Journal of Medical Virology

Sars-Cov-2 in Argentina: Lockdown, Mobility, and Contagion

Journal:	*Journal of Medical Virology*
Manuscript ID	JMV-20-10812.R2
Wiley - Manuscript type:	Research Article
Date Submitted by the Author:	n/a
Complete List of Authors:	Larrosa, Juan; Universidad Nacional del Sur, Economics; Instituto de Investigaciones Económicas y Sociales del Sur,
Keywords:	Coronavirus < Virus classification, Public policy < Social Science, Time series analysis < Biostatistics & Bioinformatics, Statistical inference < Biostatistics & Bioinformatics

Sars-Cov-2 in Argentina: Lockdown, Mobility, and Contagion

Shortened Title: Lockdown, Mobility, and Contagion in Argentina

Juan M.C. Larrosa

Departamento of Economics, Universidad Nacional del Sur
Instituto de Investigaciones Económicas y Sociales del Sur (IIESS)
Hyperia

San Andrés 800, Altos de Palihue, 8000, Bahía Blanca

Email: jlarrosa@uns.edu.ar

Abstract

There is a debate in Argentina about the effectiveness of mandatory lockdown policies in containing Sars-Cov-2 disease. This policy has already six months long making it one of the longest in the World. The population effort to comply the lockdown has been decreasing over time given the economic and social costs that it entails. This contribution analyzes the relationship between mobility and contagion in Argentina at a provincial level. It also models issues of internal political discussion on regional contagion and the effect of protests and unexpected crowd events. I use pool, fixed, and random effects panel data modeling and results show that lockdown in Argentina has been effective in reducing mobility but not in a way that reduces the rate of contagion. Strict lockdown seems to be effective in short periods of time but extend it without complementary mitigation measures it losses effectiveness. Contagion rate seems to be discretely displaced in time and resurges amidst slowly increasing in mobility.

Keywords: Covid-19, Sars-cov-2, Argentina, mobility, lockdown, social distancing, panel data

1. Introduction

A new disease has shocked the World as never before. It is caused by the new coronavirus. It is called "COVID-19" (where "CO" stands for corona, "VI" for virus, "D" for disease and "19" indicates the year) and also called severe acute respiratory syndrome coronavirus type 2 (SARS-CoV-2) is a novel zoonotic betacoronavirus that was first reported back in December 2019 in Wuhan, China [1]. By October 6th, 2020, the disease has caused more than 810 thousand confirmed cases and over 21 thousand deaths in Argentina [2, 3]. SARS-CoV-2 was declared a public health emergency of international concern on January, 30th 2020 [4]. The case fatality rate of SARS-CoV-2 infection has been estimated between 1.2 and 1.6% with substantially higher ratios in those aged above 60 years [5]. In Argentina, the fatality rate for males was 2.1% (1,233 deaths) and for females, 1.5% (884 deaths) by July, 2020. Males aged 70-79 years concentrated the highest proportion and represented 15.3% (324) of the confirmed deceased cases. The median time between the onset of symptoms and death was 11 days [2]).

This contribution focuses on how Argentina copes with Sars-Cov-2 epidemics. As information becomes available with datasets of case description, counting, date, and location across the country questions arose on how to explain the national evolution of pandemics. By July, 2020 the first national dataset was uploaded [2] and that opens many more topics to be explored. Currently, no effective medical interventions or vaccines are available to prevent or to treat the disease. For this reason, non-pharmacological public health measures such as isolation, social distancing, and quarantine are the only effective ways to respond to the outbreak. Isolation refers to the separation of symptomatic patients whereas quarantine is the restriction of asymptomatic healthy people who have had contact with confirmed or suspected cases.

The most prominent health policy of Argentina has been a long standing lockdown with a theoretical geographical segmentation that began back in March 19th and still remains active in most of the country. How this measure has affected the rate of contagion? I will present empirical evidence relating mobility and the rate of contagion combining epidemiological data with geo-located information of mobility at a provincial level to test its effectiveness.

2. Sars-Cov-2 Pandemic in Argentina

The Sars-Cov-2 pandemic is forcing countries worldwide to make consequential policy decisions with evolving and limited information. After China publicly released the information of the virus, in the last weeks of February Italy registered the first deaths and applied the first restrictions and ordered measures to monitor people who could be infected [6]. Two weeks later the epidemic was out of control in the northern part of the country (especially Lombardy) and other 11 provinces. The World Health Organization (WHO) reported that the interventions made by China authorities, including lockdown and social distancing, have significantly contributed to the containment of COVID-19 [4].

Figure 1. Map of Argentina with Provinces and Regions

By March 13th in Argentina various provincial governments began approving lockdown rules beginning by the province of Jujuy that ordered the suspension of any educational, sports, social, cultural, and religious activity (See Figure 1 for the political division of Argentina). By

March 15 the president Alberto Fernández jointly with the heads of the two most populated districts of the country (Buenos Aires Autonomous City –BAAC- and Buenos Aires Province -BAP, respectively) announced temporal lockdown measures. These included the suspension of all educational activity throughout the country, the full closure of borders for all non-residents people and the suspension of all activities and work licenses for riskier population over 60 years old, the cancellation of non-essential activities, and any related crowd-activity until March 31st. By March 16th, the government of the province of Tierra del Fuego follows. By March, 20th long-distance and regional bus services were suspended and circulation within BAAC was restricted and the province of Mendoza also ruled quarantine. The national Ministry of Economy established a maximum price policy for a basic basket of foods for dealing with the economic paralysis. By this time a particular interest was focused to the most densely populated territories in a region called as Buenos Aires Metropolitan Area (BAMA or *Área Metropolitana de Buenos Aires* in Spanish) that comprehends BAAC and 18 of its surrounding districts that jurisdictionally belongs to the BAP. BAMA is the most populated area of the country (approximately 16.4 million inhabitants) and it is practically an almost continuous urbanized area.

By then and given confirmed-cases counts, diverse provinces in the country were adopting measures for suspending circulation inside its territories, with total or partial lockdown. Still remains isolated cities and towns with checkpoints and embankments medieval-style. National government established a scale of phases for lockdown from stricter to more relaxed ones (Table 1). These phases began with an initial strict lockdown phase followed by relaxation on diverse topics, especially related to mobility but with non-pharmaceutical interventions (NPI) such a face covering, social distancing, avoiding close spaces, among others. Table 1 presents lockdown phases applicable to the whole country. So far these phases have been reduced to two main ones called Preventive and Mandatory Social Lockdown (PMSL or *Aislamiento Social Preventivo y Obligatorio* in Spanish) and Mandatory and Preventive Social Distancing (MPSD for *Distanciamiento Social Obligatorio y Preventivo* in Spanish). Districts with severe contagion or increasing rates are on PMSL and districts that show decreasing rates are permitted to MPSD. Allowing to pass from PMSL to MPSD is defined as the length of time it takes for the number of reported cases to double.

During the May 11-24th period President Fernández suspended strict lockdown in the whole country (4th phase) with the exception of BAMA that remains on 3rd phase. In the period of June 8-28th the president suspended lockdown on 18 provinces and they entered to MPSD while BAMA and five other minor urban areas remain on 4th phase.

By June 8th the president decreed defining rules for MPSD that prevailed to that date in 19 on 24 national districts. Four provinces had urban areas under strict quarantine and MPSD in the rest of their territory while BAMA remained in strict PMSL. This situation remains until at least October, 2020.

Table 1

It is by then that Argentina ends up maintaining the world's longest blockade with only a few provinces seemingly reaching a contagious peak and the rest continuing to grow exponentially [7]. Even more, by August 21st, Argentina surpasses Sweden in terms of total deaths comparing to a country that did not uses mobility restriction at all. Even more, the most prolonged lockdown is accompanied with one of the largest death rate in terms of death per million of inhabitants. Actually it shows a little more than 20 thousands deaths and more than 480 deaths per million of inhabitants approximately, still behind than other Latin American countries such as Peru (980 deaths per million) or Bolivia (683) [22].

Supporters of lockdown state that a potential slowdown in contagion rate may allow health systems to be prepared for the increasing number of positive infection but that is also an item for national discussion. A key policy response to the crisis should be increasing in health spending, including for improvements in virus diagnostics, purchases of hospital equipment and construction of clinics and hospitals [8]. By September, 2020 the district with an appreciable increase in widening critical health infrastructure is BAAC with little information on the rest of the districts. In any case, none regional health system has collapsed so far [9].

Lockdown in the very short run operates by drastically reducing mobility and it is expected this reduction will make contagion to slowdown [10, 11]. Reduction in contagion in the end would slowdown the rate of patients being derived to Intensive Care Unit (ICU) and, one of the critical bottlenecks of the health system, avoiding the collapse in the use of the scarce mechanical ventilation equipment supply [12]. This way the lockdown would buy precious time, flattening the curve of contagion and reducing the input in a health system non-prepared for this specific scale of pandemics. Evidence for effectiveness on mobility for more than 3 weeks is hard to find. As mentioned, mobility is also affected by local, provincial or national restrictions [13, 14, 15]. While containment is reported successful to a local or regional level [16] it is more difficult to observe such a result at a national scale. I will try to understand its implication national-wide considering geographical effects on diverse provinces of Argentina. Did lockdown buy time slowing down contagion? Did tightening lockdown decrease the spread of the virus? Did virus spreading increase because of relaxations on lockdown (for instance, allowing PMSL to MPSD)? Did crowded events increase the spreading? I will try to answer these questions with econometric tests on publicly available data. By early October, 2020 it is not foreseeable in the short run how the government will manage to exit lockdown. It is important then to obtain evidence if lockdown deserves still to be an option for dealing with the spread of the virus and, in case of loosening that measure, how this will affect contagion.

3. Data and Modelling Approach

I test the relation between contagion and mobility by implementing panel data models such as used by other contributions [7, 17, 18, 19] on different aspects of the Covid-19 pandemics. Panel data modeling may be approached considering fixed effects or random effects panel data model. Fixed model will assume omitted variables are constantly correlated with the variables of the model while random effects models will estimate the effects of time-invariant variables, but the estimates may be biased because of a potential omitted variables bias. However, this last aspect can be properly modelled [20] while including variables that account for regional effects by adding geographical referenced variables in our case. A fixed effect panel data model is also implemented for checking if omitted variables may affect the estimates. Fixed effects models control for the effects of time-invariant variables. I will present both models covering all possible results and interpretations.

Consider the dynamic panel data model with units $i = 1,2,...,N$, and a fixed number of time periods $t = 1,2,...,T$, with $T \geq 2$.

$$y_{it} = \beta_0 + \delta y_{i,t-j} + \beta_1 x'_{it} + \beta_2 f'_{it} + \varepsilon_{it}, \quad \varepsilon_{it} = \alpha_i + \mu_{i,t} \; (1)$$

where x'_{it} is a $K_x \times 1$ vector of time-varying variables. The initial observations of the dependent variable, y_{i0}, and the regressors, x_{i0}, are assumed to be observed. f_i is a $K_v \times 1$ vector of observed time-invariant variables that includes an overall regression constant, and α_i is an unobserved effect fixed effect of the i-th cross section and is allowed to be correlated with all of the explanatory variables x_{it} and f_i. It is also a random effect if it is independently distributed and correlated with the lagged dependent variable by construction.

Data from [21] represents the change on mobility for users who have a mobile phone with Google account and GPS-tracking authorization representing the relative respect to a reference day measured as average value of the 5-week period between January, 3th and February, 6th 2020 (prior to pandemics). There are represented categories on movements to residential locations, parks, transit stations, workplace, grocery and pharmacies, and retail business. Data was obtained for the 26 defined regions of the country: 23 provinces and three special regions (BAAC, BAMA, and BPA without BAMA; BAAC is repeated in the BAMA definition but is often study as one unit and may present an interesting regional effect). Reported cases to be analyzed are confirmed ones on the basis of clinical, epidemiological, and laboratory diagnosis. I have data updated up to July, 29th 2020 on confirmed cases of contagion from [22]. This way the dataset includes 23 districts on 166 days of information on rate of contagion, mobility indicators, and covariates.

Figure 2. Mobility Indicators and Infections in Argentina and Lockdown Dates (2/15/2020 to 7/29/2020)

In the estimation model y_t^i represents the rate of confirmed cases y in time t in the region i. x_{it}^j represents the type of mobility j identified by the Google mobility reports in time t in the region i and their lagged effects and f'_{it} represent effects fixed in time like geography, time events, and other particular items such as lockdown variables. I define temporal dummy variables for representing the time spans of the lockdown and its extension and the relaxation of confinement measures across the provinces. Time dummies identifying weekends, national festivities, and trends are also added as well as dummies for special incidents: at the beginning of the lockdown huge bank queues emerged on the day of pensioner payday because of coordination problems by central banks and commercial banks [23]. This incident created involuntary crowds that may acted as potential outbreaks of contagion ($f_{bq,t}^d$ and $f_{be,t}^d$ dummies). Another incidents were massive protests on specific days against the lockdown and government ($f_{ma,t}^d$ and $f_{cg,t}^d$ dummies). [24] These actions motivate to create one dummy of the day of the incident and another dummy after a potential incubation period (12 to 14 days later) for capturing changes in the rate of contagion [25]. Table 2 summarizes variables used in the estimations as were described. Expected signs are related to the relationship of the respective variable to contagion: more mobility would affect positively contagion (except for residential mobility), protests and crowd activities are expected also to increase contagion, lockdown and social distancing may decrease contagion as well as weekend and national festivities by reducing mobility.

As an illustrative example, a simple panel data estimation using provincial mobility data of the effect of lockdown shows that residential mobility was the only that increase (in average of 2.58%) while parks (avg. -10.33%), transit stations (-5.21%), workplace (-7.9%), grocery and pharmacies (-7.41%), and retail & recreation (-8.82%) showed sharped reductions in Argentina. Therefore lockdown and its latter extensions were effective in some way in reducing mobility just as Figure 2 presents.

I define two variables for modeling lockdown. One binary variable represents the strict lockdown present at the beginning by the presidential decree of March, 19th (f_{it}^i). The second is another binary variable that establishes almost in all provinces social distancing policy (f_{it}^d).

The time lines of activation for each region are summarized in a specific entry of [26]. This is a modelling approach also used in [18] but for international comparisons.

Table 2. Explanatory Variables Code, Description, and Expected Sign

In first approach it is tested static pool, fixed, and random effects panel models relating rate of contagion $y_{i,t}$ to mobility and lockdown measures (f_{it}^{i} and f_{it}^{d}). Table 3 presents the three estimations. Retail and recreation mobility and residential emerge as significant and positively related to the rate of contagion. Given that the decrees strictly forbidden recreational activities it must be inferred that it was the retail part that is related to contagion. Residential mobility increases in a trivial manner since lockdown so perhaps this is only a non-related correlation. And, in this case, strict lockdown reveals a negative effect on contagion while social distancing has apparently no statistical relationship.

Table 3. Initial Estimations in Pool, Fixed Effects and Random Effects Panel Data Model

However, as observed in Figure 2 time series have persistence, as past values influence future ones. For this to be taken into account I must rely in a dynamical panel data including lags values of the variables. Panel data variables also are stationary according to standard tests. Dependent variable is stationary up to 4 lags and covariates are also to even higher lags so 7 lags are included for these variables in a way of encompassing a week. I assume that provinces or regions might play an idiosyncratic role in spreading the virus so geographical binary variables were included in the case of random effects modeling.

Table 4 and Table 5 present the result for a dynamic panel data model with fixed and random effects, respectively. Five models are presented from simplest to more complex modeling adding more variables for detecting each type of effect. In the case of lags and location dummies I only publish statistically significant results (*p-values* ≤ .1). In both fixed and random effect models residential mobility emerges as correlated with the rate of contagion as previously found with some simpler model option revealing that retail also is significant. Lags of mobility are significant in diverse degrees. There is also a repeated significance of all time effects with a negative effect (weekend, festivities, and trend). The first two are related to how data was taken that made most probably to a potential infected to assist to a medical unit on weekdays than weekends to be tested. The trend remarks some diminishing but negligible effect on this period of time. Now when focus in the direct effect of lockdown only the simpler modeling most notably with random effects is where a significant relationship on contagion emerges. Social distance shows no effect and crowd effects have also no significance on the rate of contagion, contrary to findings social distance negatively related to contagion [27]. $f_{baac,t}^{d}$, $f_{sf,t}^{d}$, $f_{bama,t}^{d}$, and $f_{bap-bama,t}^{d}$ geographical dummies are significant revealing idiosyncratic shocks on the rate of contagion for BAAC, Santa Fe, BAMA and BPO without BAMA, respectively.

Does lockdown slow down the rate of contagion? The evidence is clear in terms of initially reducing mobility. However most provincial rate of contagion continue exponentially growing but apparently displaced in time from late March to early May, 2020. Statistically all mobility (including residential) are positively associated to the rate of contagion, once considering diverse lag structures. Mobility has not stopped completely but sharply reduced initially and a later positive trend was steadily growing as time evolves. As for the effectiveness of lockdown on another countries [11] the lapse of time from implementation to effectiveness in reducing rate of contagion is observed within a month. Taking that into account and reviewing Figure 2 again the first month was successful on that purpose. Besides increasing intensive care capabilities (creating new room and training new personal for ER), especially in BAAC, apparently no other measures (or combination of measures such as suggested by [18]) that have been adopted by other countries were adopted to a relevant scale in the whole country. Some of them [28, 29] that depends upon people's preventive measures of non-pharmaceutical interventions (NPI) related to mitigate the contagion (face covering, social distance, personal hygiene, self-quarantine) were suggested and effectively implemented but state-related policies are still waiting sound national implementation (such as expanding testing, widespread effective use of technology, protective equipment of frontline key workers, contact tracing, among others). Programs for tracing such as Detectar (initials from *Dispositivo Estratégico de Testeo para Coronavirus en Territorio Argentino* in Spanish or Coronavirus Strategic Testing Device in Argentina Territory) was launched on May after a spike in contagion in BAMA but still lacks an effective national scope [30].

China put several mitigation policies in place to suppress the spread of the epidemics [3]. In particular, confirmed cases were either put under quarantine in specialized hospital or put under a form self-quarantine at home but monitored by medical services. In a similar fashion, suspected cases were confined in monitored house arrest. These measures aimed at the removal of infectious individuals from the transmission process. These extreme measures lead to a sub-exponential growth in contagion [31]. Another measures such a repeated testing, contact tracing, pool testing, also proved to be effective in reducing other cases (specially many Asian countries [32]). Combination of anti-contagion policies seem to be effective in a range of countries [18]. It is interesting to note that a counterfactual to a scenario of an Argentina not applying lockdown deserves a particular analysis.

4. Conclusions

I find evidence on potential answer to different issues relative to an extensive lockdown currently operative en Argentina. Firstly, lockdown effectiveness was analyzed. Adopted measures can be divided in an initial strict implementation called mandatory lockdown and a later lesser strict variant called social distancing. Both policies focus on reducing the mobility and through that diminishing the spreading of Sars-Cov-2. Panel data models identify lagged mobility variables jointly with time and geographic effects positively correlated to the rate of infection. This way, lockdown and social distancing failed by their own in reducing contagion at least at this extended period. Abstracting from estimations and by observing data, lockdown seems to have been effective in a short period after implantation in reducing mobility but without complementary health policies this effectiveness seems to be short-ranged as modeled by [18]. On the other hand, the economic sacrifice made by the whole economy seems disproportionate to the results even while these figures are no final yet [33, 34]. In any case, this contribution has not analyzed deaths, the ultimate cost of the pandemics, even though that data on deaths are under-reported [3].

It is desirable to study these effects at a local level (city, department) too for obtaining more insights on the connection between mobility and contagion. As no contact-tracing information datasets are publicly available yet I may explore sequential pattern of contagion for inferring where the contagion began, where it moved, and perhaps anticipate where it going to be.

References

1. Wu, F. et al., “A new coronavirus associated with human respiratory disease in China”. *Nature.* 2020; 579, 265-269. https://doi.org/10.1038/s41586-020-2008-3

2. Rearte A, Baldani A.E.M., Barcena Barbeira P., Domínguez C.S., Laurora M.A., Pesce M., et al. Características epidemiológicas de los primeros 116 974 casos de COVID-19 en Argentina, 2020. *Rev Argent Salud Publica*. 2020; 12 Supl COVID-19:e5. [In Spanish]

3. BA Times, “Death toll reaches 15,000 as Covid-19 surge continues”, 09/26/2020. https://www.batimes.com.ar/news/argentina/death-toll-reaches-15000-as-covid-19-surge-continues.phtml

4. World Health Organization, "Coronavirus disease (COVID-2019) situation reports". https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports, 2020.

5. Verity, R. et al., “Estimates of the severity of coronavirus disease 2019: a model-based analysis”. *Lancet Infect Dis.* 2020. https://doi.org/10.1016/S1473-3099(20)30243-7

6. France 24: “First European coronavirus deaths in Italy send towns into lockdown”: https://www.france24.com/en/20200222-first-coronavirus-death-in-europe-sends-italian-towns-into-lockdown

7. Clarín, “Coronavirus: la matemática confirma que la provincia de Buenos Aires también superó el pico de casos”, (In Spanish), 10/6/2020. https://bit.ly/3dc38UH

8. BA Times, “Dr. Maureen Birmingham: ‘This is an opportunity to transform Argentina’s health system’”. https://www.batimes.com.ar/news/argentina/dr-maureen-birmingham-this-is-an-opportunity-to-transform-argentinas-health-system.phtml

9. BA Times, “Doctors beg citizens to ‘stay home’ amid fears for health system”.https://www.batimes.com.ar/news/argentina/doctors-beg-citizens-stay-home-amid-fears-for-health-system.phtml

10. Aleta, A.; Moreno, Y. “Evaluation of the potential incidence of COVID-19 and effectiveness of containment measures in Spain: a data-driven approach”. *BMC Medicine*. 2020. 18:157. https://doi.org/10.1186/s12916-020-01619-5

11. Alfano, V, Salvatore, E. “The Efficacy of Lockdown against COVID‑19: A Cross‑Country Panel Analysis”, *App Health Econ Health Pol*. 2020. 18:509–517. https://doi.org/10.1007/s40258-020-00596-3

12. Almeshari MA, Alobaidi NY, Asmri MA, Alhuthail E., Alshehri Z, Alenezi F, Sapey E, Parekh D. “Mechanical ventilation utilization in COVID-19: A systematic review and meta-analysis”, MedRxiv. 2020. https://doi.org/10.1101/2020.06.04.20122069

13. Xiong C, Hu S, Yang M, Younes HN, Luo W, Ghader S, Zhang L. “Data-Driven Modeling Reveals the Impact of Stay-at-Home Orders on Human Mobility during the COVID-19 Pandemic in the U.S.”, arXiv.2005.00667v2[stat.AP], 2020.

14. Zheng, R, Xu Y, Wang W, Ning G, Bi Y., “Spatial transmission of COVID-19 via public and private transportation in China”, *Travel Med Infect Dis* 2020; 34:101626. doi: 10.1016/j.tmaid.2020.101626.

15. Jiang, J., Luo, L. “Influence of population mobility on the novel coronavirus disease (COVID-19) epidemic: based on panel data from Hubei, China”. *Glob health res policy*. 2020. 5(30). https://doi.org/10.1186/s41256-020-00151-6

16. Salzberger B, Glück T, Ehrenstein B. "Successful containment of COVID-19: the WHO-report on the COVID-19 outbreak in China". *Infection*. 2020; 48:151–3. https://doi.org/10.1007/s15010-020-01409-4

17. Weill, J.A., Stigler, M., Deschenes, O., Springborn, M.R. "Social distancing responses to COVID-19 emergency declarations strongly differentiated by income", *P Natl Acad Sci USA* Aug 2020, 117 (33) 19658-19660; DOI: 10.1073/pnas.2009412117

18. Hsiang, S., Allen, D., Annan-Phan, S. et al. "The effect of large-scale anti-contagion policies on the COVID-19 pandemic". *Nature* 584, 262–267 (2020). https://doi.org/10.1038/s41586-020-2404-8

19. Guliyev, H. "Determining the spatial effects of COVID-19 using the spatial panel data model", *Spat Stat-Neth* 38, 2020, 100443, https://doi.org/10.1016/j.spasta.2020.100443.

20. Bell, A, Jones, K. "Explaining Fixed Effects: Random Effects Modeling of Time-Series Cross-Sectional and Panel Data". *Pol Sci Res & Meth*. 2015. 3: 133-153. doi:10.1017/psrm.2014.7

21. Google Local Mobility Reports on COVID-19. https://www.google.com/covid19/mobility/

22. Ministry of Health of Argentina, COVID-19. Casos registrados en la República Argentina, Downloaded 7/29/2020 at http://datos.salud.gob.ar/dataset/covid-19-casos-registrados-en-la-republica-argentina (In Spanish)

23. Olivera Doll JI. "Cash-Dependent Argentines Halt Lockdown to Line Up at Banks". 04/03/2020. Bloomberg. https://www.bloomberg.com/news/articles/2020-04-03/cash-dependent-argentines-break-lockdown-to-wait-in-bank-queues

24. BA Times. "First anti-lockdown protest takes place in Buenos Aires". 05/26/2020. https://www.batimes.com.ar/news/argentina/first-anti-lockdown-protest-takes-place-in-buenos-aires.phtml

25. Stephen A. Lauer, Kyra H. Grantz, Qifang Bi, Forrest K. Jones, Qulu Zheng, Hannah R. Meredith, Andrew S. Azman, Nicholas G. Reich, and Justin Lessler (2020) "The Incubation Period of Coronavirus Disease 2019 (COVID-19) From Publicly Reported Confirmed Cases: Estimation and Application", *Ann Intern Med*, https://doi.org/10.7326/M20-0504

26. Cuarentena en Argentina de 2020 (in Spanish). Wikipedia 2020. https://es.wikipedia.org/wiki/Cuarentena_en_Argentina_de_2020#Cuarentena_por_distrito_y_ciudad

27. Ainslie KEC, et al., "Evidence of initial success for China exiting COVID-19 social distancing policy after achieving containment", *Wellcome Open Research*. 2020. 5. DOI: 10.12688/wellcomeopenres.15843.1

28. Nussbaumer-Streit B, et al. "Quarantine alone or in combination with other public health measures to control COVID-19: a rapid review". *Cochrane DB Syst Rev*. 2020. https://doi.org/10.1002/14651858.CD013574

29. Dawoud D, "Emerging from the other end: Key measures for a successful COVID-19 lockdown exit strategy and the potential contribution of pharmacists", *Res Soc Adm Pharm*. 2020. https://doi.org/10.1016/j.sapharm.2020.05.011

30. Programa Detectar (In Spanish). https://www.argentina.gob.ar/coronavirus/detectar

31. Maier BF, Brockmann D. "Effective containment explains subexponential growth in recent confirmed COVID-19 cases in China". *Science.* 2020. 368 (6492): 742-746 (2020) DOI: 10.1126/science.abb4557

32. Lu N, et al. "Weathering COVID-19 storm: Successful control measures of five Asian countries". *Am J Infect Control*. 2020. 48: 851−852. https://doi.org/10.1016/j.ajic.2020.04.021

33. Gillespie P. "Argentine Economy Plunges More Than Expected After Lockdown". 06/29/2020. *Bloomberg*. https://www.bloomberg.com/news/articles/2020-06-29/argentine-economy-plunges-more-than-expected-after-lockdown

34. BA Times, "Economic activity slumped 12.6% in first seven months of 2020", https://batimes.com.ar/news/economy/economic-activityslumped126in-first-seven-months-of-2020.phtml

Appendix

Table 4. Panel Data Estimation of the Effect of Lockdown on the Rate of Contagion (Fixed Effects)

Table 5. Panel Data Estimation of the Effect of Lockdown on the Rate of Contagion (Random Effects)

Figure 1. Map of Argentina with Provinces and Regions

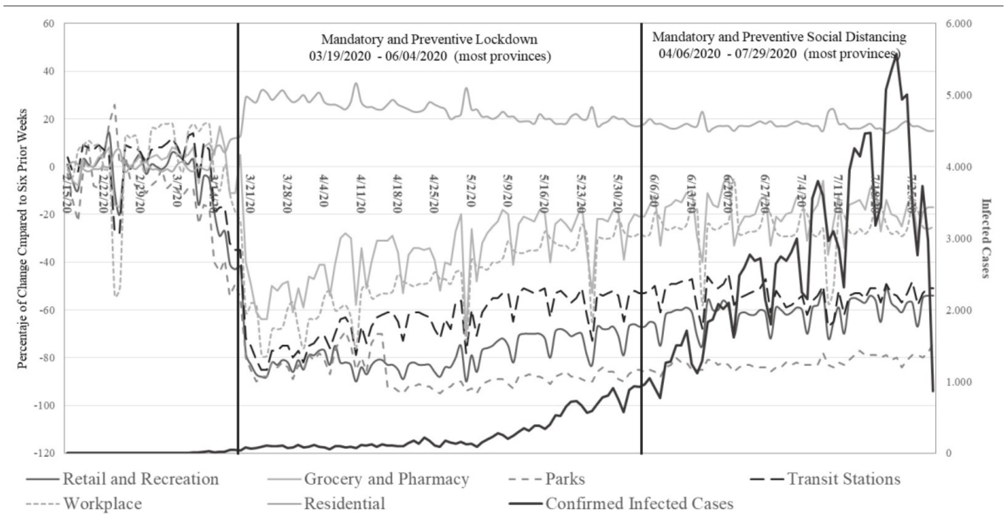

Figure 2. Mobility Indicators and Infections in Argentina and Lockdown Dates (2/15/2020 to 7/29/2020)

Table 1. Lockdown Phases in Argentina

Phases	Main characteristics
Phase 1. Strict Lockdown	Just essential services allowed, the rest of activities are banned; 10% population mobility; Doubling rate less to 5 days without geographical segmentation
Phase 2. Administrated Lockdown	Allowances require authorizations; national bans, up to 25% of population mobility allowed; Doubling rate 5 to 15 days; National exceptions
Phase 3: Geographical Segmentation	Allowances might be granted to provincial exceptions; National bans; Up 50% of people mobility; Doubling rate more 15 to 25 days; Segmentation subject to epidemiologic criteria.
Phase 4: Progressive Reopening	Allowances might be granted to provincial exceptions; National bans: Up to 75% of people mobility; Doubling rate higher than 25 days; Local restrictions.
Phase 5: New Normality	Allowances might be granted to sustained personal hygiene and cares; No national bans; Up to 75% of population mobility; No segmentation.

Source: Ministry of Health of Argentina (https://www.argentina.gob.ar/coronavirus/aislamiento/fases)

Table 2. Explanatory Variables Code, Description, and Expected Sign

Variables	Description	Expected sign on y_{it}
x_{it}^{rr}	Retail and recreation mobility and 7 lags	Positive
x_{it}^{gp}	Groceries and pharmacy mobility and 7 lags	Positive
x_{it}^{p}	Parks mobility and 7 lags	Positive
x_{it}^{ts}	Transit stations mobility and 7 lags	Positive
x_{it}^{w}	Workplace and 7 lags	Positive
x_{it}^{r}	Residential mobility and 7 lags	Negative
$y_{i,t-1}$-$y_{i,t-4}$	Dependent variable lags	
$f_{i,t}^{week}$	Dummy for weekend	Negative
$f_{i,t}^{hd}$	Dummy for national festivities	Positive
$f_{i,t}^{trend}$	Trend	Negative
$f_{ma,t}^{d}$	Dummy for protests (day of the protest)	Positive
$f_{cg,t}^{d}$	Dummy for incubation period since protests (12-14 days later)	Positive
$f_{bq,t}^{d}$	Incident in bank queues	Positive
$f_{be,t}^{d}$	Dummy for incubation period since incident (12-14 days later)	Positive
f_{it}^{i}	Dummy for lockdown (mandatory isolation)	Negative
f_{it}^{d}	Dummy for lockdown (social distancing)	Negative
$f_{ba,t}^{d}$-$f_{tu,t}^{d}$	Dummy for provinces and regions	S.D.

Dependent variable is the rate of contagion y_{it}. Provinces and regional dummies included in the estimations are: BAP ($f_{bap,t}^{d}$), BAAC ($f_{baac,t}^{d}$), BAMA ($f_{bama,t}^{d}$), BAP w/o BAMA ($f_{bap-bama,t}^{d}$), Catamarca ($f_{ca,t}^{d}$), Chaco ($f_{cha,t}^{d}$), Chubut ($f_{chu,t}^{d}$), Cordoba ($f_{cor,t}^{d}$), Corrientes ($f_{corr,t}^{d}$), Entre Rios ($f_{er,t}^{d}$), Formosa ($f_{fo,t}^{d}$), Jujuy ($f_{ju,t}^{d}$), La Pampa ($f_{lp,t}^{d}$), La Rioja ($f_{lr,t}^{d}$), Mendoza ($f_{me,t}^{d}$), Misiones ($f_{mi,t}^{d}$), Neuquen ($f_{ne,t}^{d}$), Rio Negro ($f_{rn,t}^{d}$), Salta ($f_{sa,t}^{d}$), San Juan ($f_{sj,t}^{d}$), San Luis ($f_{sl,t}^{d}$), Santa Cruz ($f_{sc,t}^{d}$), Santa Fe ($f_{sf,t}^{d}$), Santiago del Estero ($f_{se,t}^{d}$), Tierra del Fuego ($f_{tdf,t}^{d}$), and Tucuman ($f_{tu,t}^{d}$) (See Figure 1).

Table 3. Initial Estimations in Pool, Fixed Effects and Random Effects Panel Data Model

	Pool		Fixed Effects		Random Effects	
Variables	$y_{i,t}$	$y_{i,t}$	$y_{i,t}$	$y_{i,t}$	$y_{i,t}$	$y_{i,t}$
x_{it}^{rr}	0.001**	0.001***	0.001*	0.002***	0.001**	0.001***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
x_{it}^{gp}	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
x_{it}^{p}	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
x_{it}^{ts}	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
x_{it}^{w}	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
x_{it}^{r}	0.005***	0.004***	0.005***	0.004***	0.005***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
f_{it}^{i}	-0.028***		-0.031**		-0.028***	
	(0.009)		(0.012)		(0.009)	
f_{it}^{d}		-0.001		0.006		-0.001
		(0.009)		(0.010)		(0.009)
β_0	0.044***	0.045***	0.046***	0.047***	0.044***	0.045***
	(0.013)	(0.013)	(0.011)	(0.011)	(0.013)	(0.013)
Observations	4,043	4,043	4,043	4,043	4,043	4,043
Number of items	25	25	25	25	25	25
R^2			0.010	0.008		

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4. Panel Data Estimation of the Effect of Lockdown on the Rate of Contagion (Fixed Effects)

Variables	(1) $y_{i,t}$	(2) $y_{i,t}$	(3) $y_{i,t}$	(4) $y_{i,t}$	(5) $y_{i,t}$
x_{it}^{rr}	0.001**	0.001**	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
x_{it}^{gp}	-0.000	-0.000	0.000	0.000	0.001
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
x_{it}^{p}	0.000	-0.001	0.001	0.000	0.001
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
x_{it}^{ts}	-0.000	-0.001	-0.001	-0.001	-0.001
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
x_{it}^{w}	-0.000	0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
x_{it}^{r}	0.005***	0.004***	0.004*	0.004*	0.005**
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
$f_{i,t}^{week}$		-0.021**	-0.028**	-0.028**	
		(0.008)	(0.013)	(0.013)	
$f_{i,t}^{trend}$		-0.001**	-0.001***	-0.001***	
		(0.000)	(0.000)	(0.000)	
$f_{i,t}^{hd}$		-0.028***	-0.063***	-0.062***	
		(0.010)	(0.017)	(0.017)	
$y_{i,t-1}$			0.063**	0.063**	0.068**
			(0.028)	(0.028)	(0.028)
$y_{i,t-4}$			0.054*	0.054*	0.058**
			(0.027)	(0.027)	(0.026)
x_{it-1}^{rr}			-0.001**	-0.001**	-0.002***
			(0.000)	(0.000)	(0.000)
x_{it-2}^{p}			-0.002**	-0.002**	-0.001*
			(0.001)	(0.001)	(0.001)
x_{it-4}^{p}			-0.001*	-0.001*	-0.001*
			(0.001)	(0.001)	(0.001)
x_{it-2}^{ts}			-0.001*	-0.001*	-0.001*
			(0.001)	(0.001)	(0.001)
x_{it-6}^{ts}			-0.002*	-0.002*	-0.002
			(0.001)	(0.001)	(0.001)
x_{it-7}^{ts}			0.001*	0.001*	0.001*
			(0.001)	(0.001)	(0.001)
x_{it-1}^{w}			0.001***	0.001***	0.001***
			(0.000)	(0.000)	(0.000)
x_{it-4}^{w}			-0.001**	-0.001**	-0.001**
			(0.000)	(0.000)	(0.000)
x_{it-5}^{w}			0.001**	0.001**	0.001***
			(0.001)	(0.000)	(0.000)
x_{it-4}^{r}			-0.003*	-0.003*	-0.003
			(0.002)	(0.002)	(0.002)
x_{it-5}^{r}			0.005**	0.005**	0.006***
			(0.002)	(0.002)	(0.002)
x_{it-6}^{r}			-0.003*	-0.003*	-0.003
			(0.002)	(0.002)	(0.002)

x^{gp}_{it-1}			-0.000	-0.000	-0.001*
			(0.000)	(0.000)	(0.000)
x^{gp}_{it-5}			-0.001**	-0.001**	-0.001**
			(0.000)	(0.000)	(0.000)
x^{gp}_{it-7}			-0.001*	-0.001*	-0.001**
			(0.000)	(0.000)	(0.000)
$f^{d}_{ma,t}$				-0.001	-0.008
				(0.013)	(0.012)
$f^{d}_{cg,t}$				0.054	0.047
				(0.056)	(0.056)
$f^{d}_{bq,t}$				-0.009	-0.004
				(0.015)	(0.015)
$f^{d}_{be,t}$				0.014	0.012
				(0.014)	(0.012)
$f^{d}_{is,t}$	-0.050	-0.056*	-0.012	-0.012	-0.010
	(0.030)	(0.029)	(0.026)	(0.026)	(0.026)
$f^{d}_{sd,t}$	-0.024	0.001	0.015	0.015	-0.005
	(0.024)	(0.021)	(0.020)	(0.020)	(0.020)
β_0	0.045***	0.058***	0.058***	0.059***	0.046***
	(0.011)	(0.013)	(0.014)	(0.014)	(0.013)
Observations	4,043	4,043	4,004	4,004	4,004
	(0.011)	(0.013)	(0.014)	(0.014)	(0.013)
R^2	0.010	0.018	0.074	0.076	
Number of items	25	25	25	25	25

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; -- implies not inclusion

Table 5. Panel Data Estimation of the Effect of Lockdown on the Rate of Contagion (Random Effects)

Variables	(1) $y_{i,t}$	(2) $y_{i,t}$	(3) $y_{i,t}$	(4) $y_{i,t}$	(5) $y_{i,t}$
x_{it}^{rr}	0.001**	-0.001*	-0.001	-0.001	-0.001
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
x_{it}^{gp}	-0.000	0.001***	0.001	0.001	0.001
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
x_{it}^{p}	-0.000	-0.000	0.001	0.000	0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
x_{it}^{ts}	-0.000	-0.000	-0.001	-0.001	-0.001
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
x_{it}^{w}	-0.000	0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
x_{it}^{r}	0.005***	0.004***	0.005**	0.005*	0.004*
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
$f_{i,t}^{week}$		-0.018**	-0.026**	-0.027**	
		(0.007)	(0.012)	(0.013)	
$f_{i,t}^{trend}$		-0.000**	-0.000**	-0.000**	
		(0.000)	(0.000)	(0.000)	
$f_{i,t}^{hd}$		-0.031***	-0.065***	-0.065***	
		(0.009)	(0.018)	(0.018)	
$y_{i,t-1}$			0.063**	0.062**	0.074***
			(0.029)	(0.028)	(0.028)
$y_{i,t-4}$			0.054**	0.054**	0.063**
			(0.027)	(0.027)	(0.026)
x_{it-1}^{rr}			0.054**	0.054**	0.063**
			(0.027)	(0.027)	(0.026)
x_{it-2}^{p}			-0.001**	-0.002**	-0.001*
			(0.001)	(0.001)	(0.001)
x_{it-4}^{p}			-0.001*	-0.001*	-0.001**
			(0.001)	(0.001)	(0.001)
x_{it-1}^{ts}			0.002*	0.002*	0.002*
			(0.001)	(0.001)	(0.001)
x_{it-2}^{ts}			-0.001*	-0.001*	-0.001**
			(0.001)	(0.001)	(0.001)
x_{it-6}^{ts}			-0.002*	-0.002*	-0.002
			(0.001)	(0.001)	(0.001)
x_{it-7}^{ts}			0.001*	0.001*	0.001*
			(0.001)	(0.001)	(0.001)
x_{it-1}^{w}			0.001***	0.001***	0.001***
			(0.000)	(0.000)	(0.000)
x_{it-4}^{w}			-0.001**	-0.001**	-0.001**
			(0.000)	(0.000)	(0.000)
x_{it-5}^{w}			0.001**	0.001**	0.001***
			(0.001)	(0.000)	(0.000)
x_{it-4}^{r}			-0.003*	-0.003*	-0.003
			(0.002)	(0.002)	(0.002)
x_{it-5}^{r}			0.005**	0.005**	0.007***
			(0.002)	(0.002)	(0.002)

x^{r}_{it-6}			-0.003*	-0.003*	-0.003
			(0.002)	(0.002)	(0.002)
x^{gp}_{it-5}			-0.001**	-0.001**	-0.001
			(0.000)	(0.000)	(0.000)
x^{gp}_{it-7}			-0.001**	-0.001**	-0.001*
			(0.000)	(0.000)	(0.000)
$f^{d}_{baac,t}$			0.121***	0.118***	
			(0.046)	(0.045)	
$f^{d}_{sf,t}$			0.094**	0.091**	
			(0.046)	(0.045)	
$f^{d}_{bama,t}$			0.124***	0.122***	
			(0.047)	(0.047)	
$f^{d}_{bap-bama,t}$			0.082*	0.081*	
			(0.049)	(0.048)	
$f^{d}_{ma,t}$				0.002	-0.007
				(0.012)	(0.011)
$f^{d}_{cg,t}$				0.060	0.054
				(0.055)	(0.055)
$f^{d}_{bq,t}$				-0.010	-0.006
				(0.014)	(0.014)
$f^{d}_{be,t}$				-0.008	-0.004
				(0.010)	(0.010)
$f^{d}_{is,t}$	-0.053**	-0.058**	-0.021	-0.021	-0.018
	(0.025)	(0.025)	(0.020)	(0.020)	(0.020)
$f^{d}_{sd,t}$	-0.032	-0.015	-0.008	-0.007	-0.019
	(0.020)	(0.017)	(0.015)	(0.015)	(0.016)
β_0	0.045***	0.054***	0.057***	-0.011	-0.000
	(0.013)	(0.014)	(0.015)	(0.047)	(0.048)
Observations	4,043	4,043	4,004	4,004	4,004
Number of ítems	25	25	25	25	25

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; -- implies not inclusion