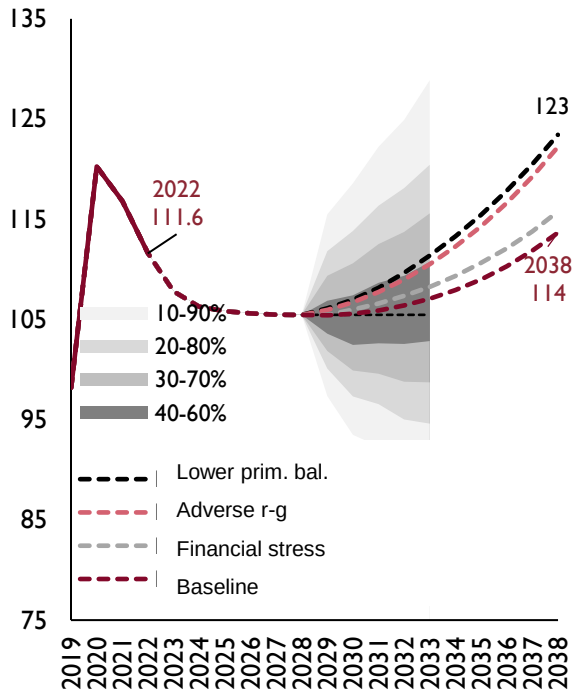
Communicating the result: practical example

- The fiscal path that would comply with the guidelines for calculating the technical trajectory of the legislative proposal to reform the governance framework, according to AIReF's interpretation and projections, would require measures to be taken during the period 2025-2028 worth 0.64 points of GDP per year
- This would meet the requirement of plausible debt reduction in the most demanding scenario which, according to AIReF's calculations, is defined by the "lower primary balance" scenario

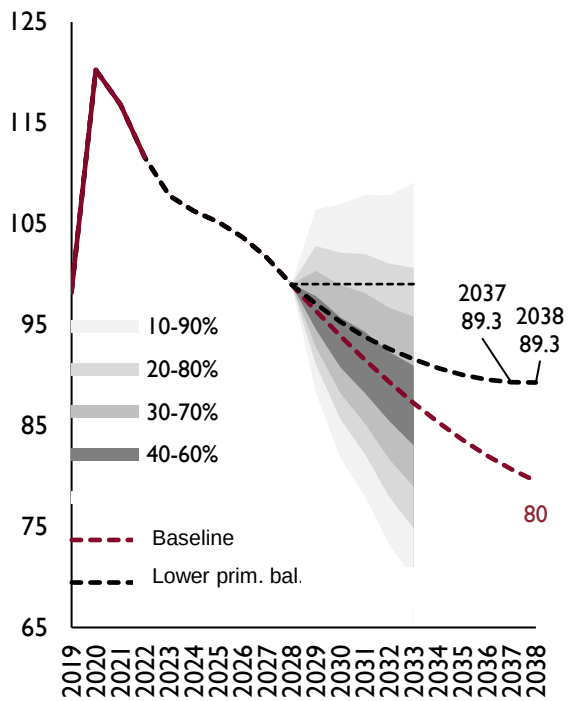
GOVERNMENT DEBT (%GDP)



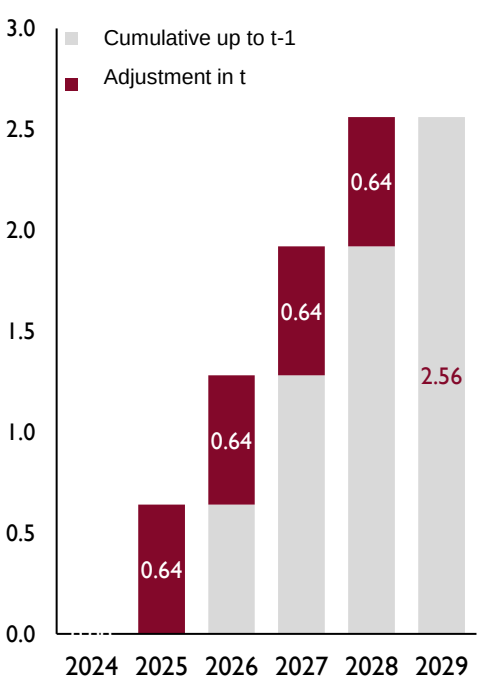
BASELINE DEBT PROJECTION (%GDP), FANCHARTS & STRESS SCENARIOS



TECHNICAL TRAJECTORY, FAN CHARTS AND MOST ADVERSE SCENARIOS



ADJUSTMENT (PP GDP) IN THE MOST RESTRICTIVE SCENARIO



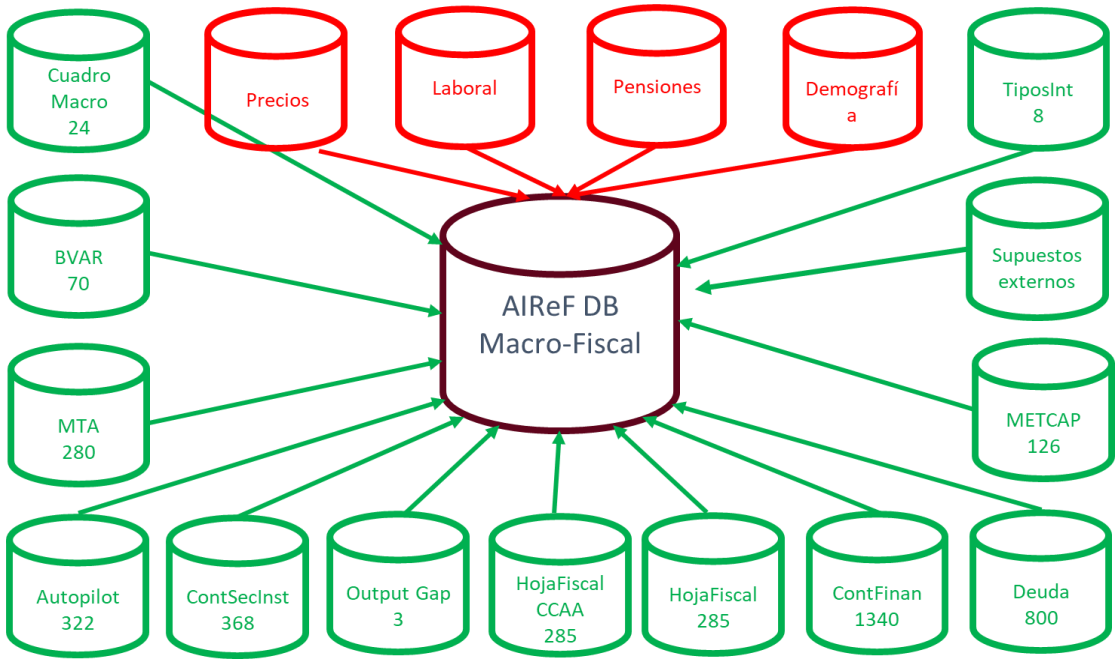
5 Practical issues

Practical issues (1): Databases

Public economic databases

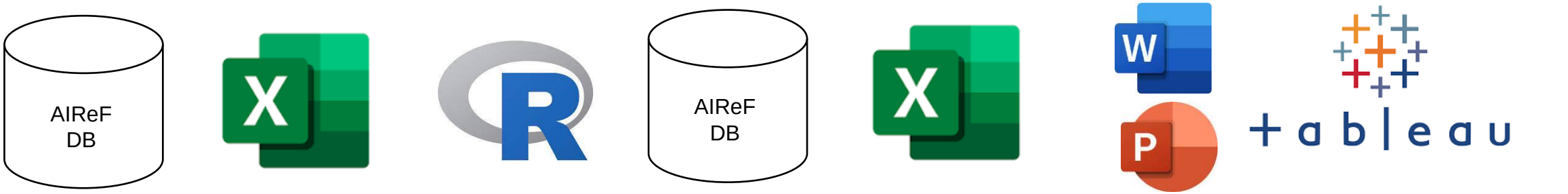
Internal database

Private data aggregators



Practical management: Our internal database follows a simple relational framework. Each time series is uniquely labelled according to source, frequency, seasonal treatment, area and unit. It stores +4.500 series which are extended up to t+h depending on the model. It takes form of E-Views database and can be access with menus using a simple Excel Add-In. It is a data meeting-point for the macro fiscal branch of de institution.

Practical issues (2): A model is only as good as its software implementation



Standard workflow

Data acquisition
- Public economic databases
- Private data aggregator
- Internal databases

Processing and modeling
- Estimation
- Software: R, EViews, MATLAB, Stata, Excel

Forecasts and simulations
- Software: EViews, MATLAB, Stata
- Excel

Communication
- Tableau
- Reports, website output, etc.
- Editors, Excel.

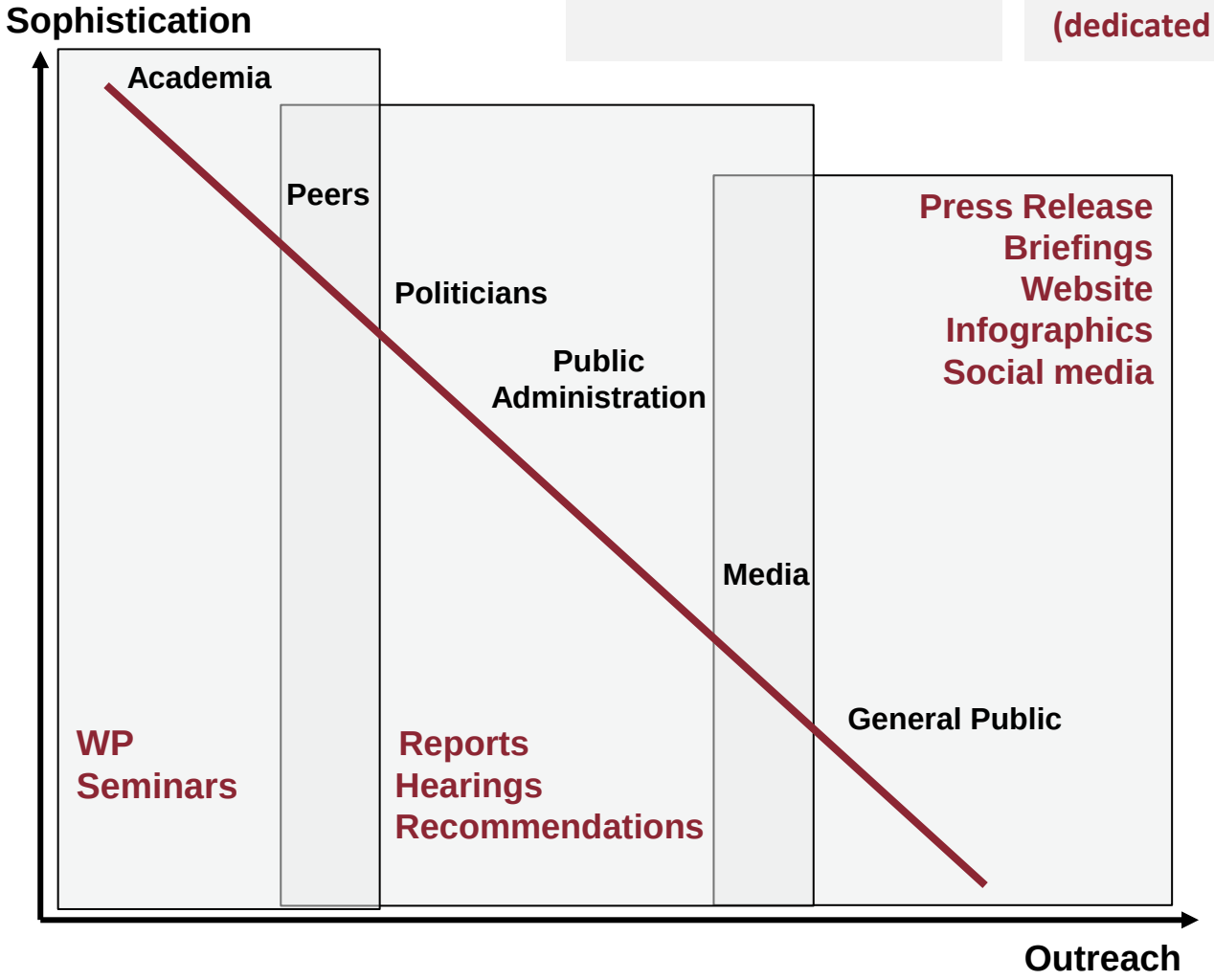
M	Why MS Office?
1	Universal language
2	Backwards support
3	Nice suite: Excel, PP, Word
4	Low learning barrier
5	Great add-ins to other software

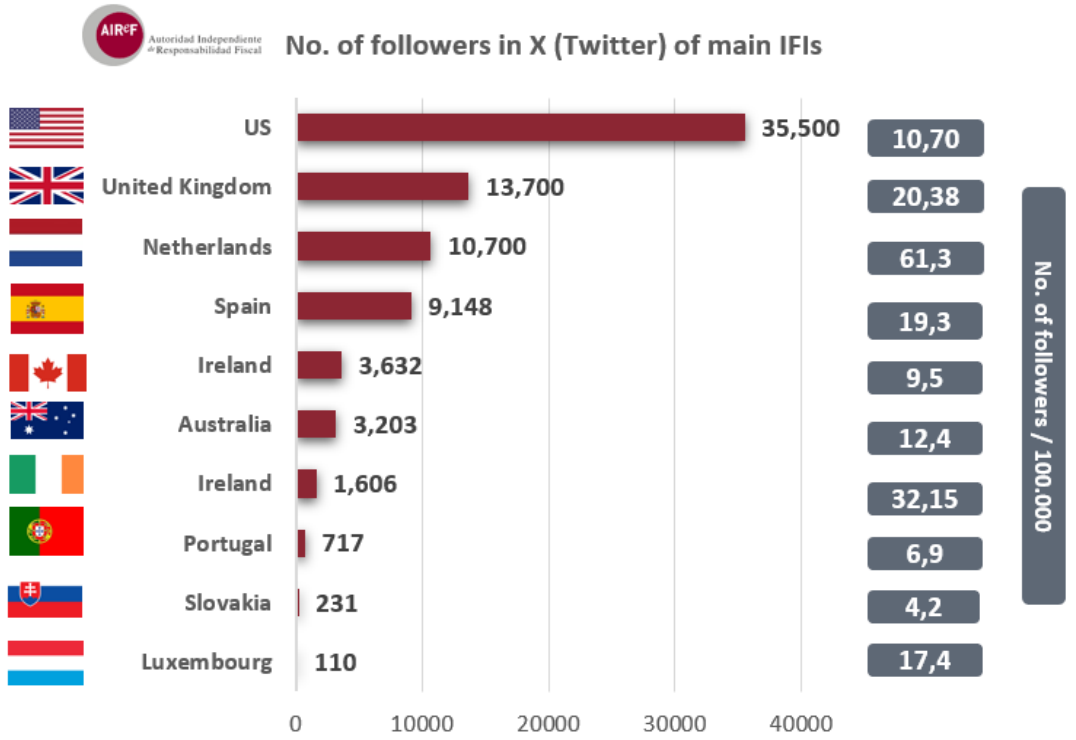
R	Why R?
1	Free open-source
2	Large community of users
3	Independent platfrom
4	Robust visualization
5	Balance data science-econometrics

Practical issues (3): How to think about the communication challenge?

1. Identification of Stakeholders
2. Selection of communication Channels (dedicated team)
3. Follow-up and assessment of Effectiveness

Key steps





To conclude

Summing up

- Economic forecasts are part science, part art. The sensible option is to use a **suite of models** that perform good on different challenges.
- It is advisable to have at least **three tools**: nowcasting, medium term and long term.
- An IFI must set the bar high. To do so means being **independent, transparent** and **accountable.**
- **Uncertainty** is a key element in the endorsement process. Fancharts are a great tool to communicate it.
- DSA is relatively simple to produce. The more detail (subsectors, microsimulation of interests flows) the more intricate the system is.
- **Stochastic DSA** are the way to go although the devil is in the details. A much prominent role it is assigned to this tool on the new framework for fiscal rules.
- To build a database to handle data and to automatize models is an investment with great return. **Communication** should always be a top priority.

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Additional slides

Background

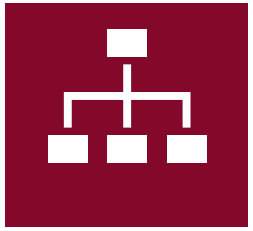
AIReF is a young, mid sized IFI, mandated to oversee the sustainability of public finances in Spain

History

- The Independent Authority for Spanish Fiscal Responsibility (AIReF) is an independent agency for fiscal monitoring in Spain.
- It was created in 2013 by the Spanish Government, on the initiative of the EU and to implement a constitutional mandate.

Tasks

- Macroeconomic government forecasts endorsement
- Fiscal rules supervision, fiscal analysis, and autonomous region fiscal targets oversee
- Costing of public policies and cost benefit analysis



Structure

- Cristina Herrero, the President, has a six-year non-renewable term of office.
- It has four divisions with 15 people each and an advisory board
- AIReF's activity is expressed through reports, opinions and studies.