Did the Declaration of Martial Law Stunt our Economic Growth? A Causal Impact Analysis in Time Series

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"We lost two decades of development"
"We became the sick man of Asia"

These were the clamors of a lot of historians[1] following the controversial decision of the former president Ferdinand Marcos, when in 1972 he placed the entire Philippines in martial law because of alleged nationwide unrest and the sought for economic prosperity during this time.[2] The claims seem to be a bit peculiar, considering that the gross domestic product (GDP) growth was still positive, and our GDP outlook seems to be healthy. While there have been multiple reports that have claimed that this policy ultimately led to other countries surpassing our once healthy economy, most of which are subjective approaches to a policy evaluation, thus we do not know for certain how much of an impact the policy has contributed to the Philippine economy we see today.

This now begs the question, if there was no imposition of a martial law in the first place, would we have progressed further? That is, the million *peso* question. Luckily, researchers have come up with models that can estimate the causal impact of a policy to certain indicators on a time-series[3]. While this is not perfect itself, the model that makes use of Bayesian structural time-series models can give us a basis for some insights on the policy decision.

The paper aims to ascertain whether economic growth and education has been stunted by Martial Law in the Philippines. The variables implored to capture economic growth and education will be the Philippines' gross domestic product (GDP), the GDP growth rate, and the country's gross enrollment ratio. A description of each variable is seen in *Table 1.* These variables were selected as

[1] Sourced by Rappler (2016)
[2] As discussed in Muego (1979)
[3] As elaborated further in Bordersen et al. (2015)

they are key indicators typically looked at when assessing the economic conditions during a certain time period. Understanding the causal impact of unconventional policy actions is crucial to understanding how massive of an impact it has done to the country and its economy. As an aside, these insights on government intervention through military action can be crucial to understanding the consequences should an administration decide to pursue an unconventional economic policy such as what was aforementioned, especially during times of economic crisis wherein policy becomes crucial.

As the study aims to look into the effects of the policy implemented in 1972, the data is evaluated from 1960 to 1997 so as to give emphasis on the Marcos regime by looking at the stunted growth for about ten years, while also only including the time period prior to the Asian Financial Crisis of 1997 to 1998. The author decided not to include a full sample as results may be confounded by other events.

The paper discusses literature relating to the subject on the second section. Using the state-space Bayesian formation discussed in the literature, the model, covariates, and time-series factors are all discussed in the methodology. The next section discusses the results obtained from each variable, included some key takeaways obtained from the causal impact simulation. Lastly, the paper offers conclusive remarks based on the results.

Methodology

Literature Review

Brodersen et al. (2015) discusses the diffusion-regression state-space model which shall be the method of choice for the study. This methodology allows for the quantification of a counterfactual estimate in a synthetic control environment which estimates the value that variables would take had no martial law been declared.

In order for results to be conclusive, the methodology must implore the use of time as the function being used which will make the counterfactual estimate consistent to the true value. Hamilton's Time Series Analysis (1994) gives an in-depth and algebraical explanation on time series. The ability to model and perform decision modeling and analysis is an essential feature of many real-world applications. This, also, is the main dynamic method we may use to evaluate such policy consequences.

Counterfactual Construction

In accordance to the literature, to construct the counterfactual, the researcher must make use of synthetic controls, which can be formed by grouping covariates into a single synthetic control. We select candidate covariates by considering variables that are not affected by the treatment, which

in this case must not be affected by the martial law declaration in 1972.

As covariates for the Philippines' GDP, the GDP of Indonesia and Malaysia, and iterations using the S&P and Dow Jones indices of equity will be used. Indonesia and Malaysia are neighboring countries that are of similar stature to the Philippines during the period, and are also developing countries whose growth are similar to one another. Whereas S&P and Dow Jones indices are good representations of the equity market. Post-martial law, we can rationalize that the policy change had no significant impact to these variables. Similarly, the GDP growth of Indonesia and Malaysia will be implored as covariates of the Philippines' GDP growth, where growth of the Philippines should not be significantly different from that of Malaysia and Indonesia if the intervention truly causes no impact on the growth of the country. The gross enrollment ratio also holds similar qualifications for covariates as Malaysian and Indonesian enrollment ratios are also used as covariates.

Model Formulation

Consistent with the literature[4], structural time-series models, which are implored as we formulate a model for causal impact, are state-space models for time-series data. They can be defined in terms of a pair of equations:

$$(1) \qquad y_t = Z_t^T \alpha_t + u_t$$
$$(2) \qquad \alpha_{t+1} = T_t \alpha_t + R_t \eta_t$$

where $\varepsilon_t \sim N(0, \sigma_t^2)$ and $\eta_t \sim \mathcal{N}(0, Q_t)$ are independent of all other unknowns. Equation (1) is the observation equation; it links the observed data y_t to a latent d-dimensional state vector α_t. Equation (2) is the state equation, which governs the evolution of the state vector α_t through time.

There is a need to make sure that covariates are unaffected by the treatment, which can be incorporated as $Z_t = \beta^T x_t$ where $a_t = 1$ which assumes that the model cannot infer on a potential lag between the series that was treated and not treated. This ensures that our covariates are contemporaneous.[5]

Results and Discussion

GDP iterations using GDP of neighboring developing countries

While the Philippines was under a dictatorship, Indonesia and Malaysia remained steady with improving its economic outlook and thus, maintained a steady growth. After inflation and maintaining constant prices, an increase in the GDP generally would mean growth in the economy. Therefore, the amount of increase of the counterfactual and true value is an important point of comparison.

[4] As elaborated further in Bordersen et al. (2015)

[5] As elaborated further in Bordersen et al. (2015)

In *Figure 1,* the causal impact of the declaration of martial law in 1972 can be observed. The black line represents the actual series while the estimated counterfactual of the series is represented by the dashed blue line with a confidence band in blue. The figure has 3 panes, namely, (1) original, (2) pointwise, and (3) cumulative. The study is only concerned with the first two panes as the third pane is non-sensical for rate reductions.

Observably, the counterfactual series maintains a higher position by 1997 than that of the actual series. During the post-martial law period, the response variable had an average value of approximately 10.93. By contrast, in the absence of martial law, we would have expected an average response of 11.23.[6] Subtracting this prediction from the observed response yields an estimate of the causal effect Martial Law had on the response variable, where this effect is -0.29.[7] Summing up the individual data points during the post-martial law period, the response variable had an overall value of 273.27. By contrast, had the intervention not taken place, we would have expected a sum of 280.64.[8] In relative terms, the response variable showed a decrease of negative three percent.[9] This means that the negative effect observed during the intervention period is statistically significant (See *Appendix A*). Lastly, the probability of obtaining this effect by chance is very small.[10] This means the causal effect can be considered statistically significant.

Interpreting the results, the significant difference in GDP means that the country would have been better off with a higher GDP had it not underwent a period of martial law.

GDP iterations using Equity indices

As a placeholder of the equities market, the author decided to go with S&P 500 and Dow Jones index. Not only are these indices available in public domains, these are also benchmarks typically used to determine the state of the overall economy, with the S&P being widely considered as the more complete and wide-market-breadth stock index.

In *Figure 2,* the causal impact of the declaration of martial law in 1972 can be observed. Seemingly, there is not much difference in the series, having a counter-intuitive value around the 1980s. During the post-martial law period, the actual GDP had an average value of approximately 10.93. In the absence of a martial law, the country would have expected an average response of 10.92.[11] Subtracting this prediction from the observed response yields an estimate of

[6] The 95% interval of this counterfactual prediction is [11.02, 11.43]
[7] This effect is with a 95% interval of [-0.50, -0.091]
[8] The 95% interval of this prediction is [275.55, 285.67], given in terms of absolute numbers
[9] The 95% interval of this percentage is [-4%, -1%]
[10] Bayesian one-sided tail-area probability p = 0.005
[11] The 95% interval of this counterfactual prediction is [10.81, 11.03]

the causal effect the intervention had on the response variable, which this effect is 0.0089.[12] Summing up the individual data points during the post-martial law period, the response variable had an overall value of 273.27. Had the intervention not taken place, we would have expected a sum of 273.05.[13] In relative terms, the response variable showed no significant increase.[14]

This means that, although the intervention appears to have caused a positive effect, this effect is not statistically significant when considering the entire post-intervention period as a whole (See *Appendix B*). The apparent effect could be the result of random fluctuations in the series that are unrelated to martial law. This is often the case when the intervention period is very long and includes much of the time when the effect has already worn off. It can also be the case when the intervention period is too short to distinguish the signal from the noise. Finally, failing to find a significant effect can happen when there are not enough control variables or when these variables do not correlate well with the response variable during the learning period.

The probability of obtaining this effect by chance is $p = 0.426$. This means the effect may be spurious and would generally not be considered statistically significant. Therefore, we cannot garner significant insights from the results given covariates of equity indices.

Economic Growth

As developing countries, the a-priori expectation of the GDP growth of the Philippines, Malaysia, and Indonesia should be at least an annual increase of 5 percent, especially for countries in South-East Asia where economies should be healthy. Thus, the divergence to an amount that is of 5 percent or higher is an important insight to observe.

In *Figure 3,* the causal impact of the declaration of martial law in 1972 can be observed. During the post-intervention period, the actual GDP growth of the Philippines had an average value of approximately 3.54 percent. By contrast, in the absence of an intervention, we would have expected an average growth of 5.16 percent.[15] Subtracting this prediction from the observed response yields an estimate of the causal effect the intervention had on the response variable, where this effect is -1.63 percent.[16] For a developing country like the Philippines, a boost of 1.63 percent a year is significant and could have helped the country prosper even further.

Summing up the individual data points during the post-intervention period, the response variable had an overall value of 88.41. By contrast, had the intervention

[12] Effect with a 95% interval of [-0.10, 0.12]
[13] The 95% interval of this prediction is [270.29, 275.82], given in terms of absolute numbers
[14] The 95% interval of this percentage is [-1%, +1%]
[15] The 95% interval of this counterfactual prediction is [4.75, 5.56]
[16] Effect is with a 95% interval of [-2.02, -1.21]

not taken place, we would have expected a sum of 129.05.[17] In relative terms, the response variable showed a decrease of 31 percent.[18]

This means that the negative effect observed during the intervention period is statistically significant (See *Appendix C*). The probability of obtaining this effect by chance is very small.[19] This means the causal effect can be considered statistically significant.

Interpreting the results, the significant difference in our GDP growth means that the country would have been better off with a higher GDP growth per year had it not underwent a period of martial law. Additionally, the counterfactual is observables a consistent 5 percent increase annually, which could have been a healthy number for a developing country like the Philippines.

Education

An ideal enrollment ratio is 100 percent, but there is a possibility of more than 100 percent value considering that there might be enrollees in the higher or lower age groups currently enrolled in primary school. Nevertheless, a higher value is preferred and thus, the divergence to a higher amount is an important insight to observe.

In *Figure 4,* the causal impact of the declaration of martial law in 1972 can be observed. Seemingly, the actual series in education holds values below the counterfactual line, with some time periods outside the confidence band. During the post-martial law period, the enrollment ratio in the Philippines had an average value of approximately 107.14 percent. By contrast, in the absence of an intervention, we would have expected an average enrollment ratio of 109.06 percent.[20] Subtracting this prediction from the observed response yields an estimate of the causal effect the intervention had on enrollment in the Philippines. In relative terms, enrollment showed a decrease of 2 percent.[21]

This means that the negative effect observed during the martial law period is statistically significant (See *Appendix D*). The probability of obtaining this effect by chance is very small. This means the causal effect can be considered statistically significant.[22]

Interpreting the results, the significant difference in our gross enrollment ratio means that the country would have been better off with a gross enrollment ratio per year had it not underwent a period of martial law. 2 percent does not seem much, but an average of 2 percent a year in enrollment would have been significant to our country in terms of educational

[17] The 95% interval of this prediction is [118.75, 139.01], where results are given in terms of absolute numbers
[18] The 95% interval of this percentage is [-39%, -24%]
[19] Bayesian one-sided tail-area probability p = 0.001
[20] The 95% interval of this counterfactual prediction is [107.65, 110.46]
[21] The 95% interval of this percentage is [-3%, -0%]
[22] Bayesian one-sided tail-area probability p = 0.006

development. Further, studies conducted by UNESCO (2020) show a direct correlation between education and poverty, thus any indication that the education of the Philippines were to increase, poverty would have ultimately reduced.

Conclusion

This is no political issue solely, but an economic one as well. Without martial law, the country would have seen an increase of 3 percent in our GDP as a whole. Without martial law, we would have seen a steady GDP growth with a boost of 1.63 percent annually. Without martial law, the Philippines would have prospered with 2 percent more students enrolled in school. The Philippines would have been more developed by now. Unfortunately, the numbers mentioned were all counterfactual.

The findings have seen negative effects of the declaration of martial law to our economy, our economic growth, and our education. This significant loss would have propelled our economy even further by this time, had it not undergone a martial law ruling. Thus, there is enough evidence to suggest that the economic policy of declaring martial law in the Philippines stunted our economy and our economic growth. Using the covariates of our neighboring countries in Southeast Asia, we also see that we really were overtaken due to the decades under martial law. Thus, results suggest that the period of the Philippines really was not the "golden age of Philippine economy" considering that such a policy stunted the growth of the country, even to the extent of the educational system of the country, at least statistically speaking.

Overall, the conduct of economic policy to address shortcomings is important as we see the detrimental effects it has caused decades in, and as such understanding what specific benefits these policies could end up doing is crucial during periods in need of necessary intervention. Unfortunately, findings suggest that this economic policy of 1972, led to suboptimal events, where *we just might have lost two decades of progress* because of economic decisions made in the Marcos regime.

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Appendix

Variable	*Description*
Philippine Gross Domestic Product (GDP)[23]	The Philippine GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. Data are in current U.S. dollars. Dollar figures for GDP are converted from domestic currencies using single year official exchange rates. This is deflated, and is taken with a log to account for a very low starting point.[24]
Philippine Gross Domestic Product (GDP) Growth Rate (%)[25]	The Philippines' annual percentage growth rate of GDP at market prices is based on constant Philippine Peso, and aggregates are based on constant 2010 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products.[26]
Gross Enrollment Ratio (%)[27]	Gross enrollment ratio, represented by School enrollment in the primary level is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Primary education provides children with basic reading, writing, and mathematics skills along with an elementary understanding of such subjects as history, geography, natural science, social science, art, and music.[28]

Table 1. *Variable Descriptions*

[23] Data from the World Bank IBRD-IDA
[24] Details of the variable is sourced from UNESCO Institute of Statistics, Licensed CC BY-4.0
[25] Data from the World Bank IBRD-IDA
[26] Details of the variable is sourced from UNESCO Institute of Statistics, Licensed CC BY-4.0
[27] Data from the World Bank IBRD-IDA
[28] Details of the variable is sourced from UNESCO Institute of Statistics, Licensed CC BY-4.0

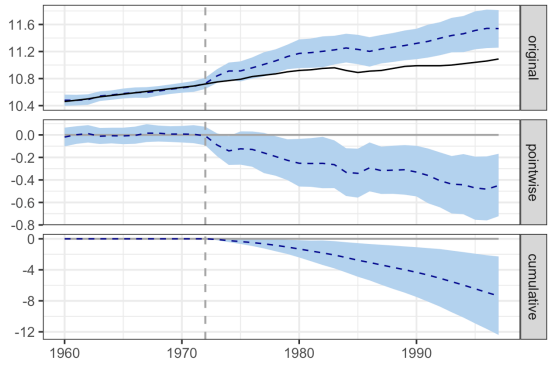

Figure 1. *Causal Impact on the Philippines' Gross Domestic Product (logarithm at constant US$) using GDP of Indonesia and Malaysia as covariates*

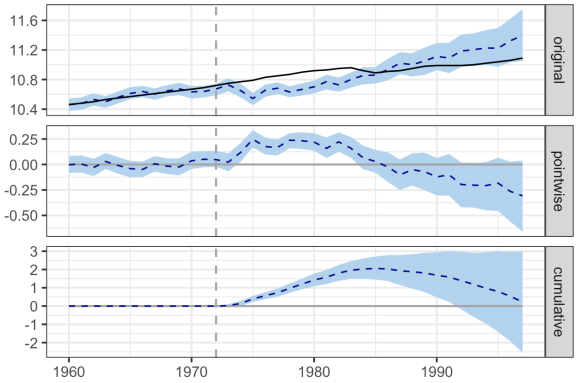

Figure 2. *Causal Impact on the Philippines' Gross Domestic Product (logarithm at constant US$) using S&P500 and Dow Jones Indices as covariates*

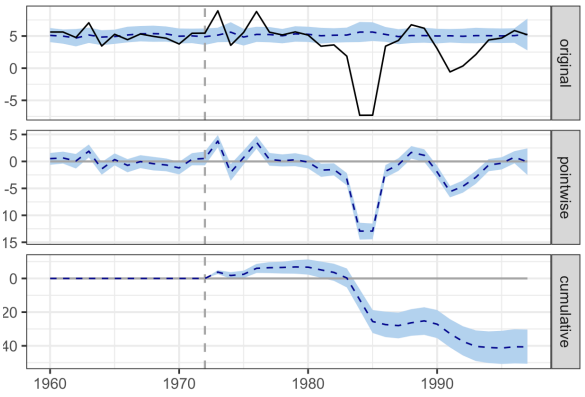

Figure 3. *Causal Impact on the Philippines' Gross Domestic Product growth (%) using GDP growth of Indonesia and Malaysia as covariates*

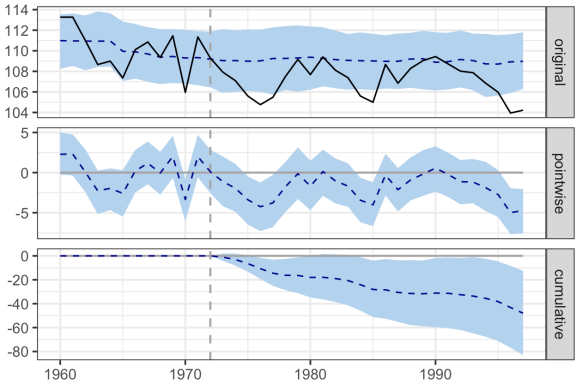

Figure 4. *Causal Impact on the Philippines' Gross Enrollment Ratio (%) using the Gross Enrollment Ratio (%) of Malaysia and Indonesia as covariates*

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Posterior inference {CausalImpact}

                          Average          Cumulative
Actual                    11               273
Prediction (s.d.)         11 (0.1)         281 (2.5)
95% CI                    [11, 11]         [276, 286]

Absolute effect (s.d.)    -0.29 (0.1)      -7.37 (2.5)
95% CI                    [-0.5, -0.091]   [-12.4, -2.278]

Relative effect (s.d.)    -2.6% (0.9%)     -2.6% (0.9%)
95% CI                    [-4.4%, -0.81%]  [-4.4%, -0.81%]

Posterior tail-area probability p:   0.00501
Posterior prob. of a causal effect:  99.499%
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Appendix A. *Posterior Inferences of Figure 1 Estimates*

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Posterior inference {CausalImpact}

                          Average          Cumulative
Actual                    11               273
Prediction (s.d.)         11 (0.057)       273 (1.435)
95% CI                    [11, 11]         [270, 276]

Absolute effect (s.d.)    0.0089 (0.057)   0.2230 (1.435)
95% CI                    [-0.1, 0.12]     [-2.6, 2.98]

Relative effect (s.d.)    0.082% (0.53%)   0.082% (0.53%)
95% CI                    [-0.93%, 1.1%]   [-0.93%, 1.1%]

Posterior tail-area probability p:   0.4257
Posterior prob. of a causal effect:  57%
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Appendix B. *Posterior Inferences of Figure 2 Estimates*

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Posterior inference {CausalImpact}

                          Average          Cumulative
Actual                    107              2679
Prediction (s.d.)         109 (0.74)       2727 (18.51)
95% CI                    [108, 110]       [2691, 2762]

Absolute effect (s.d.)    -1.9 (0.74)      -48.0 (18.51)
95% CI                    [-3.3, -0.5]     [-83.1, -12.6]

Relative effect (s.d.)    -1.8% (0.68%)    -1.8% (0.68%)
95% CI                    [-3%, -0.46%]    [-3%, -0.46%]

Posterior tail-area probability p:   0.006
Posterior prob. of a causal effect:  99.4%
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Appendix C. *Posterior Inferences of Figure 3 Estimates*

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Posterior inference {CausalImpact}

                          Average          Cumulative
Actual                    3.5              88.4
Prediction (s.d.)         5.2 (0.21)       129.0 (5.23)
95% CI                    [4.7, 5.6]       [118.7, 139.0]

Absolute effect (s.d.)    -1.6 (0.21)      -40.6 (5.23)
95% CI                    [-2, -1.2]       [-51, -30.3]

Relative effect (s.d.)    -31% (4.1%)      -31% (4.1%)
95% CI                    [-39%, -24%]     [-39%, -24%]

Posterior tail-area probability p:   0.001
Posterior prob. of a causal effect:  99.9%

For more details, type: summary(impact, "report")
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Appendix D. *Posterior Inferences of Figure 4 Estimates*