The Accuracy of IMF Crises Nowcasts

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Introduction

- The core mission of the International Monetary Fund (IMF) is to ensure the stability of the global economy through:
  - Surveillance
  - Technical assistance
  - **Lending: "lender of last resort" in times of crises!**
    IMF's Covid-19 response: 102.75 billion US$ lending for 83 countries; 488.7 million US$ debt relief for 29 countries.

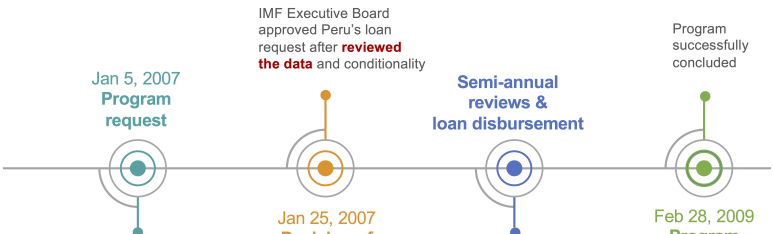
- Nowcasts (current states) vs. Forecasts (future states)
  - This paper: nowcasts produced during the crisis year, for the crisis year.

- Consequences of inaccurate IMF nowcasts:
  - Overly optimistic
    → underestimate the needs for loan and economic adjustment policy (IMF 2018); can induce economic contractions (Beaudry and Willems 2021)
  - Overly pessimistic
    → overstate financial needs, misallocation of resources

Introduction

IMF nowcasts accuracy plays a crucial role in program design and subsequent reviews, and ultimately affect the magnitude and speed of countries' crises recoveries.

Example: Timeline of 2007 Peru Stand-By Arrangement

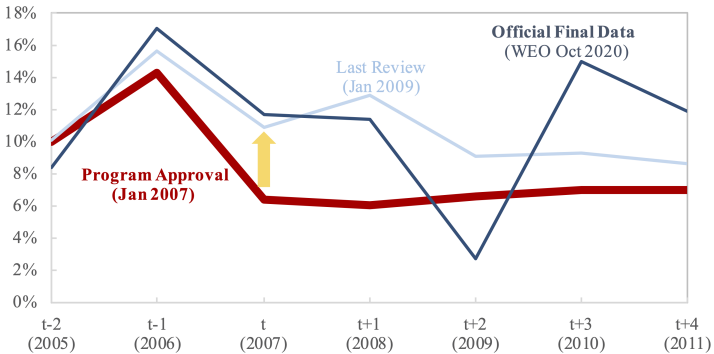


Motivation

The revised data obscures the initial situation at the height of crisis.

What factors led to the actual-nowcast deviation in t?

Peru Stand-By Arrangement: Nominal GDP Growth, Crisis Year t = 2007



Source: IMF MONA and WEO database.

Previous Literature on IMF Forecasts

- Timmermann (2007): Found systematic optimistic bias in IMF forecasts of real GDP and inflation.
  - Used revised data from World Economic Outlook (WEO) MONA vs. WEO
  - 178 countries during 1990-2006. Did not focus on crisis countries

- Atoyan and Conway (2011): Found optimistic bias in IMF fiscal/current account balances and real GDP growth. Mismeasured data on initial conditions is one of the largest contributors to the forecast errors of IMF-supported programs.
  - Focused on the revised data from MONA and WEO
  - 291 programs during 1993-2009

- Luna (2014): Found optimistic bias in real GDP growth nowcasts and forecasts, was driven by crises countries with exceptional access to IMF resources (loans to annual quota > 200%). Optimism may reflect inadequate program execution.
  - Used the revised data from MONA
  - 103 programs during 2002-2011

Previous Literature on IMF Nowcasts

- Eicher et al. (2019, EKPC): First study evaluated IMF nowcasts in times of crises. Found inefficiency and bias in some macro indicators, but the degree of biasedness and inefficiency depends on subsamples.
  - Examined only 110 programs from MONA and ignored data from 1992-2002. Coverage Comparison
  - Used the estimates of final data (MONA last reviews), not the official final data (WEO). Official vs. Estimates
  - Unnecessarily restrictive and dropped programs:
    1. Program duration < 18 months $\rightarrow$ ensure last review represents actual realized data
    2. Unbalanced data or nowcast errors > 4 st.dev
    3. We found 1/3 of dropped programs contained accurate information
  - Provided no guidance on **why** forecasts were inefficient or biased.

Contribution

Provides guidance on how to further improve IMF nowcasts efficiency to better design and assess the loan programs, and ultimately help countries restore economic growth.

1. Contradicts the popular notion that IMF forecasts are generally optimistic, by disentangling the structure of the nowcast bias:
   - Systematically overestimate (underestimate) low (high)-growth recoveries.
2. Identifies sources of inefficiencies in IMF nowcasts:
   - **2.1** program objectives (e.g. balance of payment stabilization, poverty reduction and growth etc.)
   - **2.2** program conditionality (e.g. mandated economic adjustment policies)
   - **2.3** geographic regions
   - **2.4** international crises (e.g. 2008 GFC, 1997 Asia Crisis)
   - **2.5** geopolitics (elections, conficts, disasters)

Preview of Results: Full Sample

1. RGDP/NGDP growth: inefficient but unbiased;
   Inflation: inefficient and biased.
   - Inefficiency mainly driven by subsample of Low-Income Countries (LICs).
   - Locate the sources of nowcast inefficiency: →

2. Nowcast accuracy overtime: GDP growth nowcasts substantially improved since 2013; Inflation nowcasts continue to struggle as recently as 2018.

3. Nowcast horizon: shorter horizons do not improve accuracy.

		Real GDP Growth	Nominal GDP Growth	Inflation
Intl Crises	2008 Crisis	*	***	*
Region	Americas		**	
Program Conditionality: Quantitative	Ceiling_External_Debt (MT&LT)		***	
	Floor_Int'l_Reserves	*	*	
	Ceiling_External_Arrears		**	
	Ceiling_Gov't_Credit	**		**
	Ceiling_Gov't_Deficit		***	
	Ceiling_External_Debt (ST)		*	
	Ceiling_CB_Net_Dom_Assets			**
Program Conditionality: Policy/Structual Reform	Improve_Econ_Statistics	*		***
	Open_Current&Capital_Account		**	
	Reduce_Trade_Tariff/Quota			*
	Gov't_Enterprise_Pricing			*
Program Objective	BOP_Stablization		**	***
	Struct_Adj_Poverty_Growth		*	

Note: (1) *** p<0.01, ** p<0.05, * p<0.1
(2) Insignificant covariates are not shown in this table.

Evaluating Nowcasts Accuracy: Data

- Nowcasts data: **Mon**itoring of Fund **A**rrangements (MONA), IMF
- Actual data: **W**orld **E**conomic **O**utlook (WEO), IMF
- This paper: Calculating Nowcasts Error
  - Focus on three indicators: real & nominal GDP growth, Inflation.
  - 602 programs during 1992-2019.
  - Audit 267 data points using the original IMF Executive Board Documents. 11 types of errors in MONA

Peru Stand-By Arrangement: Nominal GDP Growth, Crisis Year t=2007

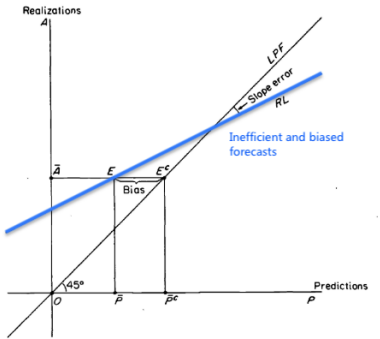
	Actual data		Nowcast/Forecast data				
MONA Review Sequence	**t-2**	**t-1**	**t**	**t+1**	**t+2**	**t+3**	**t+4**
Program Approval, Jan 2007	10.0%	14.3%	6.4%	6.0%	6.5%	7.0%	7.0%
First Review, June 2007	10.0%	16.7%	6.7%	6.0%	6.5%	7.1%	7.1%
Second Review, Dec 2007	10.0%	16.3%	10.0%	7.2%	6.6%	6.8%	7.4%
Third Review, July 2008	10.0%	16.5%	11.8%	12.2%	8.2%	5.8%	6.6%
Last Review, Jan 2009	10.0%	15.6%	10.9%	12.9%	9.1%	9.3%	8.6%
Official final data from WEO	8.4%	17.0%	11.7%	11.4%	2.7%	15.0%	11.9%

Evaluating Nowcasts Accuracy: Methodology

$$A_t = \alpha + \beta F_t + \varepsilon_t$$

- Perfect nowcasts:
  - Intercept: $\alpha = 0$
  - Slope: $\beta = 1$
- Nowcasts are **efficient** if:
  $corr(F_t, A_t - F_t) = 0 \rightarrow$ more informative
  - Nowcasts incorporate all relevant information available at the time that nowcasts are established.
  - May still see ${A_t}^i \neq {F_t}^i$ if forecast errors are random and unpredictable.
- Nowcasts are **unbiased** if:
  $E[A_t] = E[F_t]$

FIGURE 1-1. The Prediction-Realization Diagram



Key:
LPF – Line of perfect forecasts
RL – Regression line
Ā – Mean realization
P̄ – Mean prediction
P̄^c – Mean corrected prediction
E – Mean point
E^c – Corrected mean point

Source: Theil (1966); Mincer and Zarnowitz (1969)

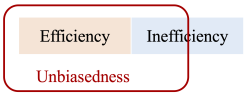
Evaluating Efficiency and Unbiasedness

Mincer-Zarnowitz (1969, MZ) necessary condition for efficiency:

$$A_t = \alpha + \beta F_t + \varepsilon_t$$

$$H_0 : \alpha = 0 \ \& \ \beta = 1$$

- If H_0 can not be rejected, nowcasts are efficient and unbiased.
- If H_0 is rejected, nowcasts are inefficient, but **may or may not** be biased.
  - Solution: Holden and Peel (1990) test establishes a necessary and sufficient condition for unbiasedness
  - Still do not know the source of inefficiency!



Efficiency is a sufficient condition for unbiasedness

Evaluating Efficiency and Unbiasedness

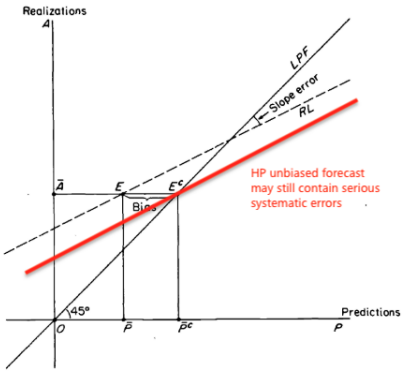
Sufficient and necessary condition for unbiasedness:

- Holden and Peel (1990, HP) test for unbiasedness $E[A_t] = E[F_t]$ requires:

$$A_t - F_t = e_t = \gamma + u_t$$
$$H_0 : \gamma = 0$$

- All HP H_0 tells us is that regression line and perfect nowcast line happen to intersect at $E[A_t] = E[F_t]$

FIGURE 1-1. The Prediction-Realization Diagram



Source: Theil (1966); Mincer and Zarnowitz (1969).

Full Sample Result: Compare with EKPC (2019)

Inclusion of previously omitted programs and the official final data have changed findings in EKPC (2019):

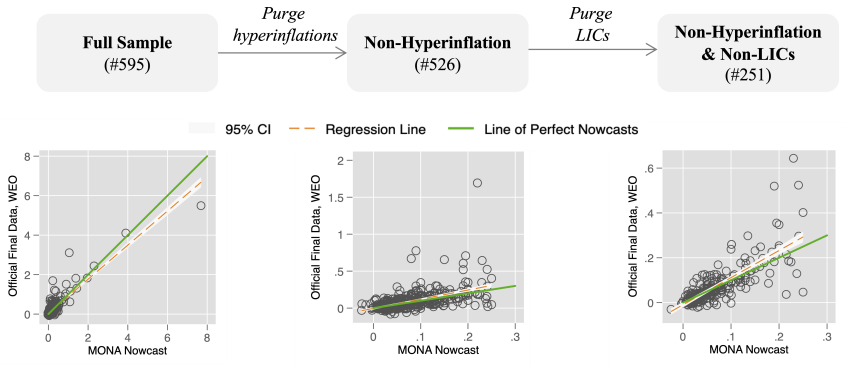
- RGDP: **in**efficient (**) & unbiased (same) $\beta \uparrow < 1$
- NGDP: efficient & unbiased → **in**efficient (***) & unbiased $\beta \downarrow < 1$
- Inflation: efficient & unbiased → **in**efficient (***) & **biased** (**) $\beta \downarrow < 1$ GDP deflator

Dependent Variable:	Actual RGDP Growth		Actual NGDP Growth		Actual Inflation	
	(1a)	(2a)	(1b)	(2b)	(1c)	(2c)
	EKPC (2019)	**Full dataset**	**EKPC (2019)**	**Full dataset**	**EKPC (2019)**	**Full dataset**
Constant, α	0.016**	0.004	0.014*	0.062***	0.002	0.038***
p-value (α=0)	0.013	0.206	0.071	0.000	0.875	0.003
IMF Nowcast, β	0.621***	0.821**	0.926	0.666***	1.091	0.864
p-value (β=1)	0.010	0.044	0.193	0.000	0.702	0.185
Observations	110	597	110	596	100	595
Adjusted R-square	0.402	0.404	0.742	0.836	0.545	0.810
MZ F-test (α=0, β=1)	3.460**	2.731*	1.740	13.93***	1.021	8.258***
p-value (α=0, β=1)	0.035	0.066	0.180	0.000	0.364	0.000
HP T-test (γ=0)	-0.111	-1.464	1.180	-0.946	1.408	2.595**
p-value (γ=0)	0.912	0.144	0.240	0.344	0.162	0.010

Note: *** p<0.01, ** p<0.05, * p<0.1

Result by Subsample: Inflation

Inflation: Largest accuracy variation across subsamples. Inefficiency in the full sample is driven by nowcasts for countries with anticipated hyperinflations (>25%) and LICs.



Inefficient (***) & Biased (**)
$\beta = 0.864$

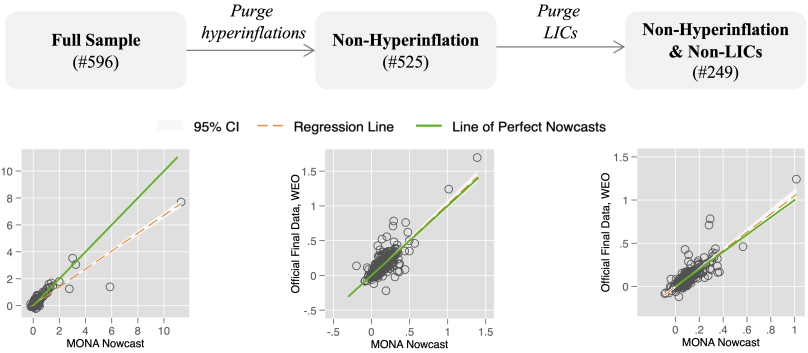
Inefficient (***) & Biased (***)
$\beta = 1.242$

Efficient & Unbiased
$\beta = 1.210$

Note: Asterisk signs indicate the null of efficient/unbiased nowcasts is rejected at *** p<0.01, ** p<0.05, * p<0.1

Result by Subsample: NGDP Growth

NGDP: Inefficiency in the full sample is driven by nowcasts for countries with anticipated hyperinflations (>25%). Biasedness is driven by Low-Income Countries (LICs).



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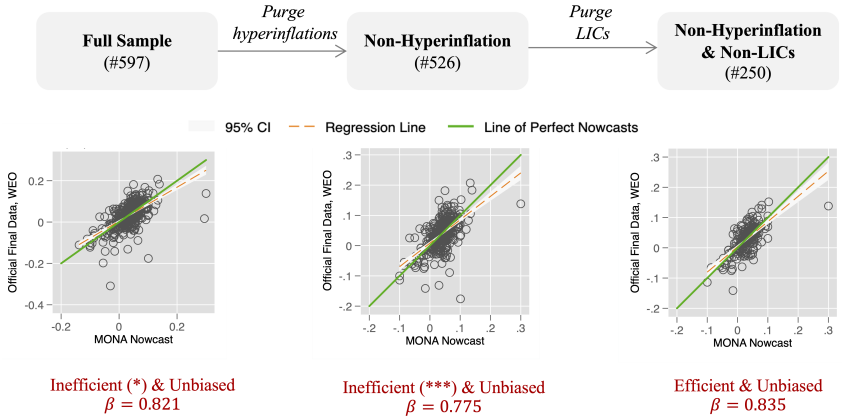
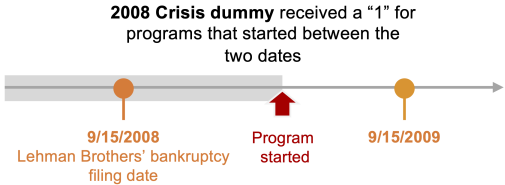


Note: Asterisk signs indicate the null of efficient/unbiased nowcasts is rejected at *** p<0.01, ** p<0.05, * p<0.1

Why are IMF Nowcasts Inefficient?

Did the IMF include all relevant (ex-ante) information available at the time of nowcasts into account for the nowcasts, or, should nowcasts differ systematically by?

- International crises?
- Geographic region?
- Program conditionatlity?
- Program objective?
- Loan amount?
- Geopolitic factors (election, conflicts, disasters)?



Evaluating Sources of Inefficiency: Methodology

- Sinclair, Joutz, and Stekler (2010, SJS), extend Mincer-Zarnowitz F-test to include an additional vector of covariates that represent information which was available to forecasters at the time of the forecast:

$$A_t = \alpha + \beta F_t + \delta X_t + \varepsilon_t$$

$$H_0 : \alpha = 0 \;\&\; \beta = 1 \;\&\; \delta = 0$$

1. Conditional on the inclusion of IMF nowcasts, If any of the coefficients associated with the additional covariates are non-zero, the controls contain information that can explain the nowcast errors.
2. If the H_0 is rejected, SJS note that the information contained in X was not fully integrated into the nowcast, identifying a possible source of inefficiency.

Full Sample Result: the Effect of International Crises and Regions

☑ **International Crises and Regions**

☐ Program Conditionality: Quantitative

☐ Program Conditionality: Policy/Structural Reform

☐ Program Objective, Loan Amount, and Geopolitic Factors

- 2008 Crisis → only common factors that were not properly accounted for by IMF nowcasts.
- Regional effect → not the source of inefficiency for RGDP and inflation nowcasts. IMF accurately takes into account of their effects.
- IMF NGDP nowcasts could have been improved if the regional effect of Americas had been properly considered.

		Real GDP Growth	Nominal GDP Growth	Inflation
Nowcast	**Constant, α**	-0.007	0.034	0.037
	p-value (α = 0)	0.533	0.336	0.553
	IMF Nowcast, β	**0.764***	**0.649*****	**0.837***
	p-value (β = 1)	0.015	0.000	0.082
Intl Crises	**2008 Crisis**	**-0.013***	**-0.046*****	**-0.035***
		(0.007)	(0.014)	(0.021)
	1997 Crisis	-0.012	-0.028	-0.033
		(0.015)	(0.037)	(0.053)
Regions	**Africa**	0.006	-0.038	-0.022
		(0.006)	(0.025)	(0.031)
	Americas	0.005	**-0.056****	-0.045
		(0.006)	(0.022)	(0.035)
	Asia	0.002	-0.011	-0.035
		(0.007)	(0.030)	(0.033)
	…			
	Observations	597	596	595
	Adjusted R-squared	0.406	0.842	0.819
	SJS F-test (α=δ=0 & β=1)	**1.368***	**3.263*****	**1.573****
	p-value (α=δ=0 & β=1)	0.081	0.000	0.021

Full Sample Result: the Effect of Quantitative Conditionality

- ☐ International Crises and Regions
- ☑ **Program Conditionality: Quantitative**
- ☐ Program Conditionality: Policy/Structural Reform
- ☐ Program Objective, Loan Amount, and Geopolitic Factors

Strong evidence that several quantitative conditionality dimensions were also not properly integrated into IMF nowcasts in the full sample:

- RGDP: (i) reserves, (ii) government credit.
- NGDP: (i) reserves, (ii) external arrears, (iii) fiscal deficit, (iv) short-term external debt.
- Inflation: (i) government credit, (ii) central bank net domestic assets.

		Real GDP Growth	Nominal GDP Growth	Inflation
	…			
Program Conditionality: Quantitative	**Ceiling External Debt(MT&LT)**	0.007	**0.040*** **	0.006
		(0.005)	(0.014)	(0.013)
	Floor Int'l Reserves	**0.010***	**0.037***	0.023
		(0.005)	(0.021)	(0.016)
	Ceiling External Arrears	-0.001	**0.033** **	0.010
		(0.004)	(0.014)	(0.021)
	Ceiling Gov't Credit	**-0.010** **	-0.003	**0.028** **
		(0.005)	(0.012)	(0.013)
	Ceiling Domestic Arrears	0.004	0.020	0.006
		(0.004)	(0.014)	(0.013)
	Ceiling Gov't Deficit	-0.004	**-0.058*** **	-0.021
		(0.004)	(0.018)	(0.021)
	Ceiling New Arrears/Default	-0.001	0.004	-0.004
		(0.004)	(0.020)	(0.019)
	Ceiling External Debt(ST)	-0.001	**-0.020***	0.006
		(0.004)	(0.012)	(0.010)
	Ceiling CB Net Dom Assets	0.002	0.010	**0.041** **
		(0.006)	(0.020)	(0.017)
	…			
	Observations	597	596	595
	Adjusted R-squared	0.406	0.842	0.819
	SJS F-test (α=δ=0 & β=1)	**1.368***	**3.263*** **	**1.573** **
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Full Sample Result: the Effect of Policy/Structural Conditionality

- ☐ International Crises and Regions
- ☐ Program Conditionality: Quantitative
- ☑ **Program Conditionality: Policy/Structural Reform**
- ☐ Program Objective, Loan Amount, and Geopolitic Factors

Strong evidence that several qualitative (policy/structural reform) conditionality dimensions were also not properly integrated into IMF nowcasts in the full sample:

- RGDP: (i) improve economic statistics
- NGDP: (i) remove current and capital account restrictions
- Inflation: (i) improve economic statistics, (ii) trade openness, (iii) state enterprises

		Real GDP Growth	Nominal GDP Growth	Inflation
	…			
Program Conditionality: Policy/Structural Reform	**Civil Service Wage/Empl.**	0.003	-0.002	-0.008
		(0.004)	(0.009)	(0.009)
	Improve Econ Statistics	**0.008***	-0.009	**-0.028*****
		(0.005)	(0.010)	(0.010)
	Open Current&Capital Account	-0.002	**-0.043****	-0.012
		(0.005)	(0.021)	(0.018)
	Financial Sector Reform	0.002	0.003	-0.001
		(0.005)	(0.015)	(0.018)
	Gen Gov't Reform	0.007	0.001	-0.055
		(0.005)	(0.024)	(0.038)
	Reduce Trade Tariff/Quota	0.001	0.023	**-0.029***
		(0.004)	(0.024)	(0.017)
	Legal/Market Reforms	0.005	-0.007	-0.013
		(0.004)	(0.011)	(0.016)
	Pension Reform	-0.003	-0.014	-0.014
		(0.004)	(0.009)	(0.010)
	Gov't Enterprise Pricing	-0.002	0.017	**0.033***
		(0.004)	(0.011)	(0.018)
	CB Stats Regs Indep.	-0.002	-0.010	-0.007
		(0.004)	(0.011)	(0.013)
	Labor Mkt Wage/Empl.	0.009	-0.025	-0.025
		(0.007)	(0.016)	(0.019)
	…			
	Observations	597	596	595
	Adjusted R-squared	0.406	0.842	0.819
	SJS F-test (α=δ=0 & β=1)	**1.368***	**3.263*****	**1.573****
	p-value (α=δ=0 & β=1)	0.081	0.000	0.021

Full Sample Result: the Effect of Program Objective, Loan Amount, and Geopolitic Factors

- ☐ International Crises and Regions
- ☐ Program Conditionality: Quantitative
- ☐ Program Conditionality: Policy/Structural Reform
- ☑ **Program Objective, Loan Amount, and Geopolitics**

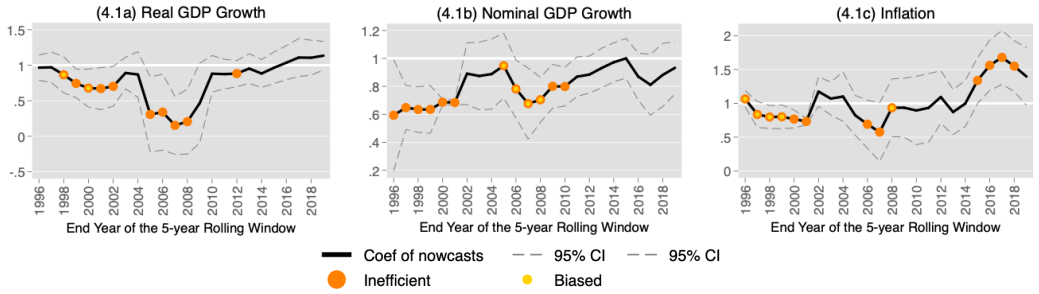
List of Programs

- Sources of inefficiency: the implications of program types that address (i) balance of payments stabilization problems (for NGDP and inflation), and (ii) structural adjustment & poverty growth (for Inflation).
- Loan amount → fully accounted for in IMF nowcasts.
- Elections/disasters/conflicts → fully accounted for in IMF nowcasts (except some subsamples of RGDP).

		Real GDP Growth	Nominal GDP Growth	Inflation
	...			
Program Objective	**BOP Stablization**	-0.005	**0.042****	**0.053*****
		(0.005)	(0.018)	(0.020)
	BOP Shocks Precautionary	0.009	0.012	-0.006
		(0.006)	(0.019)	(0.021)
	Struct Adj Poverty Growth	0.004	**-0.023***	0.009
		(0.005)	(0.014)	(0.017)
	Non Financial Reforms	0.001	0.008	0.011
		(0.005)	(0.016)	(0.012)
	Loan Amount	-0.044	-0.108	0.166
		(0.049)	(0.097)	(0.112)
	Elections	-0.001	0.012	-0.007
		(0.004)	(0.018)	(0.012)
	Natural Disasters	0.003	0.024	-0.013
		(0.004)	(0.018)	(0.018)
	Conflicts	-0.005	0.000	-0.003
		(0.005)	(0.012)	(0.013)
	Observations	597	596	595
	Adjusted R-squared	0.406	0.842	0.819
	SJS F-test (α=δ=0 & β=1)	**1.368***	**3.263*****	**1.573****
	p-value (α=δ=0 & β=1)	0.081	0.000	0.021

Result: Nowcast Bias and Efficiency Over Time

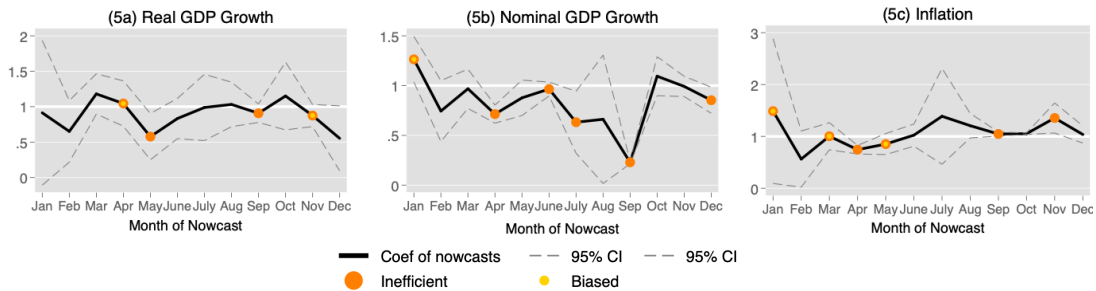
- Four distinct periods: 1992-2001(inefficient and or biased) → 2002-2005 (slightly improved) → 2006-2009/12 (again inefficient and or biased) → 2012-present (unbiased and efficient GDP nowcasts; inefficient inflation nowcasts)
- $\beta << 1$ before 2014 (for RGDP and NGDP) → a long-enduring pattern of overly optimistic (pessimistic) nowcasts for low (high)-growth countries.
- $\beta > 1$ start 2015 (for RGDP and inflation) → pattern reverses.



Result: Nowcast Horizons and Nowcast Accuracy

- No clear pattern of improved nowcast accuracy when the time horizon shortens.
- inflation nowcasts are the most stable around $\beta = 1$, while NGDP growth produces the largest deviations.
  $\rightarrow$ could be inflation data is much more readily available (monthly) than GDP growth (quarterly).

Nowcast Horizons and Nowcast Accuracy (Full Sample)



Summary of Findings

1. RGDP/NGDP growth nowcasts: inefficient but unbiased;
   Inflation nowcasts: inefficient and biased.

2. Inefficiency mainly driven by subsample of LICs.

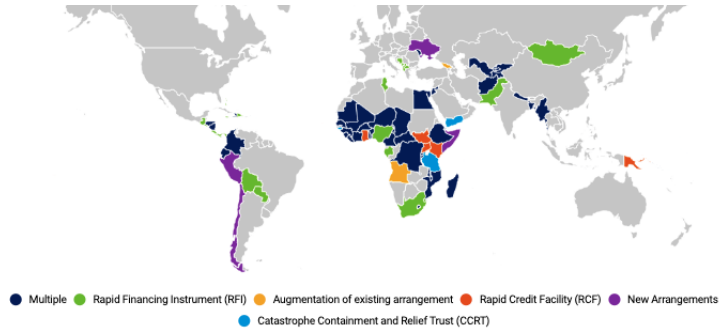
3. Identified sources of IMF nowcasts inefficiency:
   - International crises and regions → *2008 crisis (for all), regional effect in America (for NGDP)*
   - Program types and conditionatlity → *main sources of inefficiency. specific factor depends on choice of variable*
   - Loan amount → *fully accounted for in IMF nowcasts*
   - Geopolitics (election, disaster, conflicts) → *only for subsamples of RGDP nowcasts*

4. Nowcast accuracy overtime → *pattern changes overtime. GDP growth nowcasts improved since 2013.*

5. Nowcast horizon → *shorter horizons do not improve accuracy*

As the Covid-19 pandemic raises the demand for IMF programs, improved nowcasts and an understanding which areas have produced nowcast inaccuracies are thus more important than ever.

IMF COVID-19 Lending



Thank You

Appendix

Appendix List

- Calculating the Nowcast Errors link
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Calculating the Nowcast Errors

Assessment is based on the data of **growth rate** from t-1 to t only:

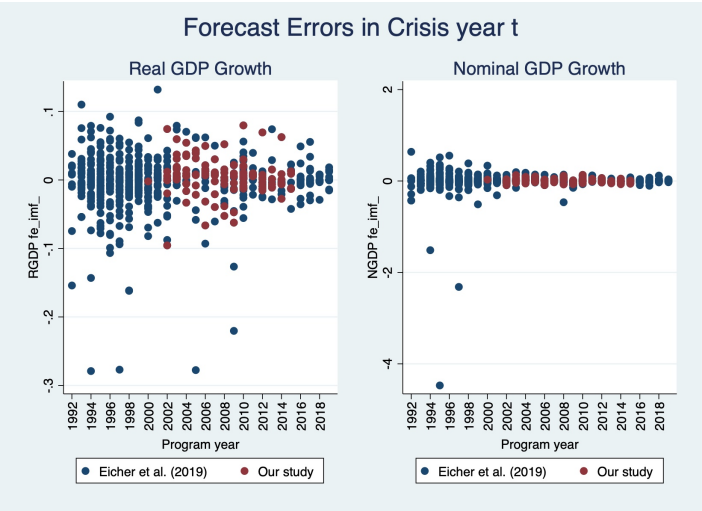
- **Nowcast errors**: $e_t = A_t - F_t$
  $\rightarrow$ a negative value represents optimistic forecast

  - **Actual growth rates**: $A_t = \frac{a_t - a_{t-1}}{a_{t-1}}$
    where a_t is the actual level at t.

  - **Nowcast growth rates**: $F_t = \frac{f_{t|t} - a^*_{t-1}}{a^*_{t-1}}$
    where $f_{t|t}$ is the nowcast level of t at time t;
    a^*_{t-1} is the preliminary actual level data of $t-1$ available at time t and subject to revision

Compare Data Coverage with EKPC (2019)

Comparison of Data Coverage



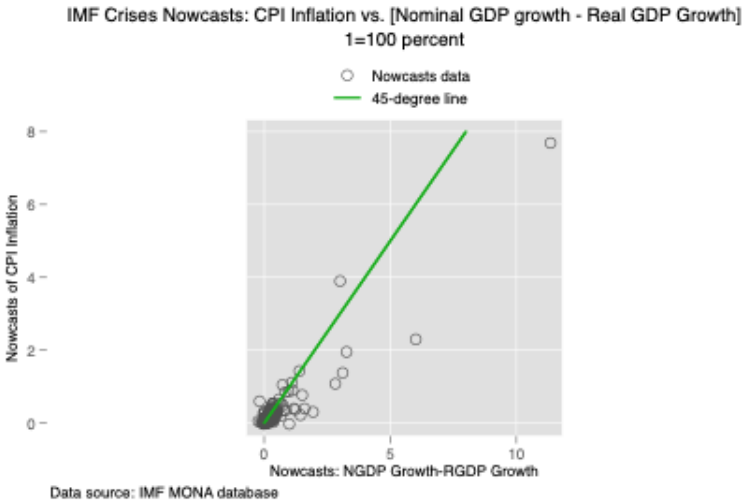
Source: Authors' Calculation

MONA vs. WEO

- Monitoring of Fund Arrangements (MONA) Database, 1992 to present
  - tracks the performance of IMF loan programs in terms of scheduled purchases and reviews, quantitative and structural performance criteria.
  - collects forecast data of macroeconomic indicators from IMF desk economists.
  - includes three years of historical data that predates the program year, t, the nowcast for t, and up to four additional years of future forecasts, for data established at program approval (initial data) and each subsequent review (revised data)
  - contains a wide range of errors that limits its values of monitoring IMF loan programs. $\rightarrow$ data auditing is necessary for a comprehensive study.
- World Economic Outlook (WEO) Database, 1999 to present
  - illustrates the unique multi-country aspects of IMF forecasts produced by the Global Projection Model maintained at the IMF Research Department (in consultation with desk economists).
  - Each WEO data vintage (released in April and October each year) includes long series of historical data and 6-year projection data for all IMF member countries and aggregates of country groups.

WEO's forecasts can differ from MONA's forecast because they are model-based estimates and have been checked for data consistency among the country forecasts made within the same region. WEO's historical data can also differ from MONA data because they are revised on a continual basis as more information becomes available, and structural breaks are often adjusted to produce smooth series using different techniques. For this reason, WEO historical data are considered the official final data.

CPI Inflation vs. Implied GDP Deflator



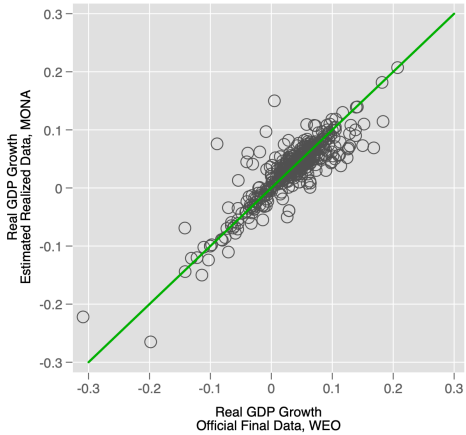
Five Categories by Program Objectives

We grouped the 13 IMF programs types into 5 program objectives:

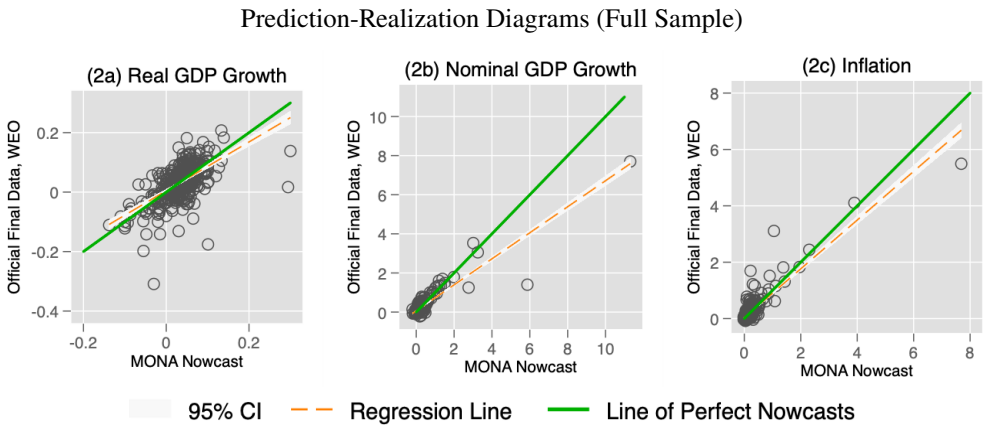
1. **BOP Stabilization:** Stand-By Agreements (SBA);
2. **BOP Shocks (precautionary):** Exogenous Shock Facility (ESF), Standby Credit Facility (SCF), Flexible Credit Line (FCL), Precautionary Credit Line (PCL), Precautionary Liquidity Line (PLL);
3. **Structural Adjustment & Poverty Reduction and Growth:** Structural Adjustment Facility (SAF), Enhanced Structural Adjustment Facility(ESAF), Poverty Reduction and Growth Trust (PRGT);
4. **Long-Term BOP Reforms:** Extended Credit Facility (ECF), Extended Fund Facility (EFF).
5. **Non-Financial Reforms:** Policy Reform Instrument (PSI), Policy Coordination Instrument (PCI);

Official vs. Estimates of Final Data

Official Final Data (WEO) vs. Estimates of Final Data (MONA)
(Real GDP Growth)



Prediction-Realization Diagrams (Full Sample)



Result by Subsample

Inefficiency in the full sample is driven by nowcasts for countries with anticipated hyperinflations (>25%) and LICs.

Dependent Variable:	RGDP Growth					NGDP Growth					Inflation				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
	All	Non-Hyper	Non-Hyper LICs	Non-Hyper Non-LICs	Hyper Inflation	All	Non-Hyper	Non-Hyper LICs	Non-Hyper Non-LICs	Hyper Inflation	All	Non-Hyper	Non-Hyper LICs	Non-Hyper Non-LICs	Hyper Inflation
Constant, α	0.004	0.008**	0.020***	0.003	-0.008	0.062***	0.003	0.011	-0.004	0.188***	0.038***	-0.004	0.002	-0.010	0.197***
p-value (α=0)	0.206	0.010	0.001	0.390	0.234	0.000	0.704	0.520	0.665	0.000	0.003	0.658	0.929	0.168	0.001
IMF Nowcast, β	0.821**	0.775***	0.601***	0.835	0.801	0.666***	1.02	0.987	1.052	0.624***	0.864	1.242	1.262	1.210	0.792**
p-value (β=1)	0.044	0.002	0.001	0.145	0.437	0.000	0.798	0.919	0.551	0.000	0.185	0.156	0.407	0.129	0.023
Observations	597	526	276	250	71	596	525	276	249	71	595	526	275	251	69
Adjusted R-square	0.404	0.353	0.155	0.486	0.383	0.836	0.665	0.625	0.699	0.834	0.810	0.309	0.207	0.595	0.822
MZ F-test (α=0 & β=1)	2.731*	4.841***	5.685***	1.362	0.988	13.93***	1.685	2.039	0.202	11.26***	8.258***	6.062***	6.222***	1.190	5.8***
p-value (α=0 & β=1)	0.066	0.008	0.004	0.258	0.377	0.000	0.186	0.132	0.818	0.000	0.000	0.003	0.002	0.306	0.005
HP T-test (γ=0)	-1.464	-0.882	-0.345	-1.001	-1.334	-0.946	1.757*	1.834*	0.508	-1.525	2.595**	2.997***	2.692***	1.345	1.135
p-value (γ=0)	0.144	0.378	0.730	0.318	0.187	0.344	0.079	0.068	0.612	0.132	0.010	0.003	0.008	0.180	0.260
St Dev: Actual Data	0.050	0.043	0.040	0.042	0.077	0.426	0.137	0.141	0.129	1.051	0.382	0.122	0.145	0.089	0.893
St Dev: Nowcast Error	0.039	0.035	0.038	0.031	0.062	0.261	0.079	0.086	0.071	0.718	0.175	0.102	0.130	0.058	0.430
MAE	2.457	2.264	2.406	2.108	3.882	7.202	4.747	5.285	4.150	25.355	6.482	4.512	5.789	3.111	21.506
RMSE	3.914	3.496	3.838	3.075	6.186	26.089	7.953	8.660	7.088	72.427	17.579	10.286	13.107	5.787	43.108

Auditing MONA Database

Data Entry Errors	
(1) Temporal Errors (the right data entered for the wrong program year)	10 programs
(2) Zeros Identify Missing Values	29 instances
(3) Data Entered with Wrong Signs	593 instances (entire database)
(4) Typos and Spelling Mistakes	49 instances
(5) Wrong Line Items Entered	2 instances
Inconsistencies	
(6) Currency Unit Magnitude Inconsistencies	19 instances
(7) Indicator Variable Inconsistencies	293 instances (entire database)
(8) Rates vs Level Inconsistencies	28 instances
(9) Base Year Inconsistencies	23 instances
Corrected Data from IMF Archives (Executive Board Documents)	
(10) Missing Data Corrected	17 missing filled
(11) Outliers Verified and Corrected	92 outliers verified/corrected

The Theil Inequality Index

- The forecast errors can be captured in Theil's inequality index that can be decomposed into three proportions:
  1. (systematic) slope bias ($\beta \neq 1$)
  2. (systematic) intercept bias ($\alpha \neq 0$)
  3. unsystematic residual portion (errors are random and unpredictable)

- The forecast errors of RGDP growth are predominantly driven by the unsystematic residuals that are essentially unpredictable!
  $\rightarrow$ Maybe include additional significant controls to reduce the forecast errors.