Nowcasting during the Pandemic:

Lessons from Argentina[1]

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[1]The opinions expressed here are those of the authors and do not necessarily represent the view of all the institutions aforementioned

Summary

Ongoing project, preliminary results

- **Objective**: Evaluate Nowcasting performance during the COVID-19 pandemic of 2020
- **Methodology**: Dynamic Factor model
  - Different estimation schemes
  - Explore new high frequency data sets
- **Main Results**:
  - Good Nowcasting performance
  - Keeping parameters fixed makes no difference
  - Gain in using energy consumption

Outline

1. General Context: Lockdown in Argentina

2. Our Nowcast Exercise
   2.1. DFM
   2.2. Evaluating models' relative predictive ability

3. Empirical Results
   3.1. Estimation Scheme
   3.2. Nowcasting using new data sources

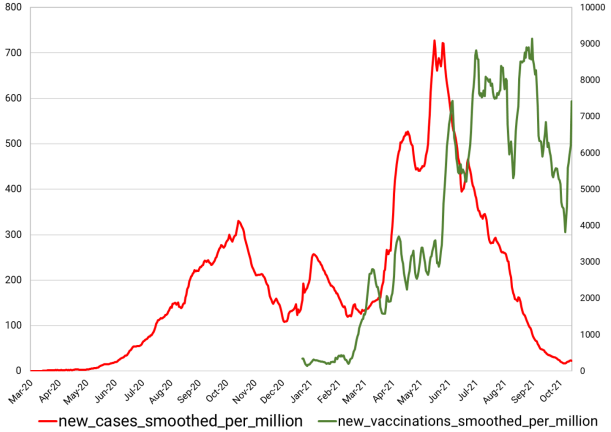
4. Concluding Remarks

General Context: Lockdown in Argentina

- Mandatory lockdown imposed on 19 March 2020
- Three distinctive phases:
  - 3/20/2020 to 6/7/2020 strong offer and mobility restrictions
  - 6/8/2020 to 03/12/2021 a progressive relaxation later
  - 6/6/2021 return to a "new normal"

General Context: Lockdown in Argentina (cont.)

Figure 1. Argentina. Daily new confirmed COVID-19 cases per million and Number of people vaccinated against COVID-19 per million



Source: ourworldindata.org

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Our Nowcast Exercise

- Objective: producing early predictions of GDP growth based on the pandemic and containment sample period 2020:Q1 - 2021:Q2.
- Initial set of 112 high frequency business cycle indicators
  - Study the time series properties: stationarity and seasonality
  - Transform when needed
- Given the updating scheme, we can obtain 6 early estimations of the GDP growth within each quarter
- Rolling pseudo-real-time one quarter ahead *Nowcast*
  - Following previous results (D'Amato et al 2015, Blanco et al 2018) we consider a smaller group of variables selected
- Last, we compare their relative forecasting ability using the Giacomini and White (2006) test
  - consider a simple AR benchmark

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The Factor Model

- A vector X_t of n stationary monthly business cycle indicators $x_t = (x_{1t}, ..., x_{nt})'$, with $t = 1, ..., T$ can be explained by the distributed lags of q common latent factors plus n idiosyncratic disturbances which could eventually be serially correlated. The dynamic factor model (DFM) is therefore:

$$X_t = \lambda(L) f_t + e_t \tag{1}$$

$$f_t = \Psi(L) f_{t-1} + \eta_t \tag{2}$$

Where f_t is a vector $q \times 1$ of unobserved (latent) factors, the lag polynomial matrices $\lambda(L)$ and $\Psi(L)$ are $N \times q$ and $q \times q$, η is a $q \times 1$ vector of (serially uncorrelated) innovations to the factors. The i row of $\lambda(L)$ is called the *dynamic factor loadings* for the ith series, X_{it}, and the e_t are the idiosyncratic disturbances that are assumed to be uncorrelated with the factors in all leads and lags

The Factor Model (cont.)

- Given a target variable y_t (in our case log GDP growth), the objective would be to estimate $E(y_t|X_t)$

$$y_t = \beta_t X_t + \gamma_t y_{t-1} + \varepsilon_t \tag{3}$$

$$y_t = \beta(L)'f_t + \gamma(L)'y_{t-1} + \varepsilon_t \tag{4}$$

- If we define quarterly GDP as the average of monthly latent observations $y_t^Q = \frac{1}{3}(y_t + y_{t-1} + y_{t-2})$ and we obtain quarterly factors f_t^Q from these observations, we can use the following equation to obtain early estimates of GDP:

$$\widehat{y_t}^Q = \beta(L)'f_t^Q \tag{5}$$

The Factor Model (cont.)

- We follow Banbura et al (2010) and Banbura and Modugno (2014) to estimate the factors
- Suppose that the errors idiosyncratic component e_t follows a independent univariate autoregression ($e_{it} = \delta_i(L)e_{it-1} + \nu_{it}$, with $\nu_{it} \sim N(0, \sigma^2_{\nu i})$)
- Defining θ as a vector that incorporates all the parameters of the model (the λ factors loadings, ε_t and σ_t)
- Once the joint model is set up in State-Space form, we estimate the parameters θ of the state space form by the Expectation Maximisation (EM) algorithm.

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Evaluating models' relative predictive ability

The Giacomini and White (2006) test

Evaluates out of sample forecasts by conducting an exercise using rolling windows

1. Compares the predictive ability of parametric models, f_{Rt} and g_{Rt}, to generate forecasts of y_t conditional on the available information set $\mathcal{F}_t$
2. Using the R sample observations available at time t, a total of P_n forecasts which satisfy $R + (P_n - 1) + \tau = T + 1$ are generated (τ steps ahead)
3. A loss function is calculated $L_{t+\tau}(y_{t+\tau}, f_{R,t})$, that depends on both, the realization of the data and the forecasts
4. The hypothesis to be tested is:

$$H_0 : E\left[h_t\left(L_{t+\tau}(y_{t+\tau}, f_{R,t}) - L_{t+\tau}(y_{t+\tau}, g_{R,t})\right) \mid \mathcal{F}_t\right] = 0$$

5. In practice, the test consists on regressing the differences in the loss functions on a constant and evaluating its significance using the t statistic for the null of a 0 coefficient ($\tau = 1$).

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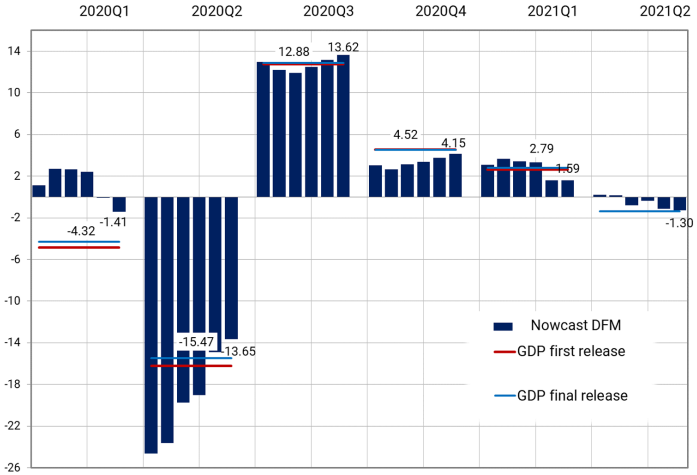
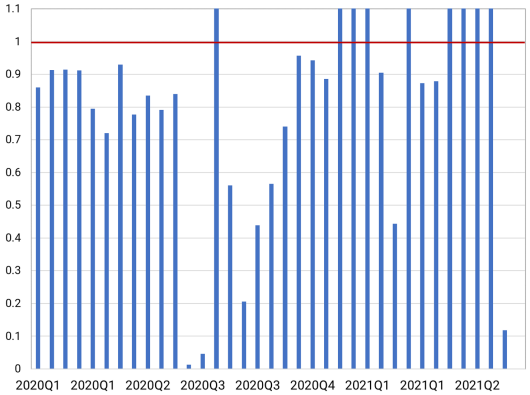
Empirical Results

Figure 2. Nowcast Sequential Updates



Empirical Results (cont.)

Figure 3. RMSE Nowcast / RMSE AR



Note: A number below 1 indicates that the Nowcast Outperforms the AR Benchmark

Table 1. Results of the Giacomini and White test

RMSE AR- RMSE DFM	
t test	p-value
2.804	0.0101

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- We applied a rolling windows estimation scheme: parameters of the nowcasting model are updated as new data becomes available
- Siliverstovs (2021) forecasts based on the recursively estimated coefficients proved out to be much closer to the out turns of GDP growth in the 2nd and 3rd quarters of 2020 than those based on pre-COVID period coefficients

Table 2. Results of the Giacomini and White test

RMSE DFMfixed - RMSE DFM

test t	p-value
0.000004	0.9909

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Figure 4. RMSE of the different models

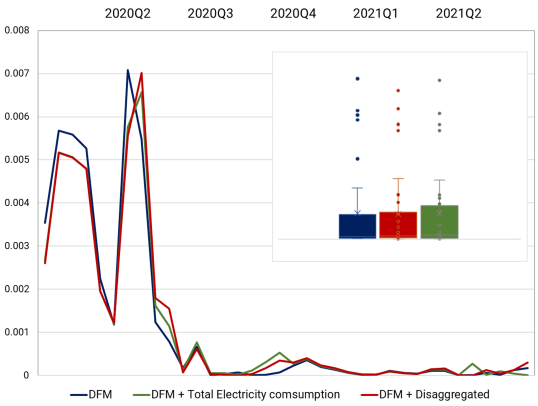

Table 3. Results of the Giacomini and White test

RMSE model in row - RMSE model in columm

	DFM	DFM+Total Electricity	DFM+Diss. Electricity
DFM		-2.47E-05	1.35E-04
DFM+Total Electricity	2.47E-05		1.10E-04
DFM+Dissagregated Electricity	-1.35E-04	-1.10E-04	

significative at 5%

Figure 5. Argentina COVID-19 Community Mobility Report 2020 - *7-day moving average*

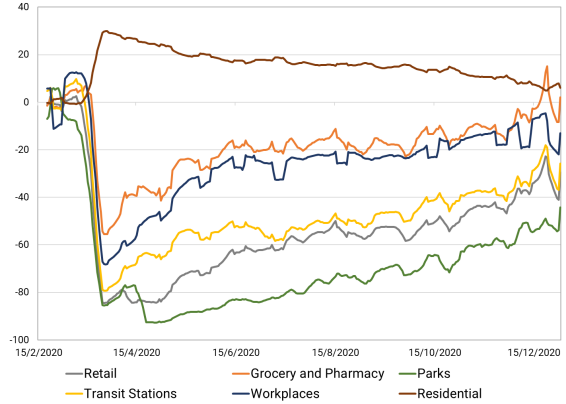

Table 4. Results of the Giacomini and White test

RMSE DFM - RMSE DFM+ Google Mob.

test t	p-value
0.000157	0.6322

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Concluding Remarks

- The COVID-19 pandemic and the unprecedented global sudden stop of 2020 posed a mayor challenge for traditional forecasting tools used in many central banks
- We evaluate a DFM nowcasting tool for Argentina during the lockdown and health crisis of 2020 and 2021 (sample period 2020:Q1 - 2021:Q2)
  - The impact of the shock in Argentina's economy was quite significant: largest annual fall in GDP since the 2002 economic crisis. Downturn of 2020 Q2 was the single biggest recorded
- Our exercise was able to capture the sign and magnitude of the q.o.q s.a. variation in GDP
  - It also outperforms an AR benchmark

Concluding Remarks (cont.)

- Re-estimation or keeping the models parameters fixed to a pre-pandemic level? **indistinguishable**
- Finally we explore a couple of new high-frequency data sources.
  - Energy consumption added as a separate regressor appears to improve nowcasts
  - Google Mobility index do not necessarily lead to a better assessment of the business cycle
- Future research agenda: exploring other high-frequency variables (i.e. financial data) and working with a methodology that allows for mixed data frequencies.

Thank you for your attention!

Questions?

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Appendix I

Business Cycle Indicators

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No	Source	Series	Group	
serie1	ADEFA	Automobile national production - units	1	hard
serie2	ADEFA	Automobile exports - units	1	hard
serie3	ADEFA	Automobile sales - units	1	hard
serie4	ADEFA	Automobile national sales - units	1	hard
serie5	AFCP	Portland cement production	1	hard
serie6	MECON	Ganancias (Total)	1	hard
serie7	MECON	Ganancias DGI	1	hard
serie8	MECON	Ganacias DGA	1	hard
serie9	MECON	Total Income revenues	1	hard
serie10	MECON	Income revenues DGI	1	hard
serie11	MERVAL	Income revenues DGA (customs)	1	prices
serie12	MERVAL	Total VAT revenues	1	prices
serie13	BCRA	VAT revenues DGI	1	prices
serie14	BCRA	Interest rate on Time Deposits - Private Banks	1	prices
serie15	CCA	Used Car Sales	1	hard
serie16	UTDT	Consumer Confidence Index - General - BSAS city	1	soft
serie17	UTDT	Consumer Confidence Index - General	1	soft
serie18	UTDT	ICC-DI	1	soft
serie19	UTDT	ICC-SM	1	soft
serie20	UTDT	ICC-SP	1	soft
serie21	UTDT	ICC-Condiciones Presentes	1	soft
serie22	UTDT	ICC-Expectativas	1	soft
serie23	CIS	Hierro Primario	1	hard
serie24	CIS	Acero Crudo	1	hard
serie25	CIS	Lam. Frío	1	hard
serie26	CIS	Lam. En caliente Total No Planos	1	hard
serie27	CIS	Lam. En caliente Planos	1	hard
serie28	FIEL	Industrial production index (IPI) - general level	2	hard
serie29	FIEL	IPI - nondurable consumer goods	2	hard
serie30	FIEL	IPI - durable consumer goods	2	hard

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No	Source	Series	Group	
serie31	FIEL	IPI - intermediate goods	2	hard
serie32	FIEL	IPI - capital goods	2	hard
serie33	FIEL	IPI - food and beverages	2	hard
serie34	FIEL	IPI - cigarettes	2	hard
serie35	FIEL	IPI - textiles input	2	hard
serie36	FIEL	IPI - pulp and paper	2	hard
serie37	FIEL	IPI - fuels	2	hard
serie38	FIEL	IPI - chemicals and plastic	2	hard
serie39	FIEL	IPI - nonmetallic minerals	2	hard
serie40	FIEL	IPI - steel	2	hard
serie41	FIEL	IPI - metalworking	2	hard
serie42	FIEL	IPI - automobiles	2	hard
serie43	Gov. BSAS city - CABA	Gross Revenue Tax Collection - City of Buenos Aires	2	hard
serie44	Gov. BSAS Prov. (State)	Gross Revenue Tax Collection - Buenos Aires province	2	hard
serie46	CAME	Sales - General Level	1	hard
serie47	CAME	Sales - FOOD AND DRINKS	1	hard
serie48	CAME	Sales - BAZAAR AND GIFTS	1	hard
serie49	CAME	Sales - Bijouterie	1	hard
serie50	CAME	Sales - Shoes	1	hard
serie51	CAME	Sales - sports	1	hard
serie52	CAME	Sales - Home appliances	1	hard
serie53	CAME	Sales - Pharmacies	1	hard
serie54	CAME	Sales - Hardware store	1	hard
serie55	CAME	Sales - Candy and Soft Drinks	1	hard
serie56	CAME	Sales - Toy stores	1	hard
serie57	CAME	Sales - Leather Goods	1	hard
serie58	CAME	Sales - Electrical Supplies	1	hard
serie59	CAME	Sales - Construction materials	1	hard
serie60	CAME	Sales - Home furniture	1	hard

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No	Source	Series	Group	
serie61	CAME	Sales - Office furniture	1	hard
serie62	CAME	Sales - Perfumery	1	hard
serie63	CAME	Sales - Textile - Clothing	1	hard
serie64	CAME	Sales - Textile - White	1	hard
serie65	CONSTRUYA	Construction Companies Activity Index	1	#N/A
serie66	CONSTRUYA	Construction Companies Activity Index SA	1	hard
serie67	INDEC	Exports - General Level	2	hard
serie68	INDEC	Exports - Q Primary Products	2	hard
serie69	INDEC	Exports - Q manufactures of agricultural origin	2	hard
serie70	INDEC	Exports - Q manufactures of industrial origin	2	hard
serie71	INDEC	Exports - Q Fuels and energy	2	hard
serie72	INDEC	Exports - P General level	2	hard
serie73	INDEC	Exports - P Primary Products	2	prices
serie74	INDEC	Exports - P manufactures of agricultural origin	2	prices
serie75	INDEC	Exports - P manufactures of industrial origin	2	prices
serie76	INDEC	Exports - P Fuels and energy	2	prices
serie77	INDEC	Imports - Q General level	2	hard
serie78	INDEC	Imports - Q capital goods	2	hard
serie79	INDEC	Imports - Q intermediate goods	2	hard
serie80	INDEC	Imports - Q Fuels and energy	2	hard
serie81	INDEC	Imports - Q Parts and Accessories	2	hard
serie82	INDEC	Imports - Q consumer goods	2	hard
serie83	INDEC	Imports - vehicles	2	hard
serie84	INDEC	Imports - P General level	2	prices
serie85	INDEC	Imports - P capital goods	2	prices
serie86	INDEC	Imports - P intermediate goods	2	prices
serie87	INDEC	Imports - P Fuel and energy	2	prices
serie88	INDEC	Imports - P Parts and Accessories	2	prices
serie89	INDEC	Imports - P consumer goods	2	prices
serie90	INDEC	Imports - P vehicles	2	prices

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No	Source	Series	Group	
serie91	Ministerio de Agroindustria	Soybean milling	2	hard
serie92	Secretaría de Hacienda	Direct real investment + capital transfers to provinces	2	hard
serie93	Secretaría de Hacienda	Direct real investment	2	hard
serie94	Secretaría de Hacienda	Capital transfers to provinces	2	prices
serie95	Tendencias	Dismissals (1986 = 100)	1	soft
serie96	Tendencias	Suspensions (1986 = 100)	1	soft
serie97	EIL - Ministerio de Trabajo de la Nación	Net employment expectancy	2	soft
serie98	EIL - Ministerio de Trabajo de la Nación	Companies that searched for personnel	2	soft
serie99	BCRA	Multilateral nominal exchange rate index (Dec-15=100)	1	prices
serie100	BCRA	Personal Credits	1	prices
serie101	BCRA	Credit Cards	1	prices
serie102	BCRA	Personal + Cards	1	prices
serie103	GCBA	Vehicule Registrations BSAS city	2	hard
serie104	GCBA	Vehicule Registrations Argentina	2	hard
serie105	GCBA	Tolls (collection)	2	hard
serie106	GCBA	Tolls (vehicle ciculation)	2	hard
serie107	GCBA	Tolls (average vehicles)	2	hard
serie108	GCBA	Stamp duty-BSAS city	2	hard
serie109	GCBA	Passengers transported by rail (in thousands)	2	hard
serie110	Banco Central de BRASIL	Brazil Industrial production s.a.	2	hard
serie111	Banco Central de BRASIL	Brazil Industrial production	2	hard
serie112	Banco Central de BRASIL	Brazil Activity indicator s.o.	2	hard
serie113	Banco Central de BRASIL	Brazil Activity indicator s.a.	2	hard
serie114	Secretaria de energía	Asphalt (in tonnes)	2	hard
serie115	Colegio de escribanos Buenos Aires	BSAS city Scriptures	2	hard