

# Bitcoin Adoption in El Salvador

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A thesis submitted to the undergraduate

Arts and Sciences Honors program

A requirement of an honors

Degree in the Economics

Department

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Date of Defense: 04/06/2023

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## Abstract

In September 2021, El Salvador was the first country in the world to adopt Bitcoin as a legal tender, marking the first introduction of a cryptocurrency into a regulated financial system. Using Gross Domestic Product as an indicator for economic growth in El Salvador, it can be estimated how bitcoin adoption affects GDP. The difference in difference design tests the influence of Bitcoin on the treatment group El Salvador whilst controlling for GDP's determinants. The results provide evidence that Bitcoin adoption had a negative impact on GDP, in which El Salvador's GDP decreased 2.22% relative to the control group.

## Introduction

In the September of 2021, President Nayib Bukele made El Salvador the first nation in the world to adopt bitcoin as a national legal tender. The president believed that bitcoin had the ability to “generate jobs and help provide financial inclusion to thousands outside the formal economy” (Reis Thebault, 2021). Determined to improve the lives of Salvadoreans, adoption was supposed to prepare El Salvador for a better future. Nayib Bukele risked the future of El Salvador’s economic welfare with his Bitcoin gamble and two years after its adoption, citizens are questioning if it is paying off. This thesis is dedicated towards understanding the effects bitcoin had on El Salvador’s economy. Specifically, we want to estimate how the adoption of bitcoin as a legal tender affected El Salvador’s GDP.

President Nayib Bukele received heavy criticism for his decision to adopt bitcoin as a legal tender. Concerns were shown by the United States, the World Bank, and the International Monetary Fund about the effects that bitcoin could have on El Salvador’s economic welfare and financial system. These officials “argue that by adopting cryptocurrencies, nations could facilitate money laundering and undermine capital controls, while exposing their citizens to severe price volatility” (Schreckinger, 2022). Their arguments highlight the potential negative impact’s bitcoin adoption could have on the economy. Although these officials can raise concerns about the direction of bitcoin’s influence on El Salvador’s economy, without further mathematical analysis and testing the implications of bitcoin cannot be understood.

Centering the focus on nominal GDP data this paper gains insight into the economic well-being of El Salvador as a whole country and analyzes the impact this could have on citizens. It is vital for Salvadoreans to understand the impact bitcoin had on their economy to gain insight about the potential economic fluctuations and changes bitcoin adoption has. This

untested experiment decides the future economic welfare of El Salvador, and no one knows the vulnerabilities and determinants behind bitcoin adoption.

When analyzing theory to predict the impact adoption had on GDP in El Salvador, it is essential to consider the determinants that define this currency. These determinants impact the decision-making Salvadoreans conduct when purchasing goods, effectively causing Salvadoreans to prefer the use of their domestic currency<sup>1</sup> when conducting daily transactions. Since bitcoin adoption, extreme currency volatility constantly influenced the decision-making of Salvadoreans. Moving from its all-time high of 69,000 USD to a bear market low of 15,000 USD its users have shown hesitation to conduct transactions because of the constant changes in purchasing power experienced by the currency. When bitcoin was signed into law El Salvador introduced the 'Chivo Wallet' to incentivize the use of the currency. By downloading the app \$30 in bitcoin was given to the user to promote the use of bitcoin, however, a study by the NBER revealed that many people who have download the app converted the bitcoin into USD or have not used the incentive. In fact, "20% of the people who downloaded the app have not used their bonus" (Fernando Alvadrex, 2022). Salvadoreans prioritized to maximize the money given from the government by exchanging it for cash rather than letting their incentive be affected by extreme volatility that could have cut the value of their incentive by more than half<sup>2</sup>. Salvadoreans that didn't exchange their bitcoin to cash have not touched their incentive and theoretically are waiting for an increase in bitcoins price to conduct purchases or exchange it to cash. This decision-making effectively deterred the use of bitcoin and decreased the returns of the incentive given out. With more

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<sup>1</sup> The domestic currency in EL Salvador is the US Dollar

<sup>2</sup> The average price at which El Salvador bought bitcoin to fund this incentive was \$ 43,357 (JHA, 2022). At its bear market low this would have decreased the value of the \$30 incentive by about 65%.

money being spent than is returned this would effectively lead to decrease in El Salvador's GDP.

Another factor that is deterring the use of bitcoin as a currency are the associated transaction fees the bitcoin asset experiences. Bitcoin fees are dependent on the volume of transactions, and during bitcoin's highest transaction volume in April 2021 Bitcoin ATM's<sup>3</sup> "reached a fee of over \$60 per transaction" (Fernando Alvarez, 2022). Even though the Chivo ATMs offer free conversion to cash, there are not many Chivo ATM's available forcing most people to find bitcoin ATM's that involve high fees. These transaction fees deter the use of the bitcoin currency to make purchases and reinforce Salvadoreans preference to use cash instead of Bitcoin. Salvadoreans avoid bitcoin use because they do not see more benefit compared to purchases with the trustworthy domestic currency.

These factors highlight the negative impact that this paper predicts bitcoin will have on El Salvador's GDP. Bitcoin is not designed to be used as a currency and deters citizens from using it over the domestic currency in El Salvador. Considering the decision-making Salvadoreans experience when purchasing goods due to the price volatility and transaction fees, it is this paper's prediction that bitcoin adoption had a negative effect on GDP in El Salvador.

Even though this paper predicts a negative impact on GDP because of adoption, the bitcoin asset could potentially still bring certain benefits to El Salvador. The universality of the Bitcoin asset could bring more investors to El Salvador by lowering the barriers of entry for firms to come to El Salvador, as well as supporting and developing existing Salvadorian firms. This potentially could increase GDP by improving the economic output of El Salvador as

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<sup>3</sup> Understanding the ATM fees are relevant due to the fact that most Salvadoreans convert their Bitcoin to cash before they make purchases.

these firms could generate more revenue through the goods and services they sell. Furthermore, the functionality, security, and simplicity of cryptocurrencies could provide citizens with more opportunity to connect with their financial system. A large part of Salvadorians are unable to access the financial system currently in place, as “approximately 70% of the population in El Salvador does not have a bank account” (Henri Arslanian, 2021). Bitcoin adoption aimed to increase the financial security and financial opportunities of citizens by providing Salvadoreans with easier access to the financial system through the security of bitcoin wallets. This effectively could increase the amount of taxable citizens in El Salvador as more citizens might use digital assets instead of holding cash, potentially adding to GDP in the long-run.

Studying the effects of bitcoin adoption on GDP provides insights for other countries to determine the viability of the bitcoin asset as a legal tender, and the potential that cryptocurrencies have in a regulated financial system. There are many countries around the world whose domestic currency suffers from high inflation and volatility, in which cryptocurrencies could provide a solution or improvement to their currency struggles. The analysis of bitcoin's effect on GDP allows these countries to theorize about the economic potential cryptocurrencies could have within their financial system. This effectively allows them to determine their willingness to accept a cryptocurrency if it can potentially bring benefit to their own country.

To mathematically determine the effect of Bitcoin adoption on GDP this paper has chosen to conduct a difference in difference regression. This regression allows us to test the differences in GDP growth experienced between the treatment and control groups. Applying this method of analysis accurately determines the effect bitcoin introduction had on GDP from 2016 to 2022. Regression analysis using difference in differences serves further benefit

by reducing the omitted variable<sup>4</sup> bias experienced by similar literature, allowing us to account for more variables to gain a more accurate answer to the research question. This in addition to the three control variables of Interest Rate, Labor Force Participation Rate, and Gross Fixed Capital formation, enables us to isolate the true effect that bitcoin adoption had on GDP in El Salvador.

This paper moves away from traditional literature associated with the study of cryptocurrencies. Instead of studying the economics of bitcoin or the functionality of the Blockchain, this paper contributes by conducting analysis on the effects of legal adoption on an economy. The most closely related literature is a paper 'The Influences of Cryptocurrency on Economic Growth' (Utomo, 2018) regresses the Solow growth model with bitcoin market price to determine the effect of bitcoin on GDP growth from 2011 to 2016. The methodology applied by Utomo inaccurately determines bitcoins influence on GDP, as she uses bitcoin market price to analyze the prices effect on GDP. This leads to omitted variable bias within model as bitcoin price is influenced by factors all around the world and is not specific to an individual country. This effectively impacts the legitimacy and accuracy of her results, as she cannot control for certain variables. This paper changes the method of analysis implemented by Utomo to a difference in difference regression to enable accurate analysis about the true effect bitcoin adoption had on GDP. Furthermore, this analysis only focuses on bitcoin within a regulated financial system removing the need to include bitcoin market price to understand bitcoins effect on GDP. This allows this paper to analyze the effects of bitcoin on GDP without the influences of omitted variable bias, enabling this paper to accurately determine bitcoins effect on GDP. This pushes literature further as it determines the exact impact bitcoin

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<sup>4</sup> Omitted Variable Bias occurs when a study fails to include variables that could influence the regression. This was commonly seen in previously literature as the nature of cryptocurrencies made estimation hard, because its determinants are universal.



adoption had on GDP within a regulated financial system and allows for analysis about the determinants driving bitcoins effect on GDP.

## Literature Review

This paper examines the influence of bitcoin adoption on El Salvador's GDP and encompasses a wide range of literature related to cryptocurrencies to understand the effect bitcoin adoption had on GDP. Existing research frequently focuses on the functionality of the blockchain network and its effects on the cryptocurrency ecosystem. The paper 'Blockchain Analysis of the Bitcoin Market' written by Igor Makarov and his co-workers analyze the main market players associated with the bitcoin asset and their distribution of ownership. The authors find that the Bitcoin market is "dominated by large and concentrated players" (Markarov, 2022) and explain that "75% of the real bitcoin volume has been linked to exchanges or exchange-like entities such as on-line wallets, OTC desks, and large institutional traders" (Markarov, 2022). This paper adds to this existing literature by analyzing how these dominant market participants have the potential to influence bitcoin volume, affecting the decision-making of Salvadoreans. The analysis of bitcoin volume and how it influences Salvadoreans gives us further insight into how these market players influence GDP in El Salvador. Although we can't analyze their direct impact on El Salvador's GDP, this paper theorizes how the volumes associated with the bitcoin asset impact the decision-making Salvadoreans experience when conducting purchases. By analyzing how the volume of the bitcoin asset influence transaction fees, this paper demonstrates that higher bitcoin volumes deter the use of the bitcoin asset to conduct purchases in El Salvador.

Understanding the functionality behind the Bitcoin ecosystem provides valuable information on the costs associated with the asset's adoption. The paper 'The Economics of Cryptocurrencies' written by Jonathan Chiu and his associates aims to understand the viability of bitcoin as a means of payment. The authors find that "Bitcoin generates a large welfare loss that is about 500 times as large as a monetary economy with 2% inflation" (Chiu, 2019).

This thesis aims to push their literature further by analyzing the effect of Bitcoin costs in a regulated financial system and its overall impact on GDP in El Salvador. By analyzing the decision-making Salvadoreans experience when using bitcoin as a means of payment, it provides insights about the effect these costs have on the useability of bitcoin to perform transactions that could add to GDP in El Salvador. Using theory to make determinations about how Salvadoreans use the asset to maximize their well-being based on costs, allows this paper to make determinations about the strength of the currency and its usability within a regulated financial system.

The NBER's paper 'Are Cryptocurrencies Currencies?' written by Fernando Alvarez and his associates study the potential of bitcoin to become a medium of exchange in El Salvador. The authors analyze various factors associated with Bitcoin's use to identify its usability as a means of payment. The authors found that "The magnitude of the elasticity between Chivo Wallet [Bitcoin] and other payment methods is larger than the elasticity of substitution between cash and cards" (Alvarez, 2022). This paper adds to this literature by theorizing how the preference of Salvadoreans to use other forms of payments instead of bitcoin to perform daily transactions influences GDP. By analyzing the determinants surrounding the reasons for this preference, this thesis can make assumptions about why bitcoin had a negative impact on GDP in El Salvador. This furthers the understanding of bitcoins effect as it provides insight into why the lack of purchases in bitcoin from Salvadorians effectively decreased GDP.

The paper 'Analysis of the Cryptocurrency Adoption Decision' written by Saeef Alzahrani and Tugurl Daim analyze the reasons behind the adoption of cryptocurrencies based off the advantages these currencies could potentially bring. They find that the main factors driving adoption "are the investment opportunity cryptocurrency forms, the anonymity of the

transactions and privacy, the acceptance by businesses as a payment method, the fast transfer of funds, the low cost of transactions, and technological curiosity” (Alzahrani, 2019). This paper pushes their literature further by analyzing if these advantages still exist in a regulated financial system. The application of their findings provide this paper with an understanding that enables determinations to be made about the driving forces behind adoption in El Salvador and the uses Salvadoreans have for bitcoin in their financial system. With this information this paper analyzes how the uses of bitcoin as a legal tender influence GDP in El Salvador. By understanding the uses of bitcoin this paper explains the struggles associated with its adoption that led to the decrease in GDP experience by El Salvador relative to the control.

The closest related literature to this paper ‘The Influences of Cryptocurrency on Economic Growth’ written by Grace Utomo examines the effect bitcoin had on GDP from 2011 to 2016 for the 5 countries with the most Bitcoin transactions. The author finds that “BTC significantly affects GDP, as every one unit of bitcoin changes” (Utomo, 2018) GDP will decrease by 29247,49 USD. This paper adds to this existing literature by applying a different methodology to make more accurate determinations about the effect of bitcoin on GDP. Instead of regressing bitcoin market price with labor, capital, and technology in the form of the Solow growth model, this paper uses a difference in difference regression to test the differences in GDP before and after adoption relative to the control. By analyzing if bitcoin adoption affected GDP in El Salvador this paper can draw more accurate conclusions about the true effect that bitcoin had on GDP. Furthermore, this papers method of analysis also removes the omitted variable bias and inaccuracies experienced by Utomo’s regression model. Removing bitcoin market price from the regression allows for accurate determinations about the effect of bitcoin on GDP because it removes the omitted variable bias influencing

the model. By testing before and after this paper can accurately isolate the effect bitcoin adoption had on GDP within a regulated system in which we can control all variables influencing GDP. Additionally, this paper will also use time and country fixed effects within the regression model to control for any cross variation across countries and any variation between quarters. The change in methodology that this paper implements provides a more accurate methodology to determine the true effect bitcoin adoption had on GDP.

## Methodology

To identify the impact Bitcoin adoption had on economic growth in El Salvador this paper implements a difference in difference regression model. This model accurately evaluates the influence of Bitcoin on El Salvador's GDP relative to the control by mathematically determining differences before and after the treatment was applied. This method of analysis accurately isolates the true effect bitcoin had on El Salvador's GDP.

The quarterly GDP data collected stems from the International Monetary Fund and ranges from the first quarter of 2016 to the third quarter of 2022. The countries<sup>5</sup> from which data was collected are all in the South American region of the world to reduce the potential influence of omitted variables in the regression. This ensures a better comparison to the treatment group and provides us with a more reliable understanding of the effect bitcoin adoption has on GDP.

The difference in difference methodology will use log GDP as the dependent variable to reduce the variability of the dataset. Logging the data allows this paper to minimize the differences within the data, effectively increasing the precision of the results to draw the most accurate conclusions about the effect of bitcoin adoption on GDP in El Salvador. The three independent variables in the baseline regression are all dummy variables that serve to make distinct the timeframe of adoption between the control and treatment groups. The Treatment variable differentiates the control and treatment groups by assigning a 1 to every data point associated with El Salvador and a 0 to every control country. The Post variable indicates the timeframe of Bitcoin introduction, where the variable equates 1 once the time series reaches the third quarter of 2021 and 0 before that quarter. This allows us to separate log GDP before

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<sup>5</sup> The control countries used are Guatemala, Honduras, Paraguay, Costa Rica, Ecuador, Colombia, Peru, Chile, and Brazil.

and after the adoption of Bitcoin as a legal tender. The last independent variable Treat x Post consists of an interaction term between the two previous dummy variables to indicate the specific difference in log GDP after the adoption of Bitcoin In El Salvador. This variable assigns a 1 if it is from El Salvador and after the adoption date, where the rest is 0.

$$\text{Equation 1} \quad : \quad \text{Log (GDP)}_i = \alpha + \beta_1 \text{Treat}_i + \beta_2 \text{Post}_i + \beta_3 \text{Treat*Post}_i + \varepsilon_i$$

The next equation introduces control variables to statistically remove their effects on the other variables in the regression. The control variables selected are all known determinants of GDP and allow us to isolate their effects from the main variable of interest Treat x Post. The control variable interest rate impacts the decisions Salvadorians make with their money. Controlling for interest rates allow us to control for the differences in saving and investments Salvadorians experience during the time frame from 2016 to 2022. The other two control variables of Labor Force Participation Rate and Gross Fixed Capital Formation stem from the effects analyzed in Solow's growth model. The variable for labor allows this regression to control for differences in the work force that could have impacted GDP. The variable for capital controls for differences in the production capabilities that influence the output produced per worker. These control variables are the most influential determinants of GDP and serve to isolate the effect of bitcoin adoption had on El Salvador.

$$\begin{aligned} \text{Equation 2} \quad : \quad \text{Log (GDP)}_i = & \alpha + \beta_1 \text{Treat}_i + \beta_2 \text{Post}_i + \beta_3 \text{Treat*Post}_i + \beta_4 \text{Interestrates}_i \\ & + \beta_5 \text{Labor}_i + \beta_6 \text{Capital}_i + \varepsilon_i \end{aligned}$$

Even though the regressions now controls for the various determinants of GDP this third regression will also implement country fixed effects and yearly fixed effects. The implementation of these fixed effects serve to accurately compare the datapoints to eliminate any cross variation within the dataset. Country fixed effects fix the datapoints of every country to avoid any cross variation between countries. Yearly fixed effects fix every years datapoints to draw accurate comparisons from year to year to avoid any cross variation over time. These fixed effects effectively increases the accuracy of the comparisons being made between datapoints and allow for more precise conclusions about the dataset.

$$\text{Equation 3} \quad : \quad \text{Log (GDP)}_i = \alpha + \beta_1 \text{Treat}_i + \beta_2 \text{Post}_t + \beta_3 \text{Treat*Post}_{it} + \beta_4 \text{Interestrates}_{it} \\ + \beta_5 \text{Labor}_{it} + \beta_6 \text{Capital}_{it} + \gamma_t + \delta_i + \varepsilon_{it}$$

The final regression equation differentiates from equation three by changing the yearly fixed effects to quarter fixed effects. This change allows for comparisons to be made for every individual quarter in the dataset. Due to the limited amount of datapoints in the regression in the period after adoption, this adjustment allows for more comparisons to be drawn in the period after adoption compared to the yearly fixed effects. Additionally, this also eliminates any differences across years that could have been affected by economic fluctuations such as the covid-19 pandemic and effectively allows for more accurate comparisons to be drawn over time.

$$\text{Equation 4} \quad : \quad \text{Log (GDP)}_i = \alpha + \beta_1 \text{Treat}_i + \beta_2 \text{Post}_t + \beta_3 \text{Treat*Post}_{it} + \beta_4 \text{Interestrates}_{it} \\ + \beta_5 \text{Labor}_{it} + \beta_6 \text{Capital}_{it} + \gamma_t + \delta_i + \varepsilon_{it}$$



## Data

This paper will use a variety of data sets to accurately determine the effect bitcoin adoption had on GDP growth in El Salvador. The data for Gross Domestic Product was pooled from a public dataset published by the International Monetary Fund. This source provides reliable quarterly GDP data from the first quarter in 2016 to the third quarter of 2022. This data was consistent for all 10 countries used within this paper being: El Salvador, Guatemala, Honduras, Paraguay, Costa Rica, Ecuador, Colombia, Peru, Chile, and Brazil.

Even though the dataset from the International Monetary Fund was used for GDP, it had many gaps in the data regarding the control variables. These inconsistencies from the control variables led this paper to pool data from each individual central bank of each country<sup>6</sup>. These central banks provided consistent and accurate quarterly data from 2016 to 2022 for interest rates, labor force participation rate, and Gross Fixed Capital formation. The data for these control variables is essential as it enabled this paper to isolate the effect of bitcoin adoption on log GDP.

The recency of Bitcoin adoption made it essential to collect as much data as possible within the timeframe of introduction. Inconsistencies across various countries concerning their data collection removed the ability to accumulate monthly level data for all variables. Therefore, it was vital to collect data on a quarterly level to draw accurate conclusions from the regressions ran within the paper. The combination of these data sources alleviates any data inconsistencies and therefore provides the most accurate results about the effect of Bitcoin adoption on El Salvador's log GDP.

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<sup>6</sup> List of all Central Bank names: "Banco Central de Reserva de El Salvador", "Banco Central del Honduras", "Banco Central del Paraguay", "Banco Central de Costa Rica", "Banco Central del Ecuador", "Banco de la República", "Banco Central de Reserva del Perú", "Banco Central de Chile", "Banco Central do Brasil".

## Descriptive Statics

Table 2: Table of Means for the treatment and control groups over all quarters from 2016-2022

<i>Group</i>	<i>Pre</i>	<i>Post</i>	<i>Difference</i>
<i>Treatment</i>	3.802	3.875	0.073
<i>Control</i>	6.339	6.423	0.094
<i>Difference</i>	-2.527	-2.548	-0.021

Table 2 reflects the means of the treatment and control groups in periods before and after the adoption of bitcoin as a legal tender. The variable 'Pre' represents the mean of log GDP before adoption, and the variable 'Post' represents the mean of log GDP after adoption. The variable difference highlights the differences in means between the 'Pre' and 'Post' periods for the treatment and control groups as well as the differences between the means of the treatment and control groups within each time period. These differences in means indicated by table 2 provide us with insights into the difference in log GDP without the control variables. Specifically, table 2 indicates that the differences in means between the treatment and the control groups is -0.021. This effectively demonstrates that log GDP in El Salvador decreased by 2.1% relative to the control, revealing a negative impact that bitcoin adoption had on El Salvador's log GDP.

Table 3: Means and standard deviations of all the Variables

Variable	Treatment		Control	
	Mean	SD	Mean	SD
Log (GDP)	3.816	0.040	6.347	0.051
Interest Rate	4.354	0.205	4.688	1.666
Labor Force Participation Rate	60.20	0.754	64.559	2.002
Gross Fixed Capital Formation	4.89e+09	8.58e+08	7.58E+12	1.02E+12

Notes: All the countries used had a sample size of 26, associated with the number of quarters used in analysis.

Table 3 highlights the means and standard deviations (SD) of the treatment and control groups for all the variables used in the regression. Generally, table 3 demonstrates that the means of the control are relatively higher than the treatment group. Furthermore, the standard deviations are relatively similar for log GDP for both groups, however, the control experiences higher standard deviations for every other variable. Even though this difference is high, the control groups are averaging out nine different countries to compare to the treatment group. Therefore, when we implement country fixed effects within the regression this should decrease the variability of the results reflected in table 3. This is because comparisons to the treatment group are being made between each individual country.

Figure 1: GDP over time for the treatment and control groups

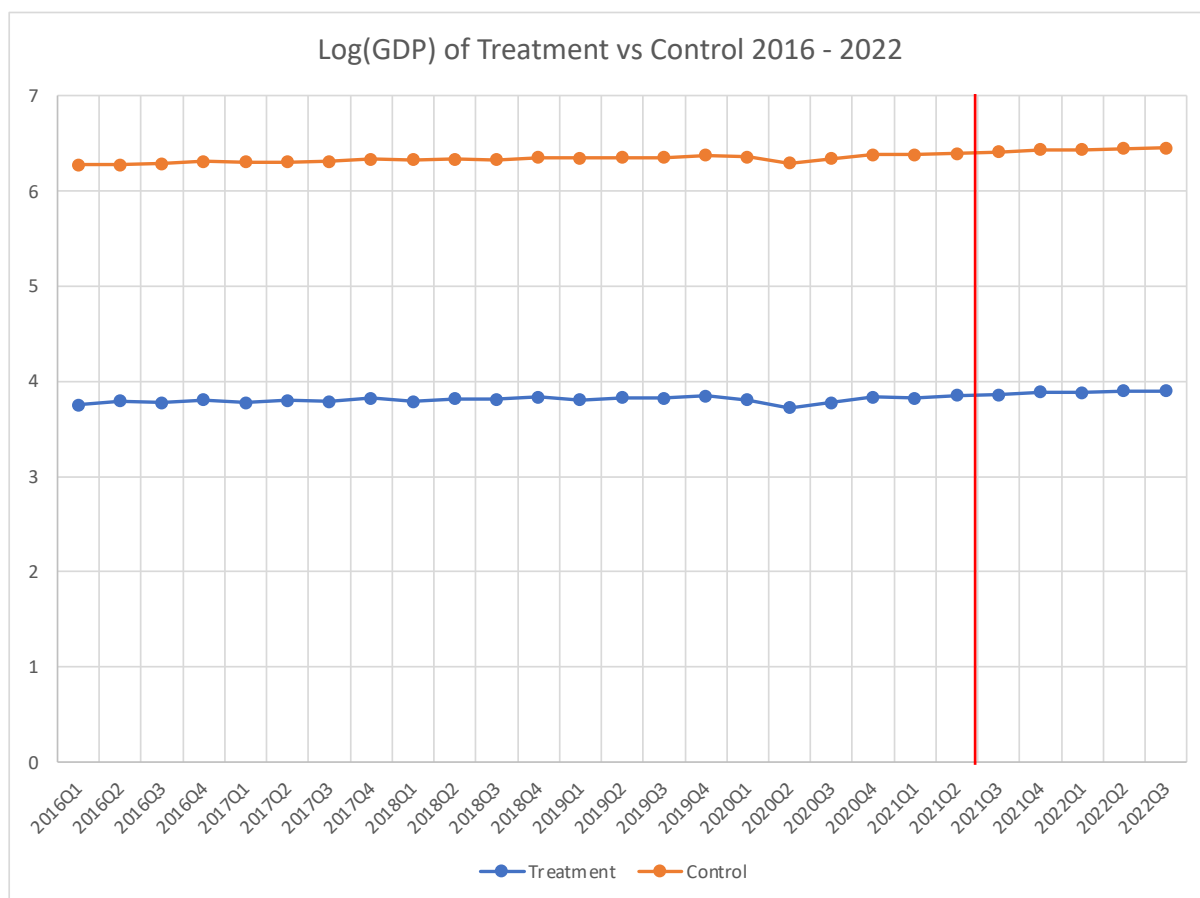


Figure 1 visually demonstrates the relationship between the treatment group El Salvador and the South American control countries log GDP from 2016 to 2022. These two groups reflect similar trends over time with very low variability, only demonstrating a deviation in trend in the second quarter of 2020 because of the effects of the Covid-19 pandemic. The red line in Figure 1 pinpoints the third quarter of 2021, which separates bitcoins adoption date in the pre and post periods. Figure 1 doesn't represent a clear difference between the treatment and control groups, demonstrating that the regression should reflect a small difference in log GDP, if one exists.

## Results

Table 4: Difference in Difference regression of the treatment group El Salvador and the South American control country.

<i>Variable</i>	<i>Equation 1</i>	<i>Equation 2</i>	<i>Equation 3</i>	<i>Equation 4</i>
<i>Treatment</i>	-2.527* (1.50)	-2.507** (1.125)		
<i>Post</i>	0.094*** (0.006)	0.091*** (0.006)		
<i>Treat x Post</i>	-0.021 (0.019)	-0.017 (0.019)	-0.016 (0.013)	-0.022** (0.011)
<i>Interest Rate</i>		-0.005*** (0.001)	-0.0007 (0.001)	-0.002** (0.0009)
<i>Labor Force Participation Rate</i>		-0.0007 (0.001)	.0009 (0.001)	0.001 (0.0009)
<i>Gross Fixed Capital Formation</i>		3.3e-15** (1.23e-15)	1.33e-15 (9.06e-16)	1.32e-15* (7.78e-16)

Notes: Standard Errors are in parenthesis, \*p-value<0.1, \*\* p-value<0.05, \*\*\* p-value<0.01. The number of observations in all regressions equations is 260. Equation 3 – Country Fixed Effects and Yearly Fixed Effects. Equation 4 – Country Fixed Effects and Quarter Fixed Effects.

The baseline results from table 4 indicate that log GDP in El Salvador decreased by 2.1% relative to the other South American control countries. This coefficient result in the first equation indicates a negative trend for the Treat x Post variable, however, the variable does not reach statistical significance. This means that there is a possibility that the observable trend in the regression for this variable could still be explained by chance and doesn't accurately answer the research question.

When we add the control variables of Interest Rate, Labor Force Participation Rate, and Gross Fixed Capital Formation into the regression model, the trend demonstrated from the first equation continues to dominate. Even though this negative trend continues in the Treat x Post variable, the regression differences relative to the control are minimized. The second equation from table 4, specifically indicates that El Salvador's log GDP decreased 1.67% relative to the control. Although other variables in the regression experience statistically significant results, the coefficient in the Treat x Post variable could still be explainable by chance.

The application of the fixed effects model in the regression aims to remove the omitted variable bias that is influencing the model. Controlling for country fixed effects enable us to remove any cross variation between the treatment and control groups within the regression. Whereas, timed fixed effects allow us to control for any cross variation between datapoints over time. The combination of these two fixed effects accurately isolate the effect of Bitcoin adoption on El Salvador's GDP. The third equation in table four applies time fixed effects for every year within the regression, allowing us to control for differences in year-to-year variation within the dataset. This regression explains that El Salvador's log GDP decreased by 1.6% relative to the control countries. Even though we use country and time fixed effects to control for variation within the model, equation 3 does not reach statistical

significance to provide us with an accurate answer to the research question. This might be due to the small amount of datapoints that can be included in the treat x post period. When implementing yearly fixed effects the five data points in the treat x post period can only draw a limited number of comparisons from year-to-year. This effectively does not allow the model to gain statistical significance for the treat x post variable, explaining how chance is still able to influence the model.

To account for this factor within the model we implemented the use of quarter fixed effects. This allows us to control for more variation between datapoints and maximizes the comparisons that can be made due to the limited data in the treat x post period. Instead of controlling for variation across years, we can control for variation across every quarter to draw more accurate comparisons within the dataset. This adjustment is represented by the fourth equation, which indicates that El Salvador's log GDP decreased by 2.2% relative to the control after the adoption of Bitcoin as a legal tender. This equation also demonstrates a statistical significance to the .05 level, meaning there is only a 5 percent chance that El Salvador's decrease in log GDP is explainable by chance. Adjusting to quarter fixed effects, allowed us to mathematically determine that the adoption of Bitcoin in El Salvador had a negative effect on log GDP in El Salvador.

## Discussion

The results from the regressions align with the negative prediction made previously in the paper about the effect that Bitcoin adoption would have on El Salvador's GDP. The various regressions that were run all point to the same conclusion, and therefore leave us to theorize about the various factors that could have driven this negative difference in El Salvador's GDP relative to the control countries.

Initially, I want to acknowledge that there are some limitations to the assertions that are to come in this section of the paper. Since Bitcoin was only legally adopted in El Salvador's financial system on the September 7<sup>th</sup>, 2021, we will only be able to analyze the short-run effects of Bitcoin adoption. This effectively limits our theory to the short-run and does not enable us to make accurate assertions about the long-run since the data is not available yet. Additionally, the 2.2% decrease in El Salvador's log GDP determined from the regression only explains the difference in log GDP relative to the control group and does not allow us to mathematically explain the reasons behind this effect. However, we can use underlying theory and relative literature to try and understand the determinants behind the negative effect that Bitcoin adoption had on El Salvador's GDP, and what this could mean for cryptocurrencies in the future of our financial systems.

Using theory to understand the reasoning behind this decrease in log GDP, this paper wanted to focus specifically on the factors known about Bitcoin adoption from related literature to theorize why this negative impact on GDP exists. Initially, this paper focuses on the devaluation of the Bitcoin currency since adoption. After reaching an all-time high at around 69,000 USD bitcoin decreased to a current bear market low of 15,000 USD. This decline in the value of the currency had a dramatic effect on the incentive that was given out during adoption. Millions of Salvadoreans accepted a 30\$ incentive, whose value was reduced



by 65% due to the devaluation of the currency<sup>7</sup>. This decline in the purchasing power of the incentive due to bitcoin's extreme volatility deterred its use as a means of payment in El Salvador. This intense volatility would have effectively led to a reduction in the return of the incentive given out by the government. With people not using bitcoin to make purchases the money spent on the incentive did not reflect the money returned to the economy through GDP. Additionally, most Salvadorians decided to convert their incentive to cash because it did not experience bitcoin's volatility and allowed them to maximize their benefit from the incentive. Due to these facts, we can theorize that a factor contributing to the reduction in GDP is that the government spending on bitcoin exceeded the return of the currency, effectively leading to a decrease in GDP in the short-run.

This theory reflects the fact that Salvadorians do not want to use bitcoin as a currency because they don't benefit as much from using the bitcoin in comparison to the domestic currency of the US dollar. By analyzing the Chivo app this paper gains insights into the uses Salvadorians have for bitcoin and allows us to understand the currency preference to conduct purchases with businesses. A study by conducted by the NBER analyzed the use of Bitcoin as a medium of exchange by calculating the elasticity of substitution between bitcoin and other means of payments, when purchasing gasoline. The study found that the "magnitude of the elasticity between Chivo Wallet and other payment methods is larger than the elasticity of substitution between cash and cards" (Fernando Alvarez, 2022). This reveals that Salvadorians prefer to use other forms of payment before using Bitcoin to conduct gasoline purchases. If Salvadorians are unwilling to conduct transactions using Bitcoin, the stimulus given out by the government will not be put back into the economic system of El Salvador.

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<sup>7</sup> El Salvador bought bitcoin at an average price of \$43,357 (JHA,2022) . Therefore, at its bear market low (\$15,000) the bitcoin owned by the government (including the \$30 incentive) saw around a 65% drop in value.

Instead, the stimulus in short-run analysis will be accounted for as an increase in government spending, where the returns to the government are minimized because of the unwillingness of Salvadoreans to conduct purchases with bitcoin. This effectively decreased the value of all the final goods and services purchased by Salvadoreans in their economy, decreasing El Salvador's GDP by 2.2% as reflected in the regression results.

## Conclusion

The results from the regression explain that President Nayib Bukele's bitcoin gamble is not paying off for El Salvador. Even though citizens might have benefitted from the \$30 incentive that was given out, the bitcoin policy did not benefit the country. The losses incurred from bitcoin adoption will affect future policies and the well-being of Salvadoreans in the future. With less money available to improve factors such as education, infrastructure, and crime, citizens are worse off in the short-term. Even though the long-term effects are still unknown, there is still a chance Salvadoreans could benefit in the future. This would be because of an increase in the valuation of the currency could lead to an increase in the purchasing power of Salvadoreans. This could potentially increase the use of the bitcoin currency as Salvadorians would gain more from using their incentive given to them by the government<sup>8</sup>. This could effectively boost GDP in the long-run as more money would be returned than was originally spent. The money gained from an increase in bitcoins value could allow El Salvador and its citizens to invest into better technologies and increase the capital of Salvadoreans. This effectively could increase production capabilities of El Salvador, allowing Salvadorean business to incur more profits in the long-run to increase GDP. However, these assumptions about the long-run are only theory until proven mathematically in the future.

Lastly, the result from the regression provides other countries with information about the potential effects of Bitcoin within their own financial system. In the short term they might not necessarily see benefit, but the effects of the long run effects are still unknown. This research will allow nations to understand the struggles associated with the adoption of the bitcoin currency and provides insights into the viability of cryptocurrencies as a legal tender.

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<sup>8</sup> Around 20% of Salvadoreans who downloaded the Chivo Wallet still have not used their incentive.

Understanding the effects of bitcoin adoption could allow nations to implement new strategies to improve the system seen in El Salvador. The adoption of bitcoin in El Salvador is a potential steppingstone to the implementation of cryptocurrencies within financial systems in the future. This could present an opportunity for other cryptocurrencies that are better suited to handle the daily transactions of a domestic currency. Other cryptocurrencies offer improved solutions to issues associated with the bitcoin currency and could be more beneficial to be used within regulated financial systems. However, these cryptocurrencies will have to win public trust and outcompete the domestic currencies to potentially be a part of the international financial system in the future.

## References

- [1] Alvarez, F., Argente, D., & Van Patten, D. (2022, April 27). *Are cryptocurrencies currencies? bitcoin as legal tender in El Salvador*. SSRN. Retrieved April 3, 2023, from [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=4094160](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4094160)
- [2] *Banco Central de Honduras - Gobierno de la República de Honduras*. Banco Central de Honduras Inicio. (n.d.). Retrieved April 3, 2023, from <https://www.bch.hn/>
- [3] Banco Central de Reserva del Perú. (n.d.). Retrieved April 3, 2023, from <https://www.bcrp.gob.pe/>
- [4] Banco Central de Reserva. (n.d.). Retrieved April 3, 2023, from <https://www.bcr.gob.sv/>
- [5] *Banco Central do Brasil*. Banco Central do Brasil. (n.d.). Retrieved April 3, 2023, from <https://www.bcb.gov.br/>
- [6] *Bank of Canada*. (n.d.). Retrieved April 3, 2023, from <https://www.bankofcanada.ca/wp-content/uploads/2019/09/swp2019-40.pdf>
- [7] *BCE*. Banco Central del Ecuador. (n.d.). Retrieved April 3, 2023, from <https://www.bce.fin.ec/>
- [8] Bureau, U. S. C. (2021, October 8). *Seasonal adjustment questions and answers*. Census.gov. Retrieved April 3, 2023, from <https://www.census.gov/data/software/x13as/seasonal-adjustment-questions-answers.html#Q2>
- [9] Difference in difference. (n.d.). Retrieved April 3, 2023, from <https://ds4ps.org/PROG-EVAL-III/DiffInDiff.html#:~:text=It%20represents%20how%20much%20the,the%20treatment%20had%20no%20effect.>
- [10] Federal Reserve Bank of Dallas. (n.d.). Retrieved April 3, 2023, from <https://www.dallasfed.org/research/basics/seasonally>
- [11] G, M. F. G. (n.d.). *Principales indicadores*. BCCR. Retrieved April 3, 2023, from <https://www.bccr.fi.cr/SitePages/Inicio.aspx>
- [12] *IMF data home page - IMF Data*. (n.d.). Retrieved April 3, 2023, from <https://data.imf.org/>
- [13] *'the IMF is evil': Rich countries take aim at nations adopting crypto*. POLITICO. (n.d.). Retrieved April 3, 2023, from <https://www.politico.com/news/2022/06/13/imf-rich-countries-adopting-crypto-00038975>

- [14] Inicio - Banco Central de Chile. (n.d.). Retrieved April 3, 2023, from <https://www.bcentral.cl/inicio>
- [15] *Inicio | Banco de la República*. (n.d.). Retrieved April 3, 2023, from <https://www.banrep.gov.co/es>
- [16] Jha, P. (2022, November 17). *Nayib Bukele announces Bitcoin Prescription for El Salvador: 1 BTC A day*. Cointelegraph. Retrieved April 3, 2023, from <https://cointelegraph.com/news/nayib-bukele-announces-bitcoin-prescription-for-el-salvador-1-btc-a-day>
- [17] *Live stock, index, futures, forex and bitcoin charts on TradingView*. TradingView. (n.d.). Retrieved April 3, 2023, from <https://www.tradingview.com/chart/>
- [18] Makarov, I., & Schoar, A. (2021, October 25). *Blockchain analysis of the Bitcoin market*. NBER. Retrieved April 3, 2023, from <https://www.nber.org/papers/w29396>
- [19] Nikolopoulou, K. (2023, March 16). *What is omitted variable bias?: Definition & examples*. Scribbr. Retrieved April 3, 2023, from <https://www.scribbr.com/research-bias/omitted-variable-bias/#:~:text=Omitted%20variable%20bias%20occurs%20when,important%20factor%20in%20your%20analysis.>
- [20] *PDXScholar: The Institutional Repository of Portland State University*. Site. (n.d.). Retrieved April 3, 2023, from <https://pdxscholar.library.pdx.edu/>
- [21] Sigalos, M. K. (2022, June 25). *El Salvador's \$425 million Bitcoin experiment isn't saving the country's finances*. CNBC. Retrieved April 3, 2023, from <https://www.cnbc.com/2022/06/25/el-salvador-bitcoin-experiment-not-saving-countrys-finances.html#:~:text=The%20government%20has%20an%20unrealized,%24374%20million%2C%20according%20to%20estimates.>
- [22] Thebault, R., & Villegas, P. (2021, June 7). *El Salvador's president wants to make country world's first to use Bitcoin as legal tender*. The Washington Post. Retrieved April 3, 2023, from <https://www.washingtonpost.com/world/2021/06/06/bitcoin-el-salvador/>
- [23] Utomo, G. O. T. (n.d.). *The influences of cryptocurrency on economic growth: Case study of bitcoin in 5 Asian countries 2011-2016 period*. Jurnal Ilmiah Mahasiswa FEB. Retrieved April 3, 2023, from <https://jimfeb.ub.ac.id/index.php/jimfeb/article/view/4707>
- [24] *Www.bcp.gov.py*. (n.d.). *Banco Central del Paraguay*. BCP. Retrieved April 3, 2023, from <https://www.bcp.gov.py/>