SCVS Letter Draft

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Abstract

[Here goes my abstract.]

Resumen

[Aquí va mi resumen.]

Introduction

Although the 21st century is still far from over, COVID-19 will necessarily be reminded as one of the most important happenings during this age. The changes that the pandemic has brought about have been long-lasting, as the virus which originally emerged in China by late 2019 has had effects still suffered by the time this article was written. In April 2020, the IMF predicted that the economic turmoil caused would be the greatest since the Great Depression (International Monetary Fund, 2020c). By October 2020, the IMF revised down their projections of world economic growth from April 2020, and the pandemic accumulated over a million deaths to COVID-19, proving to be a worse crisis than what it was initially expected. It was understood that both the health risks posed by COVID-19 and the lockdown policy enacted by the world's governments had greatly hampered economic conditions around the world, specially in the Western Hemisphere (2020b).

Ecuador barely escaped economic and social chaos by securing an agreement with the IMF worth 6.5 billion dollars after facing terrible consequences due to high public debt and the precipitous fall of oil prices (International Monetary Fund, 2020a). However, the Ecuadorian economy was still expected to shrink by 11% in 2020 and its unemployment rate was expected to increase in 4.3 percentage points relative to 2019 (International Monetary Fund, 2020b). Guayas became the COVID-19 epicenter in Ecuador with a 900% excess deaths rate (Naranjo, 2020) and with its capital Guayaquil becoming an international attention center due to the extreme humanitarian crisis caused by its inability to cope with its COVID-19 deaths (Zibell, 2020).

However, by 2021 new hope surfaced as newly-developed COVID-19 vaccines received approval and started to be massively distributed around the world by April 2021, and the actual economic downturn in 2020 was smaller for both Ecuador and the global economy. The IMF revised its 2021 projections upward as vaccine rollouts developed in the United States and other developed economies (2021a). However, on the developing world and notably in Ecuador vaccine distribution became increasingly unequal, as top government officials and private agents received their first vaccine doses before those that actually needed them (Taj & Politi, 2021). In Ecuador the immunization process was initially slow and corrupt: the Ministry of Health's mother and two well-connected TikTok influencers received a vaccination dose before some first-line workers were even eligible to receive one (Machado, 2021; Sandoval, 2021). Corruption and vaccination scandals played a key role in the resignations and removals of four Ministries of Health between March 2020 and April 2021 in the country.

Yet once again, in the second half of 2021 Ecuador became the center of international attention as its sovereign bonds gave the best returns in the world after the possession of economically-liberal President Guillermo Lasso (Vizcaino & Kueffner, 2021). The Lasso Administration was able to immunize over half of the country's population in 100 days after his possesion in May 24th, which may have converted Lasso into one of the most popular presidents in the region by October 2021 (Hurtado, 2021). The new Administration's economic agenda promised economic recovery through investment-friendly policy (Madrid, 2021), even marketing the massive vaccination plan as an initial step for recovery after the pandemic shock (Brik, 2021).

The Ecuadorian economy grew 4.2% in 2021 (Banco Central del Ecuador, 2022), 50% more than the October 2021 IMF projection (2021b).The Ecuadorian Central Bank attributes the increases due to important economic gains in the oil, tourism, agriculture and commerce industries, citing the economic recovery brought about by the successful vaccine rollout as the main motivator for the internal economic reactivation. However, the statement by the institution may pose an important causal inference issue: even if vaccines have proven to be successful in mitigating COVID-19 infection (Katella, 2022), not much is known about their effect on economic activity. Additionally, the vaccination process may also correlate with other reactivation motivators which may become confounders. Among them stand the 162.6133553 % increase in the price of the WTI oil barrel (*Crude Oil WTI Price*, 2022) and the loosening of pandemic restrictions which took place after Lasso took office.

The aim of this paper is to investigate a potential causal effect of COVID-19 vaccination in economic recovery. This is done by implementing a regression-based approach to a difference-in-differences research design to estimate an average treatment effect of vaccine hesitancy across different variables which proxy economic reactivation. Province-level data from Ecuador on several economic and demographic indicators published in a monthly basis is used for the econometric analysis, which focuses on the 24 months between January 2020 and December 2021.

Literature Review

In general, literature on COVID-19 and its economic effects which focuses on causal inference is limited. More has been said about causal effects of vaccination and social distancing measures on health outcomes. Causal evidence has been found in support of social distancing and lockdown measures as a means to reduce COVID-19 infections (Banerjee & Nayak, 2020; Sharkey & Wood, 2020) as well as infection in other pandemics [Stern et al. (2009); Bootsma.2007; Mandavilli (2020)]. Numerous randomized trials have been conducted to assess the effects of COVID-19 vaccines, finding that these vaccines are safe for mass distribution and effective in slowing down the spread of the virus (Chen et al., 2021; Deb et al., 2021; Polack et al., 2020; Yap et al., 2021; Zheng et al., 2022), deeming them essential in the fight against the pandemic.

Regarding economic impacts, it is understood that pandemics hamper economic activity through several channels. According to Brodeur et al. (2021) these channels are the impact of social distancing measures, direct and indirect costs (hospitalization, loss of labor and production) as well as offsetting and cascading effects as the disruption of services are the most important. These channels translate macroeconomically to reductions in household consumption and wealth, and indirect effects may translate in financial market shocks as well a supply-side disruptions which hamper labor demand. The macroeconomic models which were studied by Brodeur et al. (2021) predict a mostly demand-deficient recession, where policy that benefits the economy's supply may not be successful in inducing recovery. Other studies quantified the opportunity cost of shutdowns in the economy, finding that shutdowns put market production in a 25% production deficit, and that medical development and innovation may reduce the shutdown cost in about 70% (Mulligan, 2021). Additionally, Deb et al. (2022) find that containment measures hurt economic activity, associating a containment measure with a 10 percent loss in industrial production over 30 days of measure implementation. Regarding business creation, Meunier et al. (2022) find that newly registered firms fell in 58% of economies in 2020 relative to 2019, when the normal trend was to see new business creation in 2/3 of economies.

If COVID-19 was indeed an aggregate demand-intensive shock, it is natural to see a fall in business creation as potential customers become wary of spending in an uncertain environment like the pandemic, where the associated health risks appear to affect the likelihood of spending. If vaccines are indeed the best way to fight

the pandemic, it would be expected that economies with higher vaccination rates experience higher economic recovery. However, the effect of vaccines might be two-fold. On one hand more vaccination may foster less pandemic restrictions which would foster economic activity as businesses are less restrained. On the other hand, vaccination may foster economic recovery by reducing the likelihood of contagion and thus increase aggregate demand for goods and services. Furceri et al. (2021) develop an empirical model of vaccination and economic effects across 46 countries, finding a positive statistically significant relationship of vaccination rates and economic activity proxied by nitrogen emissions. The effect could be understood as causal given that "vaccine surprises" are used, the key effect being that an unexpected increase in vaccination per capita is associated with increases in economic activity. Effects may be larger at higher vaccination rates as there is evidence of a non-linear relationship of vaccination and economic activity. Furthermore, it has been said that countries with higher vaccination rates were expected to make stronger economic recoveries according to IMF data, as the projections for regions with higher vaccine inequality were revised downward by April 2021 (United Nations Development Programme, 2022). However, this analysis does not make a causal investigation, as indeed it is countries that have been historically richer which had higher vaccination rates in 2022. The lack of causal inference research regarding this key topic is evident, considering that the results of the only study which infers a causal effect may not be applicable to countries outside their sample or at time horizons which can include stronger COVID-19 variants.

Methodology

Data

A province-level database was constructed for this paper. Monthly-published data at the province level was recovered from various government sources to construct a repeated cross-section in which every province has 12 observations on several economic and demographic variables. Thus, the database has 288 observations, although not all variables had data available for all months on all twenty-four provinces.

To proxy economic recovery, data from the Ecuadorian Companies, Securities and Insurance Superintendency (SCVS) was used for the dependent variable, namely, business creation based on the Companies Directory database. The number of businesses created in any given month between January 2020 and December 2021 was computed based on the date of creation of the business in the SCVS system. The following table describes all other variables used in the paper.

Table 1: Variable descriptions and sources

Variable	Source	Notes
Inmuno-preventable cases	Ministry of Health	Parotiditis, Chickenpox and Hepatitis B.
Vaccination rate	Datos-Ecuacovid Project	Data obtained from Ministry of Health Vacunómetro.
Deaths	Civil and Identification Registry	
Excess deaths	Excess Deaths Dashboard by Naranjo (2022)	Normal death rate computed based on historic death rates per province.
Thefts	Ministry of Government	
Homicides	Ministry of Government	
Transit accidents	National Transit Agency	
COVID-19 cases, case rate and deaths	Datos-Ecuacovid Project	
Registered labor contracts	Open Data Catalogue Government Database	Number of registered labor contracts in the Unique Labor System (SUT).
Tax Collection	Open Data Catalogue Government Database	Amount of taxes paid by registered taxpayers in a province. Used 2019-2021 data.
Registered taxpayers	Open Data Catalogue Government Database	Number of registered taxpayers in a province per month. Used 2019-2022 data.

Variable	Source	Notes
Registered sales	Open Data Catalogue Government Database	Amount of sales reported by taxpayer agents for the calculation of value-added tax.
Mobility	COVID-19 Community Mobility Reports by Google	Movement trends on several types of place categories based on Google location history data

Empirical approach

A differences-in-differences design is implemented to investigate a potential causal effect of vaccination rates in business creation. The shock that will be exploited for the estimation will be the Delta Variant. This variant of COVID-19 was initially identified in India in late 2020, and spread to the United States in June 2021. It was identified that while the variant's symptoms were the same as the original version of the disease, they seemed to be more severe in the respiratory tract and it also spread quicker. Additionally, the variant seemed to put unvaccinated people at a much higher risk than other variants. It quickly became the principal variant in the United States throughout the fall of 2021 (Katella, 2022; UCDavis Health, 2022). In Ecuador, cases of the variant were initially identified in the summer of 2021 and by October it became the dominant variant in COVID-19 infections (Heredia, 2021; Mendoza, 2021).

The treatment group will be defined in terms of vaccination hesitancy and actual COVID-19 vaccination rates. In order to accurately exploit vaccination hesitancy and not confound it with logistic issues, the treatment group is defined with basis to the number of vaccine-preventable diseases detected in each province through time. The number of vaccine-preventable disease per capita is computed with basis to the 2020 population projections for each province, and along with the average monthly vaccination rate. The treatment group is then composed of the following provinces: Carchi, Chimborazo, Cotopaxi, Morona Santiago, Orellana, Pastaza, Santo Domingo, Sucumbíos, Zamora Chinchipe. The following table shows descriptive statistics for each province in the sample, as well as group totals. The following table shows some descriptive statistics for the groups.

Table 2: Descriptive Statistics for the Treatment and Control Groups

Group	Business.Creation.2020	Business.Creation.2021	Average.Vaccionation.Rate	Average.Vaccine.preventable.cases.per.1K
Control	6102.00	4745.00	39.99	1.28
Treatment	622.00	472.00	32.82	1.95

Having defined the treatment and the exogenous shock, the empirical models to be estimated will be based on the following general equation

$$\ln(bc_{it} + 1) = \alpha_i + \alpha_t + \beta_1 T_i + \sum_{j=2}^{m} (\beta_j x_j) + u_{it}$$

where α_i is a set of coefficients for province fixed effects, α_t is a set of coefficients for period fixed effects (24 periods from January 2020 to December 2021). $\hat{\beta}_1$ will be the point estimate for the two-way fixed effects (TWFE) difference-in-differences estimator, as the dummy variable T_i will equal unity for provinces in the treatment group and period (treatment periods are from September to December 2021). Note that β_1 equals the coefficient of an interaction term between treatment period treatment group dummies, however, the interaction notation is not used here as introducing a treatment group dummy would induce perfect collinearity. In some of the models estimated, the period dummies are dropped and month fixed effects are included instead as a robustness check. Finally, the β_j will be the coefficients on time-varying variables which may affect business creation across the treatment groups.

Given that the treatment variable implies some sort of vaccine hesitancy among the population of the treated provinces, it would be expected that the TWFE DiD estimator is statistically significant and negative. After a shock in which the pandemic worsens which induces health concerns among consumers, provinces with more vaccine-hesitant populations see less business creation than provinces with less vaccine hesitant populations.

Results

Justifying parallel trends

In order to determine parallel trends, prior trends are graphed in the following figure, by plotting the natural logarithm of business creation plus unity against time.

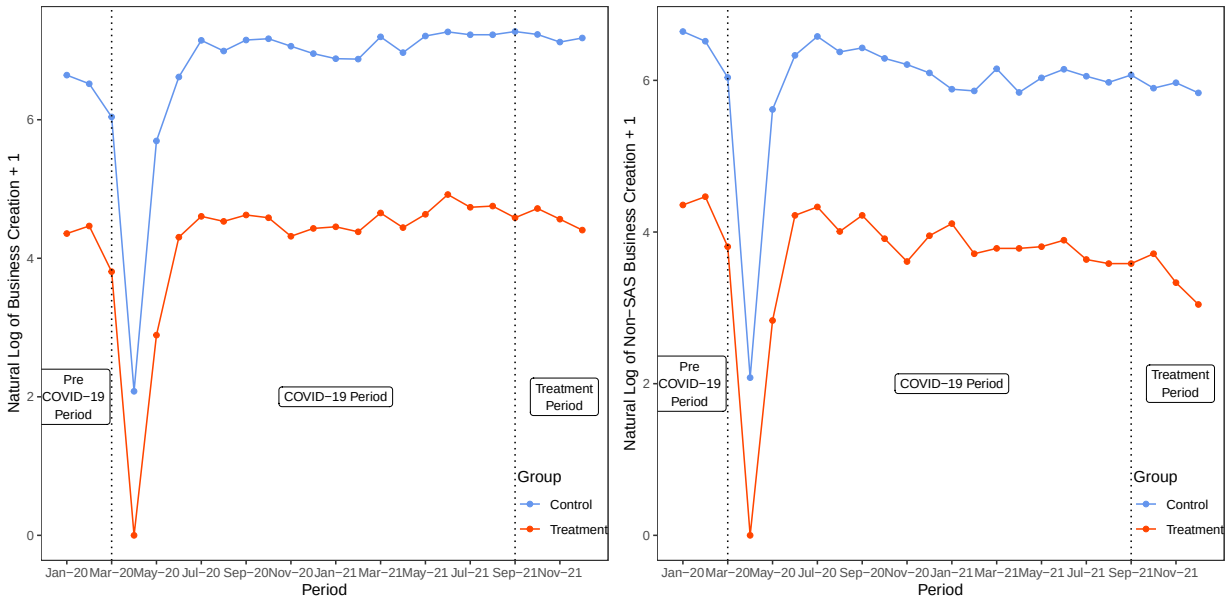

Figure 1: Prior Trends Graph

Conclusion

References

Banco Central del Ecuador. (2022). *La economía ecuatoriana creció 4,2% en 2021, superando las previsiones de crecimiento más recientes*. https://www.bce.fin.ec/index.php/boletines-de-prensa-archivo/item/1482-la-economia-ecuatoriana-crecio-4-2-en-2021-superando-las-previsiones-de-crecimiento-mas-recientes

Banerjee, T., & Nayak, A. (2020). A county level analysis to determine If social distancing slowed the spread of COVID-19. *Revista Panamericana de Salud Pública*, *44*, e90. https://doi.org/10.26633/RPSP.2020.90

Brik, D. (2021). *Lasso ante el reto de impulsar las vacunas y reactivar la economía en Ecuador*. https://www.swissinfo.ch/spa/ecuador-investidura--an%C3%A1lisis-_lasso-ante-el-reto-de-impulsar-las-vacunas-y-reactivar-la-econom%C3%ADa-en-ecuador/46641098

Brodeur, A., Gray, D., Islam, A., & Bhuiyan, S. (2021). A literature review of the economics of COVID-19. *Journal of Economic Surveys*. https://doi.org/10.1111/joes.12423

Chen, M., Yuan, Y., Zhou, Y., Deng, Z., Zhao, J., Feng, F., Zou, H., & Sun, C. (2021). Safety of SARS-CoV-2 vaccines: a systematic review and meta-analysis of randomized controlled trials. *Infectius Diseases of Poverty*, *10*(1), 94. https://doi.org/10.1186/s40249-021-00878-5

Crude Oil WTI Price. (2022).

Deb, P., Furceri, D., Jimenez, D., Kothari, Siddhart, Ostry, J. D., & Tawk, N. (2021). *Determinants of COVID-19 Vaccine Rollouts and Their Effects on Health Outcomes: WP/21/247: International Monetary Fund Working Papers*. International Monetary Fund. https://www.imf.org/-/media/Files/Publications/WP/2021/English/wpiea2021247-print-pdf.ashx

Deb, P., Furceri, D., Ostry, J. D., & Tawk, N. (2022). The Economic Effects of COVID-19 Containment Measures. *Open Economies Review*, *33*(1), 1–32. https://doi.org/10.1007/s11079-021-09638-2

Furceri, D., Deb, P., Kothari, S., Tawk, N., Jimenez, D., & Ostry, J. D. (2021). *The Effects of COVID-19 Vaccines on Economic Activity: International Monetary Fund Working Paper Series* (Vols. WP/21, 248). International Monetary Fund; International Monetary Fund. https://doi.org/10.5089/9781589063761.001

Heredia, V. (2021). *Delta es la variante que predomina en Ecuador*. https://www.elcomercio.com/tendencias/sociedad/delta-variantes-ecuador-coronavirus-pandemia.html

Hurtado, S. (2021). *The Ups and Downs of Guillermo Lasso*. https://americasquarterly.org/article/the-ups-and-downs-of-guillermo-lasso/

International Monetary Fund. (2020a). *Ayudar al Ecuador a enfrentar la pandemia*. https://www.imf.org/es/News/Articles/2020/10/05/na100520-helping-ecuador-confront-the-pandemic

International Monetary Fund. (2020b). *World Economic Outlook (International Monetary Fund): A Long and Difficult Ascent*. International Monetary Fund; International Monetary Fund. https://www.imf.org/-/media/Files/Publications/WEO/2020/October/English/text.ashx

International Monetary Fund. (2020c). *World Economic Outlook (International Monetary Fund): The Great Lockdown* (1st ed.). International Monetary Fund. https://www.imf.org/-/media/Files/Publications/WEO/2020/April/English/text.ashx

International Monetary Fund. (2021a). *World Economic Outlook (International Monetary Fund): Managing Divergent Recoveries* (No. 1; 1st ed.). International Monetary Fund; International Monetary Fund. https://www.imf.org/-/media/Files/Publications/WEO/2021/April/English/text.ashx

International Monetary Fund. (2021b). *World Economic Outlook (International Monetary Fund): Recovery During a Pandemic: Health Concerns, Supply Disruptions, and Price Pressures* (1st ed.).

Katella, K. (2022). *Comparing the COVID-19 Vaccines: How Are They Different?* https://www.yalemedicine.org/news/covid-19-vaccine-comparison

Machado, J. (2021). *Polémica por confidencialidad de la lista de vacunados VIP en Ecuador*. https://www.primicias.ec/noticias/sociedad/polemica-lista-vacunados-covid-ecuador/

Madrid, R. (2021). *Lasso expone su propuesta de reactivación económica para el Ecuador en Foro de Davos*. https://www.elcomercio.com/actualidad/politica/presidente-lasso-exposicion-foro-davos-plan-reactivacion-economica-ecuador.html

Mandavilli, A. (2020). *Wondering About Social Distancing?* https://www.nytimes.com/2020/03/16/smarter-living/coronavirus-social-distancing.html

Mendoza, D. (2021). *Ecuador ha detectado 85 casos de la variante delta en su país*. https://www.aa.com.tr/es/mundo/ecuador-ha-detectado-85-casos-de-la-variante-delta-en-su-pa%C3%ADs/2316134

Meunier, F., Coste, C., & Maia, R. (2022). *How did the COVID-19 pandemic influence the pace of new business formation?* (World Bank, Ed.). https://blogs.worldbank.org/developmenttalk/how-did-covid-19-pandemic-influence-pace-new-business-formation

Mulligan, C. B. (2021). Economic Activity and the Value of Medical Innovation during a Pandemic. *Journal of Benefit-Cost Analysis*, *12*(3), 420–440. https://doi.org/10.1017/bca.2021.5

Naranjo, S. (2020). *Ecuador registró hasta julio un exceso de mortalidad de 80,2%*. https://www.revistagestion.ec/sociedad-analisis/ecuador-registro-hasta-julio-un-exceso-de-mortalidad-de-802

Polack, F. P., Thomas, S. J., Kitchin, N., Absalon, J., Gurtman, A., Lockhart, S., Perez, J. L., Pérez Marc, G., Moreira, E. D., Zerbini, C., Bailey, R., Swanson, K. A., Roychoudhury, S., Koury, K., Li, P., Kalina, W. V., Cooper, D., Frenck, R. W., Hammitt, L. L., … Gruber, W. C. (2020). Safety and Efficacy of the BNT162b2 mRNA Covid-19 Vaccine. *The New England Journal of Medicine*, *383*(27), 2603–2615. https://doi.org/10.1056/NEJMoa2034577

Sandoval, C. (2021). Salud ordena investigar inclusión de 'tiktokers' en lista de vacunados covid-19. *El Comercio*. https://www.elcomercio.com/tendencias/sociedad/salud-investigacion-tiktokers-vacunados-covid19.html

Sharkey, P., & Wood, G. (2020). *The Causal Effect of Social Distancing on the Spread of SARS-CoV-2*.

https://osf.io/preprints/socarxiv/hzj7a/

Stern, A. M., Cetron, M. S., & Markel, H. (2009). Closing the schools: lessons from the 1918-19 U.S. influenza pandemic. *Health Affairs (Project Hope)*, *28*(6), w1066–78. https://doi.org/10.1377/hlthaff.28.6.w1066

Taj, M., & Politi, D. (2021). *'V.I.P. Immunization' for the Powerful Rattles South America.* https://www.nytimes.com/2021/02/25/world/americas/covid-south-america-vaccine-corruption.html

UCDavis Health. (2022). *Delta variant: 8 things you should know about this COVID-19 strain | UC Davis Health.* https://health.ucdavis.edu/coronavirus/covid-19-information/delta-variant

United Nations Development Programme. (2022). *Impact of vaccine inequity on economic recovery 2022 - UNDP Data Futures Platform* (Data Futures Platform UNDP, Ed.). https://data.undp.org/vaccine-equity-archive/impact-of-vaccine-inequity-on-economic-recovery-2022/

Vizcaino, M. E., & Kueffner, S. (2021). *Ecuador Defaulted Last Year. Now Its Bonds Are World's Best.* https://www.bloomberg.com/news/articles/2021-08-02/ecuador-defaulted-last-year-now-its-bonds-are-the-world-s-best

Yap, C., Ali, A., Prabhakar, A., Prabhakar, A., Pal, A., Lim, Y. Y., & Kakodkar, P. (2021). Comprehensive literature review on COVID-19 vaccines and role of SARS-CoV-2 variants in the pandemic. *Therapeutic Advances in Vaccines and Immunotherapy*, *9*, 25151355211059791. https://doi.org/10.1177/25151355211059791

Zheng, C., Shao, W., Chen, X., Zhang, B., Wang, G., & Zhang, W. (2022). Real-world effectiveness of COVID-19 vaccines: a literature review and meta-analysis. *International Journal of Infectious Diseases : IJID : Official Publication of the International Society for Infectious Diseases*, *114*, 252–260. https://doi.org/10.1016/j.ijid.2021.11.009

Zibell, M. (2020). *Coronavirus en Ecuador: el drama de Guayaquil, que tiene más muertos por covid-19 que países enteros y lucha a contrarreloj para darles un entierro digno.* https://www.bbc.com/mundo/noticias-america-latina-52116100