

Causal Study Design:  
A Synthetic Control Approach to Evaluating Bangladesh's  
Remittance Incentive Program

A Thesis  
by  
Ethan Lobdell

MASTER OF SCIENCE IN DECISION ANALYSIS

Chair of Committee, Alexis Diamond, PhD  
Cochair of Committee, Biru Paksha Paul, PhD  
Head of Minerva Graduate Program, Casey Saengar, PhD

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# Causal Study Design: A Synthetic Control Approach to Evaluating Bangladesh's Remittance Incentive Program

Ethan Lobdell<sup>1</sup>

## Abstract

This paper designs a causal study to explore Bangladesh's 2% remittance incentive program on formal channel remittances. Globally, remittances are the most significant mechanism of foreign financial inflows with an estimated \$550 billion sent annually. Globally, remittances surpass international development aid by three-fold and marginally outperform foreign direct investment as the primary form of foreign financing. There is clear empirical support for the impact remittances have on elevating individuals out of poverty. With an approximately 25% poverty rate in Bangladesh, the opportunity to amplify remittances that specifically target Bangladesh's poor is a compelling opportunity. The 2% incentive program is a 53% reduction in the average 3.75% transaction fee that most Bangladeshi foreign nationals pay to remit. This could translate to anywhere between a 13% and 85% increase in overall remittances - with the higher outcome nearly doubling overall remittance inflows. Through the use of the synthetic control method, this paper has designed a comparative case study to establish the initial phases in evaluating the causal effect Bangladesh's remittance incentive policy has on overall remittances compared to a synthetic control unit. The result of this paper was an empirical model that closely balanced key covariates, matched synthetic remittances with real remittances during the pre-treatment period, and tested the robustness of the model against control unit bias, covariate bias, and unmeasured covariate impacts. The strength of this paper is in its ability to maintain blindness to outcomes thereby preserving one of the most important causal comparative studies principles.

**Keywords:** Remittances, Bangladesh, Synthetic Control Method, Incentives, Transaction Costs, Study Design, Migration

**JEL Classification:** F24, C15, E42

**Abstract**

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<sup>1</sup> Minerva Graduate School. For all inquiries, please contact lead author: [ethan.lobdell@minerva.kgi.edu](mailto:ethan.lobdell@minerva.kgi.edu)

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## **1.0 Introduction**

In recent decades, Bangladesh’s economy has drawn significant attention in economic and political arenas due to its rapid growth and development. Remittances play a key role in facilitating imports, balancing foreign currency reserves, and ultimately managing a healthy balance of payments. The central bank’s unique 2% incentive program is the first program to

utilize central bank support through formal remittance channels to incentivize increased remittances. There hasn't been any rigorous study on the impact of this incentive program and this paper attempts to fill that gap.

Remittances are defined as sums of money, typically sent across national borders, to individuals or businesses. They are often sent by individual migrants who have either temporarily or permanently left their home nation in pursuit of higher paying wages and send some portion of those wages back to their families in predominantly low to middle income countries.

Globally, in 2019, it is estimated that over 270 million migrants work outside of their native countries. Those estimated 270 million migrants participate in one of the largest financial mechanisms used to transfer funds across international borders. In 2019, remittances were expected to reach USD 550 billion, becoming the largest source of external financing for low to middle income nations (World Bank, 2019). Low to middle income countries will have received over three times as many remittances compared to what they receive in total international development aid (both grants and loans) and will surpass foreign direct investment by over USD 100 million (Barne & Pirlea, 2019).

Between 2012 and 2017, Bangladeshi remittances as a percent of GDP dropped from 10.5% to 5.4% (World Bank, 2021). A 50% decrease in remittances as a percent of GDP during Bangladesh's transition from a low-income country to a middle-income country is a noteworthy change. Second, in 2019, Bangladesh identified a 1.9% account balance deficit. Both of these negative economic trends contributed to Bangladesh's central bank implementing a 2% incentive (Central Bank of Bangladesh, 2019). In July 2019, the remittance incentive program began, which effectively reduced the transaction cost associated with remitting. Over the last five years, Bangladesh's average remittance fee was approximately 3.75%. This 2% rate cut would result in a 53% reduction in overall fees.

The true effect of Bangladesh's remittance incentive program is currently unclear and won't be until 2025. This paper employs the synthetic control method to carefully design an observational study that is blind to remittance outcomes. The ability to maintain blindness to outcomes preserves the integrity of any potential inferences derived from analysis (Rubin, 2008).

The synthetic control method (Abadie and Gardeazabal, 2003; Abadie et al., 2010; Abadie et al., 2015) was created in 2003 to provide a novel technique for determining causal inference for complex policy actions. As Athey & Imbens (2017) argue, this is the most important innovation in the policy evaluation literature in the last fifteen years. The synthetic control method better incorporates uncertainty about the appropriateness of control units used to compare against the treatment unit. In a social sciences comparative case study, the outcomes of interest of a unit affected by a particular policy are compared against the same outcomes for a control group that did not experience the policy of interest. With our single aggregate unit (Bangladesh) it can be difficult to find an appropriate single unit to compare with given the diversity of macro variables that could conceivably impact the outcome of interest. As such multiple units are averaged in traditional comparison techniques. Averaging often lacks the ability to closely match the treatment and control units predictors values and is hence limited in its accuracy. The synthetic control method was designed to improve matching, minimize bias, and elevate transparency around control unit selection in service of closely replicating the outcome trajectory of the treatment unit under a condition of non-treatment.

This paper has designed a synthetic control study to evaluate the impact of Bangladesh's remittance incentive policy. It is hypothesized that a 2% reduction in the average 3.75% remittance fee will increase remittances by 13% and 85%. Initial indications of running the synthetic control method over the pre-treatment period and conducting placebo and bias checks demonstrate strong model alignment between actual Bangladesh and its synthetic counterpart. Thus providing confidence in the model's ability to accurately demonstrate the causal effect of Bangladesh's incentive policy in 2025.

This paper is divided into seven sections. The first section is the introduction, the second section is the literature review. Section 3 outlines the theory associated with transaction costs and the hypothesized effect of Bangladesh' policy. Section 4 presents the research design. Section 5 presents the current results including robustness tests using placebo's, Section 6 presents the discussion and Section 7 presents the conclusion.

## **2.0 Literature Review**

Remittances literature is extensive and the papers on Bangladesh are impressive. Yet, despite an impressive body of work examining the factors that determine remittances and the impact of remittances, the lack of literature on the effect of remittance policy incentives is

distinct. And while the primary focus of this paper is to explore the impact of Bangladesh's remittance incentive policy, the motivations to remit and impact of remittances are important contexts to be explored.

There are fewer than five academic papers that use the synthetic control method (SCM) to determine a causal relationship between events and remittance outcomes. In 2014, a paper studying the impact of the 2004 Indian tsunami used SCM to evaluate the effect on remittances as a percentage of GDP (Mitrut, 2014). In 2019, Best & Burke looked at the impact on macroeconomic outcomes from the 2010 Haiti earthquake and assessed remittances as one of those outcomes. And lastly, in 2014 remittances were utilized as a sub-factor in a study of migration as a determinant in evaluating food security (Bedin, 2014).

As of December 2020, Bangladesh was the first with Pakistan being only the second country to implement a remittance incentive program (PRI, 2020). Remittance incentive policies appear to be gaining favor in south Asia without robust empirical evidence of their efficacy.

## **2.1 Remittances Impact on Economic Output:**

Two areas are of primary interest when it comes to the effect remittances have on the recipient nations; the alleviation of poverty and the long-term effect on the economy. While this paper doesn't directly study the impact within those domains, the results of this paper have the potential to amplify the effects shown by other papers.

On the surface it would appear that transferring capital from developed nations to developing nations would necessarily benefit recipients and the nation, but upon deeper investigation, some impacts are well supported while others are not.

In 2018, Bangladesh's foreign direct investment (FDI) was \$2.4 billion, its international development aid (ODA) was \$3 billion, and its remittances were \$15.6 billion, three times as large as FDI and ODA combined (WorldBank, 2020). While Bangladesh's remittances as a percentage of GDP have dropped from 10.5% in 2012 to 5.4% in 2019, it is still assumed that remittances play a significant role in economic development. One of the key questions in the literature is how Bangladesh's economy would have fared without those remittances and are there any signs of development enhancement associated with those investments? Benmamoun and Lehnert (2013) found that Foreign Direct Investment, International Development Aid, and remittances are all positive and significantly correlated with low-income countries' economic

growth. But Barajas et al. (2009) concluded that at best the long-term economic impact of remittances have no impact on the economic growth of the recipient nation. Their conclusion found that typically remittances are used as a social safety net to purchase basic necessities and are less frequently used to invest in businesses or the economy in more structural ways. Lending further support that remittances don't have a causal effect on Bangladesh's economic output, through the autoregressive distributive lag method, Paul, et al. (2011) found the contrary - that economic output instead had a causal impact on inbound remittances. They concluded this was counter to the prevailing belief in causal directionality between economic output and remittances. They hypothesized that investment opportunities emerging out of a Bangladesh economy that is successful enough to be exporting and is hence worthy of the risk and cost to remit and invest. Further supporting the directionality of that conclusion, Sobiech (2019) generally agrees that the evidence is inconclusive regarding the economic impact of remittances, she clarifies that for nations with more developed financial sectors, the evidence suggests there is less of an economic effect. The causal reasons for why a lack of an effect exists, are weakly supported by the literature. It is suggested that methodological weaknesses such as changes in measurement and poor causal statistical tools contribute to this lack of understanding. Through the confounder lens, the lost opportunity cost to a nation's GDP when skilled workers emigrate from the country appear to counteract any potential positive effects on the long-term growth of an economy in response to remittances (Clemens & McKenzie, 2018). To clarify, migration is strongly correlated with increased remittances as the volume of remittance inflows naturally increase with more migrants. But typically those migrants represent some of the healthiest and most skilled workers of their nation. As such, those individuals are no longer participating in the home nation workforce where they could be contributing to the overall economic health. Instead their value is replaced by remittances that more often than not serve the purpose of injecting resources into the basic needs sector as opposed to economic infrastructure. Hence the mixed economic effect associated with migration. Specific to Bangladesh it was observed through regression analysis that remittances led to a decrease in economic activity, attributed to high skilled worker migration, poor investment in infrastructure and production, and disincentives for individuals to increase economic output and a disincentive for institutions to remedy infrastructure weakness due to the subsidizing effect of remittances (Sutradhar, 2020). And while the inferences and associations revealed in this regression analysis are sound statistical findings,

regression analysis does not necessarily support a causal relationship between remittances and decreased economic activity.

Lastly, Barai (2012) did conclude positive economic effects were associated with remittances to Bangladesh but the domains of those impacts were limited to the social insurance sectors like nutrition, living conditions, housing, education, health care, poverty reduction, social security, and investment activities of the recipient households. And while the long-term economic effect of remittances is under debate and contextually sensitive to make conclusions inaccurate, less so are the conclusions regarding the ability of remittances to alleviate poverty.

## **2.2 Remittances Impact on Poverty:**

An empirical study evaluating the effect of remittances between 1990 and 2014 years across 39 countries found statistically significant support for remittances alleviating poverty (Azam et al., 2016). More specifically, a seminal paper by Adams & Page concluded that a 10% increase in formal remittances resulted in a 3.5% decrease in per capita poverty rate using the instrumental variable strategy (Adams & Page, 2005). They also concluded that reducing transaction costs associated with remittances would be an important tool in reducing poverty.

From a different angle, a separate paper, using a binary logistic model concluded that the probability of a poor Bangladeshi household moving out of poverty is 28% higher if that household receives remittances (Kumar, 2019). Serino & Kim (2011) further clarified that the poverty alleviating effects of remittances were most pronounced in the lowest quantiles of poor families. Indicating that remittances are beneficial towards both the poorest nations and the poorest individuals. Lending further support of the effect remittances have on Bangladesh are the findings that remittances lead to smaller poverty propensity scores both for urban and rural households; with urban households being 11% less likely to be poor if they receive remittances and rural households being 16% less likely to be poor (Rahman & Moni, 2019).

Based upon the above research, remittances have been shown to have a statistically significant effect on reducing poverty. Their ability to improve a nation's macroeconomy conditions are supported if the particular uses of remittances are to invest in production and infrastructure. As such if a nation seeks to reduce poverty and perhaps increase macroeconomic output then increasing remittances through formal channels seems to be a worthy goal given the aforementioned literature.

## 2.3 Determinants of Remittances:

Determining what factors are likely to increase remittance is necessary to determine which policy actions are most likely to contribute to an increase in remittances. Breaking up the remittance determinants into macroeconomic determinants and microeconomic determinants focuses policy maker resources towards different theoretical frameworks, actors and actions.

From the microeconomic perspective, in 1985, Lucas and Stark wrote a seminal paper outlining some of the core theoretical tenets of why individuals send money home. They found that there are two primary motivations - altruism and self-interest. Altruism being the desire to improve the conditions of others and self-interest being the desire to improve one's own condition. Briefly put, Lucas & Stark determined that those two primary motivations to remit are not mutually exclusive. Effectively remittances serve as a mutual benefit to both the remitters and their recipient families. Lucas and Stark concluded that the mutual benefits of sending family members away from home serves the purpose of mitigating financial risk through a diversified collective effort. A more recent look at these dynamics as they pertain to Bangladesh, revealed three factors: altruism, investment, and kinship affect remitters behavior (Kazi, 2015). Kazi breaks down self-interest into the personal gains associated with investment, maintaining kinship with the remitter's family, and serving their families through adverse times. The remitter looks to optimize their utility across those three factors.

The above microeconomic conditions are critical to understanding determinants of remittance and the nuances that drive individual decisions that ultimately aggregate into macroeconomic conditions. But this paper is focused on the macroeconomic conditions that determine changes in remittances. The belief being, that macroeconomic indicators can serve both as proxy observations for the microeconomic conditions that drive remitters behavior and fundamental determinants themselves. Secondly, the synthetic control method is particularly well suited to using macroeconomic data and macroeconomic data is often readily and easily accessible to researchers.

As previously stated, foreign direct investment and international development aid are financial mechanisms commonly used to serve the outcomes of poverty alleviation and economic growth. The empirical evidence supports the idea that as FDI increases, so too does remittance (Piteli et al., 2021). An econometric analysis in 2006 showed that very few macroeconomic factors had explanatory power over global remittances with the exception being determinants

that indicate economic activity from the remitter source countries and that periods of negative agricultural growth in the home country also led to increased remittances (Gupta, 2006). Contrary to that, empirical findings by Abbas et al. (2017), using the generalized moment method (GMM), found government debt and inflation had negative effects on remittances with the hypothesis being that debt and inflation can be attributed to instability and hence a risky investment for the remitter. And while their findings are compelling the GMM is more valuable for inference or estimation of future potential effects as opposed to evaluating true causality. Migration has a positive effect on remittances which the literature supports (Clemens & McKenzie, 2018). Lastly, the literature supports the effect migrant stock, exchange rate stability and financial development have on increasing remittances (Ahmed et al., 2020). Greater detail into the selection of macroeconomic determinants will be discussed in the methods and results section.

There are clearly microeconomic and macroeconomic determinants that drive a migrant's frequency and volume of remittances back to their home country and home family. Having established a baseline understanding of those various determinants that influence the behavior of an individual actor, the next question this paper seeks to better understand is the role transaction costs have in mitigating those remittances. The distinction this paper makes between the effect of macroeconomic determinants and transaction costs is that transaction costs are a factor that financial and political institutions have the ability to actively manage and set policy around; as opposed to something like inflation. Certainly, banks and governments can influence and set policy around inflation but those are one of many factors that influence inflation rates.

## **2.4 Transaction costs and Remittances:**

A migrant who chooses to send money back to their family typically has two primary channels, the informal and formal. The formal channel is through financial institutions (banks, post offices, money transfer offices, etc.) where the remittances are monitored and require a known and variable transaction fee. The other is informal channels, in the case of Bangladesh, the 'hundi', where migrants pass funds through in-person intermediaries and sometimes hidden agents to their families. And while informal channels are riskier than formal channels, the challenges of recipient literacy and banking inefficiencies has led many Bangladeshi migrants to historically prefer informal channels over formal ones (Ullah et al., 2007). And while that balance is perhaps still mostly intact, travel restrictions in place during the last 14 months and

most likely moving forward coupled with the continued increase in banking competition and technological capabilities, the practicality of informal remittance channels was constrained and the use of formal and recorded channels were externally and internally incentivized. So while formal remittances may show a dramatic increase, overall remittances may have stayed the same simply due to a rebalancing of the transfer platforms (Dinarte et al., 2021).

Informal channels are often risky and expensive and so there is a political and financial incentive for developing nations to formalize remittance transactions. A counterfactual study of 66 mostly developing countries between 1980 and 2005 found that higher remittances was significantly correlated with financial openness (Beine et al., 2012). Nations are motivated to open up their financial systems to further incentive formalized remittances channels. As countries seek to drive down transaction costs, financial openness creates a more competitive marketplace. If remittance corridors between two nations have greater competition, then the price to remit has been shown to lower and as such, the overall number of migrants and remittances increases and hence transaction cost lower due to economies of scale and a need to maintain competitive advantages (Beck, & Martínez, 2011). It has been shown that there is an inverse relationship between transaction costs and remittances. Two factors are hypothesized to create this effect: more remittances move to the formal channels and are hence recorded, and two overall volumes actually increase (Kakhkharov et al., 2017). Either outcome is favorable from the perspective of the recipient nation as both create more stable economic conditions that lead to greater inflows. These findings were further corroborated by a study conducted in New Zealand where remittance fees can be greater than 15% (Gibson et al., 2019). The literature confirms what appears to be an obvious conclusion: that if remittance transaction costs decrease, then the net contribution to the recipient nation will increase. But more interestingly so too does the volume of remittances increase and the use of formal channels increase. These last two points highlight the enhanced effects associated with reduced transaction costs. This is an important point as Bangladesh's incentive program requires an investment by the government and central bank to fund that incentive. As such, their goal would be to produce a return that is greater than that investment. Ultimately, there are two possible ways that transaction costs can be reduced. One is that the institutions that process the transactions are motivated to reduce their fees through market competition and increased transactional volume and two, central banks or national

governments create incentive programs that result in reducing the transaction cost. This paper looks at the latter.

Globally, on average, the cost of sending remittances has remained relatively stable at a rate of around 7% in the first quarter of 2019 (World Bank, 2019). The United Nations has established a goal of reducing the cost of remittances down to around 3% by 2030. South Asia typically has the lowest remittances rates at around 5.2% (Ratha et al., 2018), with Bangladesh averaging 3.75% transaction costs over the last five years (Remittance Prices Worldwide, 2020). Single percentage point decreases in remittance fees are comparatively significant and given that it has been shown that for every 1% decrease in real transactional costs can lead to between 0.25% and 1.6% increase in overall remittances (Ahmed, Mughal & Martínez-Zarzoso, 2020) the enhanced or scaling effects of reducing transaction costs is significant. Stated from a different direction but with the same result, Ahmed & Martínez-Zarzoso (2015) found that high remittance costs will have a significant and negative effect on remittance sent through both informal and formal channels.

The current literature explores the approach of reducing transaction costs through competition and market-based policies to create greater financial openness, competition, or opportunity to drive down the cost of transactions. The current gap in the literature exists around central banks or national governments implementing policies which incentivize migrants to send remittances home. An incentive program effectively serves the same purpose as a reduction in transactional costs but occurs on the back-end, the user pays less in transaction fee and the institution processing the transaction is compensated by the central bank. There is no literature this author could find on either Bangladesh's specific incentive program nor on central bank incentive programs designed to reduce remittance fees.

The literature clearly demonstrates that remittances have significant leverage and potential import to both national and individual economic outcomes. The varied determinants of remittances are often difficult to control except for the transactional costs associated with those transfers. The literature strongly support the idea that reduced transaction costs will have positive effects on the overall amount of remittances transferred, but as the previous section states, the lack of literary support for an incentive program is clear and this paper's goal of using Bangladesh's remittance incentive program will help fill that gap in our understanding of both transactional costs and the specific causal effect of incentive programs.

## **2.5 Covid-19 Impact on Remittances:**

In March of 2020, the Covid-19 outbreak was declared a global pandemic by the World Health Organization. The lock-downs, travel restrictions, and impact on nearly all facets of life had a definitive impact on migration, employment and invariably remittances. The World Bank projects that remittances will decline globally by 14% by the end of 2020 compared to pre-Covid levels in 2019. In April of 2020, Bangladesh's remittances dropped by 25% but cumulatively and surprisingly, over the second and third quarters of 2020, Bangladesh showed a year on year 53% increase in remittance growth. This growth is hypothesized to be a result of cancelled pilgrimages to Mecca with subsequent savings being reinvested back into Bangladesh as remittances, a dramatic in-country demand for support due to massive flooding, and the shift of remittance transfer channels from informal to formal channels due to travel restrictions. On this last point, the question of whether real remittances actually increased or simply moved to monitored channels is currently unknown. The yearly projections for 2020 remittances expect Bangladesh's inflows to grow by 8%. Lastly, the number of migrants was projected to drop from around 700,000 to 180,000 (Ratha et al, 2020). Covid-19 clearly has had and will continue to have a significant effect on migration, employment, and remittances. How this factor will unfold with regards to this study is still an open question.

## **3.0 Theory & Hypothesis**

### **3.1 Remitter and Transaction Fee Theory:**

Two primary theories drive the argument for this paper. The first provides a framework for why individuals send remittances home and the second is the rationale for why an incentive program or a transaction cost reduction policy would lead to increased overall remittances.

The dominant theory of individual remitters behavior is that altruism and self-interest drive decision-making as it pertains to remittance behavior (Lucas & Stark, 1985). The normative theory of rational choice posits that an individual seeks to maximize their expected utility. Through remittances, that maximum expected utility could be manifest through both motivations as defined above by Lucas and Stark. From the self-interested perspective, if an individual seeks to maximize their inheritance through economic investments or other tangible financial gains associated with remittances, their utility is maximized when more assets can be

invested. Reducing the transactional cost associated with remitting behavior serves the purpose of maximizing the expected utility of a self-interested remitter.

From the altruistic perspective, a remitter similarly derives greater expected utility if their remittances translate to greater impact for their family, friends, and community. Again, reducing the transaction cost associated with remittances would translate to increased impact for the recipients and an increased utility for a remitter. Thereby providing a reasonable argument for how a decrease in remittance transaction costs will incentivize a remitter who acts from the theoretical lens of a self-interested or altruistic individual and conceivably an individual who embodies some combination of both motivations.

Second is the theory of how transactional costs influence behavior. In this context, transaction cost economics pertains to actors trading as or with an institution. And while this theory is more typically applied to businesses and institutions, conceiving of the collective of remitting individuals in aggregate that interfaces with the banking institutions allows aspects of the theory to guide our understanding of how transactional costs can influence remitter behavior collectively. Of relevance here are the determinants of frequency, rationality, and opportunistic behavior in driving the transactional costs associated with remittances. Individuals and institutions seek to act rationally and opportunistically as often as possible when it pertains to financial transactions. It seems to logically follow that a remitter would increase their remittances if the transactional cost associated with their trade behavior was reduced. Empirically this idea has been supported where it was observed that a reduction in transaction costs did lead to an increase in remittances (Schiopu & Siegfried, 2006).

### **3.2 Hypothesis:**

A 2% reduction in the average 3.75% Bangladesh remittance fee represents a 53% reduction in fees. Whereas, Ahmed, et al. (2020) concluded that for every 1% decrease in remittance fees a subsequent increase in remittances of between 0.25% and 1.6% can be expected, this paper hypothesizes that Bangladesh's 53% reduction in remittance fees will increase remittances by between 13% and 85%.

Alternatively, the incentive program could have no systemic effect on the annual difference in remittances between real Bangladesh and synthetic control Bangladesh over the five year period post treatment.

## **4.0 Research Design & Data Issues:**

### **4.1 Data Collection & Issues:**

The data used to create our model was collected from the World Bank Data Bank between the years of 2005 and 2019. We selected 15 years of data prior to the 2019 policy onset to provide ample (>10years) data necessary to develop an accurate synthetic control unit. In looking at monthly versus yearly data, the fact that the policy was implemented in July of 2019 there was over six months of post policy data that could have conceivably been utilized on a monthly basis. The challenge was in finding monthly data for all of the donor countries and finding monthly data for the predictors used to construct and balance the treatment and control units.

### **4.2 Synthetic Control Method:**

Given the limited precedence for studying the causal effect of incentive programs to increase remittances, this paper relies upon one of the most widely held best practices in determining causal inference within the social sciences - the synthetic control method.

Guido Imbens and Susan Athey (2017) argue that the synthetic control method is “*the most important innovation in the policy evaluation literature in the last 15 years*”. The real remittance outcomes post incentive policy - our treatment data will be definitively known, but the challenge lies in determining the counterfactual case of real remittance data, had Bangladesh not implemented an incentive policy. In the biological sciences, overcoming the theoretical impossibility of a single unit experiencing both treatment and control conditions is accomplished by studying hundreds or thousands of units with a balanced distribution of predictors spread between the control and treatment units. The challenge in the social sciences in replicating that statistical technique for causal inference in Bangladesh is the fact that the incentive is a novel treatment with only one unit experiencing that treatment. To bypass traditional difference-in-difference techniques used in the biological sciences, the synthetic control method was designed to generate a synthetic counterfactual condition that represents a control unit’s outcome in the absence of the treatment under investigation (Abadie and Gardeazabal, 2003; Abadie, et al., 2010; Abadie, et al., 2015).

The synthetic control method accomplishes the above comparison through a process of weighting and selecting a convex hull of covariates believed to influence the outcome of interest, in this case, remittances. Within that hull exists the treatment unit with its values for all input parameters and outcome values, at each year under study. An optimization algorithm then seeks to weight the control units from a donor pool to generate a single synthetic control unit that attempts to match the treatment unit as closely as possible for each year under the model generation period. Once those control unit weights are established, the synthetic control unit is then used to evaluate the treatment effect, by generating the counterfactual history of the treated unit had the policy not been implemented. We establish confidence in the model during the pre-treatment period where the synthetic control unit is optimized to closely approximate the treatment unit. The synthetic unit is then set “free” into the wild of the post-treatment period to model the outcome of interest had the treated unit not undergone the policy. In the results section below, greater detail on this technique will be explained, including the placebo testing and robustness checks to demonstrate the confidence in the model design and minimize model bias.

### **4.3 Selection of the Synthetic Control Method as a Causal Inference Tool:**

The synthetic control method is particularly well suited to comparative case studies similar to the Bangladesh remittance incentive policy. The following list of characteristics are useful in identifying a strong use case for the application of the synthetic control method study:

- There is a unique policy or event.
- There is a clear outcome of interest.
- The units being compared are aggregate units.
- There is a donor pool of similar units that are unaffected by similar policy/events.

This paper chose to study the unique Bangladeshi remittance incentive policy because it had a clear outcome (remittances), was a unique policy (1st of its kind), countries are aggregate comparison units, and there was a strong pool of donor units whose remittances were unaffected by shocks to their remittances or those shocks were uniformly shared (Covid-19). As discussed in the literature review, only Pakistan has implemented a similar incentive policy and as such was removed from the donor pool of countries. And while the broader topic of transactional costs was frequently studied there were no examples of a national government and its central bank instituting remittance fee reduction policies. Our outcome of interest is the overall formal

remittance inflows to Bangladesh, measured in millions of US dollars. Given that the policy incentivized remittances, this was an obvious selection for an outcome of interest. Aggregate units (i.e nations, states, provinces, etc.) are important because of the small number of units used to conduct a comparative case study. Microeconomic conditions such as age or gender are assumed to be normally distributed and balanced between the treated and control units due to the use of aggregate units and effectively mitigate the potential causal effects associated with those characteristics. The selection of units to be included in the donor pool and subsequent counterfactual synthetic control unit needs to be deliberate. Finding nations whose general geographic, economic, and social conditions nearly mirror that of the treated unit will minimize the potential for other causal factors to influence the outcomes of interest. In our case, we selected countries that were of a similar size to Bangladesh, in the lower to middle income developing nation status, and whose predictor values bounded the predictor values for Bangladesh. Also important in the selection of these nations, is that they did not experience a policy intervention similar to Bangladesh's intervention nor did they experience any exogenous shocks that might have influenced their remittances outcomes. It is acknowledged that in 2020, the Covid-19 pandemic impacted all countries and clearly had an effect on employment, migration and subsequently remittances. Given that all nations included in our donor pool were affected by travel restrictions and Covid-19 responses, the uniformity of impact allows this exogenous factor to be controlled for when evaluating future results. The semi-unique impact Covid-19 had upon Bangladesh with an increase in remittances will need to be considered when evaluating post policy effects. The countries selected for the donor pool are Kenya, Mexico, India, Morocco, Cambodia, Myanmar, Nepal, Nigeria, Albania, Panama, China, Philippines, Colombia, Sri Lanka, Guatemala, Thailand, Honduras, Ukraine, Malaysia, and Vietnam. Originally Pakistan was included in the donor pool but given that Pakistan implemented a similar remittance incentive program it was removed from the donor pool.

#### **4.4 Predictors:**

There needs to be a vector of predictor values that are selected to generate the outcome of interest (remittances). In this paper our annual predictors are

- a) Log transformed Agricultural Sector as a percent of GDP
- b) Ratio of gross Primary School enrollment

- c) Log transformed Foreign Direct Investment
- d) Log transformed Direct International Aid
- e) Log transformed Migration
- f) Log transformed Gross Domestic Product Purchasing Power Parity

These annual predictors were pulled from the World Bank Online Database between 2005 and 2019. Agricultural Sector as a percentage of GDP was used as a predictor as it was found to be a macroeconomic predictor for remittances where negative agricultural growth led to greater remittances, out of increased necessity of the remittance recipients (Gupta, 2006). The ratio of gross primary school enrollment was used because of the role education plays in economic conditions, migration, and access to financial institutions. Foreign direct investment is the investment by corporations and individuals into business interests in a foreign country. This metric is structurally very similar to remittances just with different actors or purposes. It is similarly beholden to transactional costs and governmental policies and is frequently used in comparison to the effects of remittances. Direct International Aid are financial transactions between nations, NGO's, and international banking institutions designed to address social and economic challenges. There is often overlap between the outcomes sought (poverty alleviation, economic growth) by Direct International Aid, FDI, and remittances. Direct international aid has been shown to have a negative effect on remittances (Abbas et al., 2021). Migration would have an obvious effect on remittances as by definition remittances are sent by individuals who have emigrated from their home country. Gross Domestic Product Purchasing Power Parity is an indicator that represents the sum of gross in country economic production that is then adjusted based upon currency prices to normalize purchasing power between countries.

Four of the six predictors were log transformed to reflect their exponential growth. It has been shown that for predicting economic variables, log transforms can lead to greater precision in those predictions, if the log transform actually does reduce the variability within the predictor indicators (Lütkepohl & Xu, 2012). All of these predictors are used by the synthetic control optimization algorithm to weight each country within the donor pool. In principle, given the optimized donor pool weights, the synthetic control method should find near perfect balance across all of the above predictors for actual Bangladesh and synthetic Bangladesh. In practice, some deviation between these predictors always exists.

#### **4.5 Placebo Tests:**

Two credibility tests utilized within the synthetic control method are backdating (in-time placebo test) the treatment year and the placebo in space test, assigning a different country as the treatment country.

Backdating chooses a unique treatment date (typically halfway through the pre-treatment period) to test whether the synthetic control method is still able to demonstrate a tight fit between the treated Bangladesh and the synthetic control Bangladesh prior to the actual treatment data. It also allows the researcher to evaluate whether artificially setting a different treatment date still allows the model to show an estimated effect. If both pre-treatment alignment between synthetic and control are preserved and an outcome effect is shown even with a different treatment date set within the model, this lends greater credibility to the overall results and greater confidence that our synthetic Bangladesh model is resilient to changes in parameters. This test was not conducted given the lack of post-treatment data.

Second is the placebo in space test. This test omits Bangladesh from the model, iteratively sets each donor pool unit as the treatment unit and constructs a synthetic unit from the remaining units of the donor pool. This technique allows the researcher to test whether any of the countries selected for the donor pool experience a treatment effect through their isolation and comparison to their synthetic unit. Ideally, no effect size (difference between new treatment unit and its synthetic control unit) is measured for all units within the donor pool. If a significantly sized effect is established for a country within the donor pool, then the quantitative results established in the original run for Bangladesh are less credible. This is often explained by external factors that were not included in the set of predictors selected. Comparatively, we are also able to visualize each donor pool unit's estimated effect or "gap" between the control and treatment unit and compare those gaps against the gap of Bangladesh. Greater significance is placed on the overall results if Bangladesh's gap in overall remittance received is greater than the gap produced with all of the other donor pool units. If the gaps are similar, then our results are weakened and possible other causal effects could be at play or no causal effect is present.

#### **5.0 Results:**

To effectively evaluate the accuracy of our model in comparing Bangladesh and its synthetic control, we first compare the initial conditions of the two units across all of the pre-treatment predictors. Ideally, synthetic Bangladesh would closely match the predictor values

of real Bangladesh. In Table 1, below, we see the degree of balance between Real Bangladesh, Synthetic Bangladesh, and the traditional mean of all the donor pool countries.

In Table 1, we observe in descending order the balance between the six predictors used to predict remittances for synthetic Bangladesh. Migrant stock and agricultural growth have the most significant imbalances of all predictors, yet in comparison to the mean of all donor pool countries they are relatively small, especially migrant stock. From Table 1, we observe that the synthetic Bangladesh formed from our donor pool of 21 countries appears to be a better comparative unit than the mean of all donor pool countries given that all predictors are more

Remittances Predictor	Bangladesh Real	Bangladesh Synthetic	% out of balance	Donor Pool Mean	% out of balance
Primary School Enrollment(Gross Ratio %)	105.699	105.83	0.12%	106.02	0.30%
ln(Development Aid) (USD Millions)	21.41	21.320	0.42%	20.17	5.79%
ln(GDP Purchasing Parity Power) (USD Millions)	7.98	8.03	0.63%	8.86	11.03%
ln(Foreign Direct Investment) (USD Millions)	21.1	20.81	1.37%	21.88	3.70%
ln(Migration Stock)	14.08	13.81	1.92%	12.61	10.44%
Agricultural growth(%)	4.149	3.549	14.46%	3.002	27.65%

**Table 1:** Balance of remittance predictors in the pre-treatment period (2005-2019) for Bangladesh, Synthetic Bangladesh and the donor pool mean. (Source: World Bank Online Data Bank <https://data.worldbank.org/>)

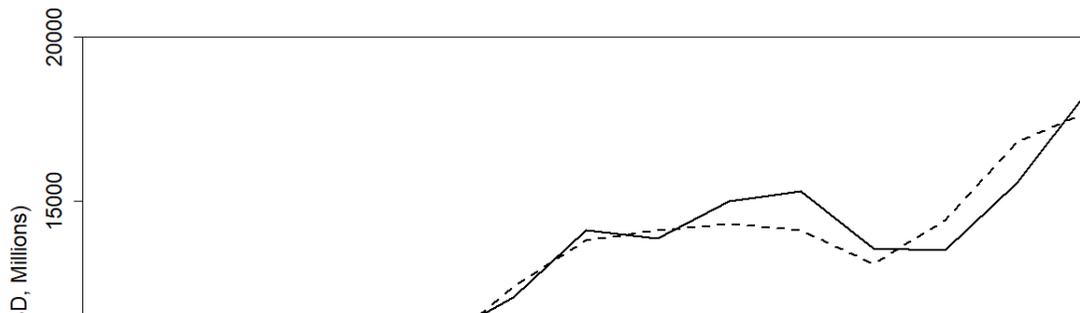
balanced for the pretreatment period of 2005 through 2019 and given that five of the six predictors are less than 2% out of balance. Agricultural growth was the least balanced due to significant growth Bangladesh experienced in comparison to the donor pool countries who all experienced less growth than Bangladesh. The period of 2005 to 2019 was selected as a 15-year window prior to the 2019 policy onset to provide ample covariate data necessary to accurately create a reliable synthetic control unit.

In Table 2, we see the weights associated with the various countries used to construct the synthetic Bangladesh. Only three countries of the 21-country donor pool received weights greater than 0. The majority of the synthetic unit is constructed from Kenya with a 70.5% weight, next is India with an 18.7% weight and last is Cambodia with a 10.7% weight. India and Cambodia are both Asian countries with India being a direct neighbor to Bangladesh. Kenya is similar to Bangladesh in that it is a lower-middle income nation.

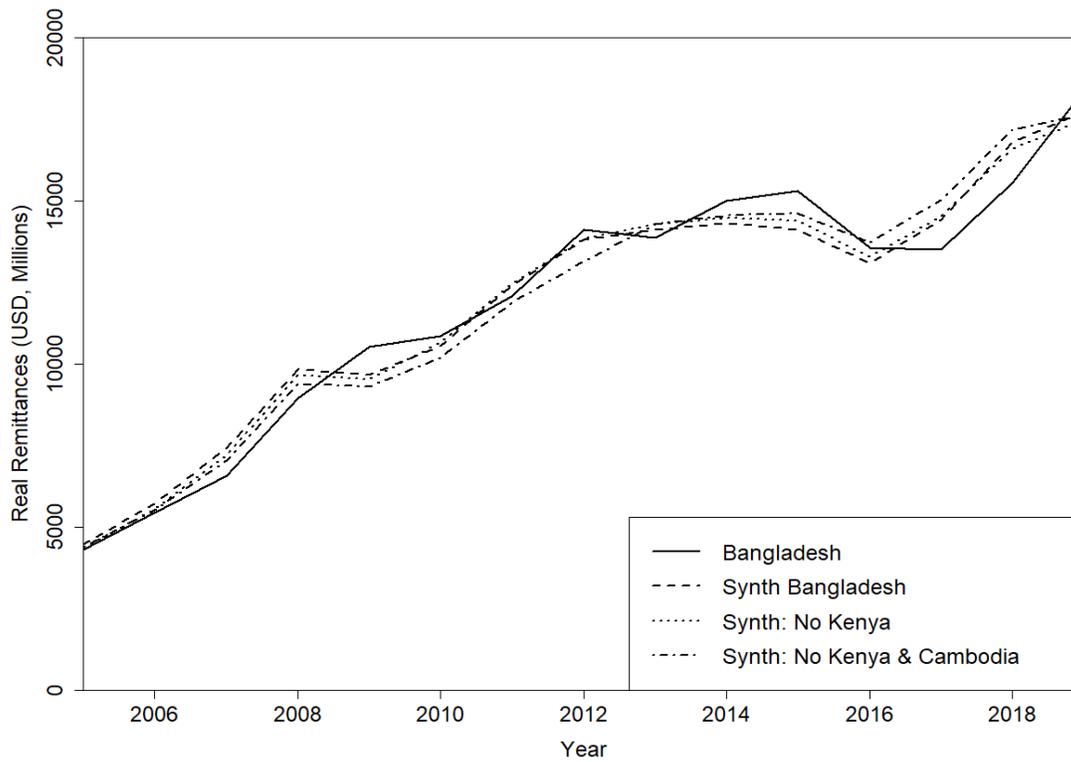
Weights	Country	Weights	Country
0.705	Kenya	0.000	Mexico
0.187	India	0.000	Morocco
0.107	Cambodia	0.000	Myanmar
		0.000	Nepal
		0.000	Nigeria
0.000	Albania	0.000	Panama
0.000	China	0.000	Philippines
0.000	Colombia	0.000	Sri Lanka
0.000	Guatemala	0.000	Thailand
0.000	Honduras	0.000	Ukraine
0.000	Malaysia	0.000	Vietnam

**Table 2:** Donor pool weights used to create synthetic Bangladesh

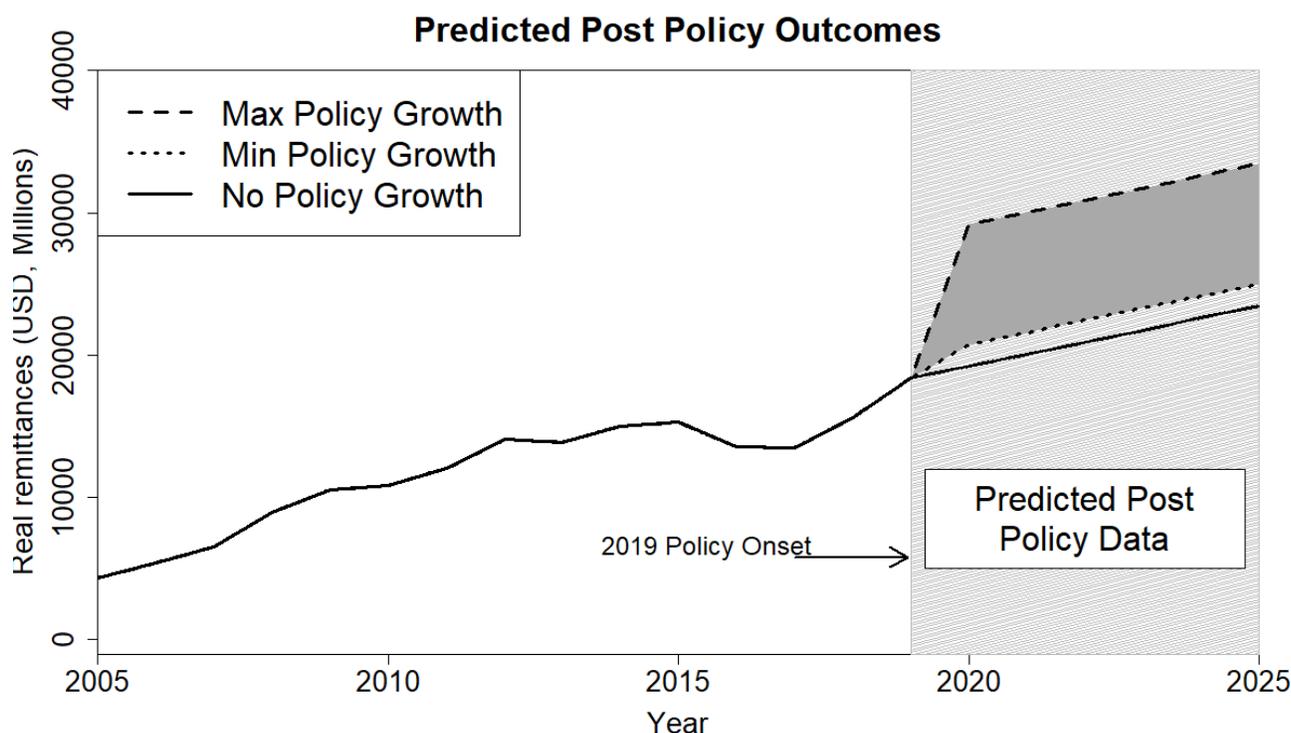
In Figure 1a (below), the real remittances received by Bangladesh between 2005 and 2019 are plotted in comparison to the modelled remittances received by a synthetic Bangladesh composed of the weighted countries listed in Table 2. We see negligible deviations between the control unit (synthetic Bangladesh) and the treatment unit (real Bangladesh) during the pre-treatment period. The control unit in Figure 1a, is highly dependent upon Kenya (weight 0.705). To verify that the model is not overly dependent on any one country, a robustness check is run in Figure 1b. In Figure 1b, Kenya is removed from the donor pool at which point, Cambodia rises to the top as the highest weighted unit (weight = 0.659) and then Cambodia is hence removed. Small discrepancies exist between all three synthetic control units and all three are closely aligned with real Bangladesh’s remittances between 2005 and 2019. The removal of top weighted countries reveals the potential dependency the synthetic control unit has on any one country. Our model shows limited bias associated with any one donor country.



**Figure 1a:** Real remittances for the pre-treatment period for Bangladesh and its Synthetic unit. (Source: World Bank Online Data Bank)



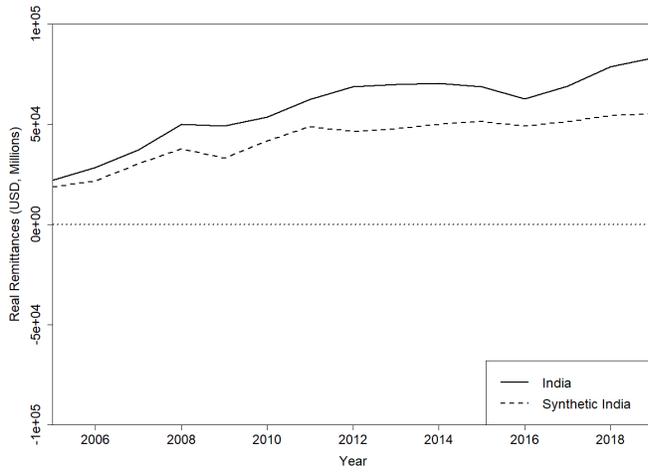
**Figure 1b:** Robustness check of three synthetic models with top weighted countries removed. (Source: World Bank Online Data Bank)



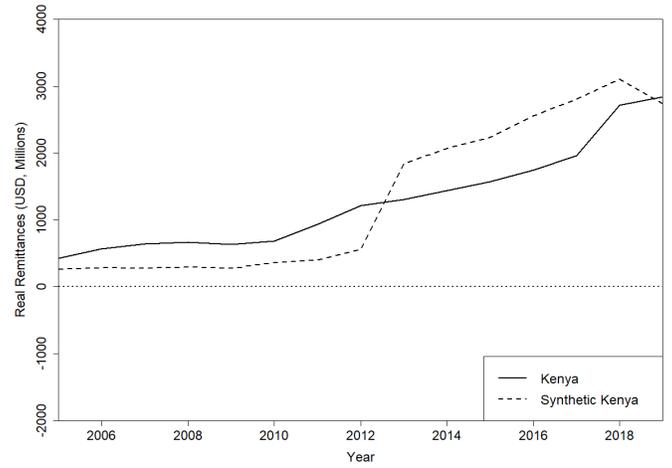
**Figure 2:** The predicted outcomes of Bangladesh’s 2% incentive policy.  
 (Source: World Bank Online Data Bank)

In Figure 2, the hypothesized impact of Bangladesh’s 2% incentive policy is shown. Given that Bangladesh’s pre-treatment transaction cost was approximately 3.75%, a 2% incentive is a 53% decrease in transactional costs. For every 1% decrease in transactional cost, an associated 0.25% (lower bound) to 1.6% (upper bound) of increased remittances is possible (Ahmed, et al., 2020). The subsequent result of a 53% decrease in cost would be a 13% to 85% increase in remittances. In Figure 2, we see within the first year of implementation, a 85% increase in remittances followed by a steady increase in remittances at approximately USD 880 million per year in-line with the linear trend established in the pretreatment period leading up to the 2019 policy. The duration over which the increase is experienced is unclear from Ahmed’s work and hence assumed to be accomplished within the first year.

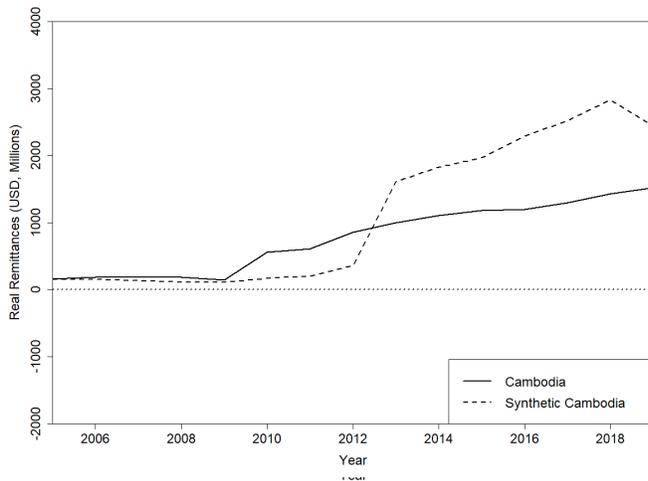
In Figures 3a through 3d, we omit Bangladesh from the analysis and used the top four weighted countries as the treatment unit with a synthetic unit being composed of the remaining 19 units. We see general alignment between treatment and control units with some deviation.



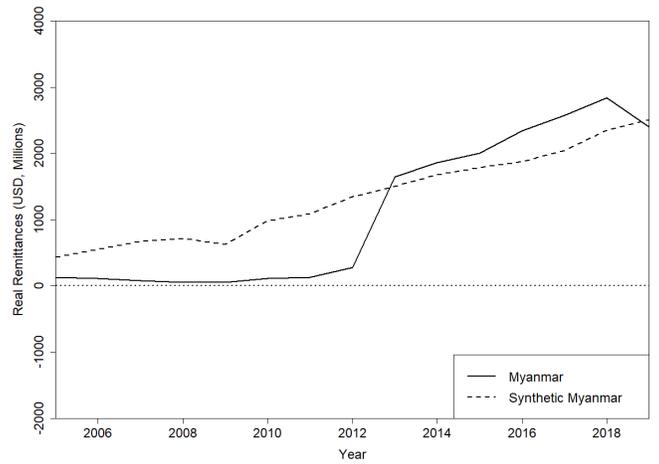
**Figure 3a:** Substitute India as treatment unit



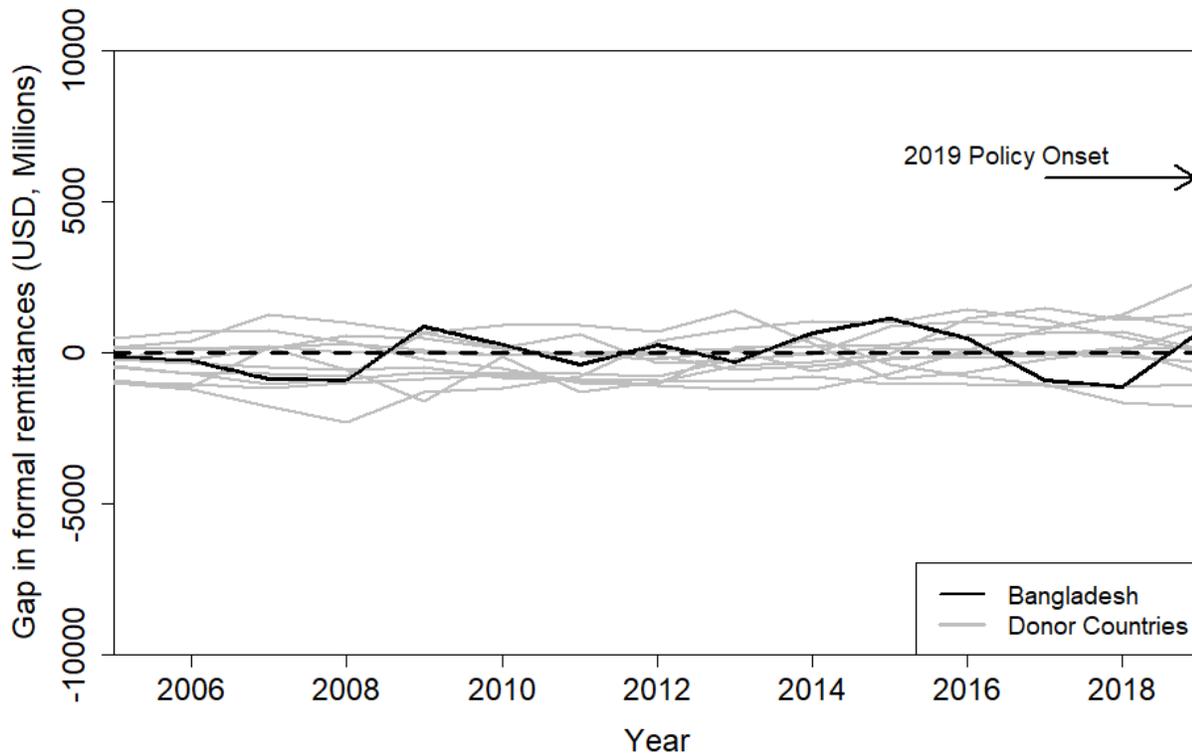
**Figure 3b:** Substitute Kenya as treatment unit



**Figure 3c:** Substitute Cambodia as treatment unit



**Figure 3d:** Substitute Myanmar as treatment unit



**Figure 4:** Gaps in Formal Remittances to Bangladesh and placebo gaps for all 15 donor pool countries. Discard countries whose gaps were greater than three times Bangladesh’s MSPE. (Source: World Bank Online Data Bank)

In Figure 4, we iterate the synthetic control method to each donor pool country, similar to what is observed in Figure 3a through 3d and plot the gap between it and its synthetic counterpart. This process is conducted during the pre-treatment period with those countries whose mean squared prediction error (MSPE) are greater than 3 times the MSPE of Bangladesh. The top 15 best-fitting donor countries remain, in grey, above. During the post-treatment analysis, the potential policy effect will conceivably be reflected in an increasing gap between Bangladesh and it’s synthetic unit, greater than the remaining 15 donor pool countries.

## **6.0 Discussion:**

As Bangladesh seeks to improve its macroeconomic conditions, their remittance incentive policy is targeting one of the three pillars (remittance, foreign direct investment, international development aid) of international financial inflows. An incentive policy or transaction cost reduction policy broadly has literature support that it will positively influence overall remittance inflows. But the specific question of whether Bangladesh's remittance incentive policy will positively impact remittances is unanswered nor is it known what degree of impact will be achieved.

The ability to evaluate a causal effect of the incentive on remittances outcomes requires a strong comparative case study design. This comparative design identified three countries (Kenya, Cambodia, India) to be used as our comparative unit. The socioeconomic and geographic similarities between these three countries align very well with Bangladesh lending greater support to their use beyond the algorithms selection. None of them at this stage in the analysis has experienced an economic shock that would confound remittance outcomes. Multiple alternative models were developed by removing specific donor countries and modifying the selected covariates. Evaluation of non-measured factors was conducted by running placebo in space testing where each donor pool country was assigned to treatment and a synthetic unit was generated to test for any abnormal treatment effects. The gaps between those synthetic models had little variance. These findings coupled with balancing predictors and evaluating the pre-treatment accuracy of the synthetic control unit support the conclusion that the comparative model generated is guarded against confounding and biasing factors.

It is worth noting that the external Covid-19 shock that is actively having significant impacts on migration, GDP, and remittances will still be an important factor for future analysis. As mentioned in the literature review, the impact Covid-19 had on Bangladesh was unique given that they had an increase in remittances during 2020 which will be an important factor to further evaluate moving forward.

## **7.0 Conclusion:**

Comparative case studies in the social sciences are difficult. The accurate identification of control units that can sufficiently compare to the treated unit across predictor variables is

difficult when seeking a causal effect. Second, one of the primary challenges within the domain of causal inference is that full visibility to outcomes during the design phase has the potential to bias that design. The novelty of this paper and this model is that both are blind to remittance outcomes and hence is more closely approaching a randomized experiment.

This was accomplished by using a data-driven approach, the synthetic control method, to weigh and select valid donor countries to use as synthetic control units in comparison to the real Bangladesh. The model design allows for the causal evaluation of the impact Bangladesh's 2019 remittance incentive policy had on overall remittance inflow. The results showed the model was able to find balance across six predictors, performed well through placebo testing, predictor bias testing, and donor pool bias testing. The pretreatment results period showed strong alignment between the synthetic and real Bangladesh. And, in 2025, the results of this paper can be extended by incorporating five years of post-treatment data to determine the effect size of Bangladesh's incentive program.

The most significant limitation of this paper was the ability to comprehensively evaluate the precise selection of both donor countries and predictors. The sheer number of potential permutations of predictors and donor countries that could be utilized to create this model is massive. The evaluations and testing conducted suggest that this synthetic control model is accurate but greater alignment could be achieved by better combinations of countries selected for the donor pool and a more thorough analysis of the predictors selected. The second limitation is the ongoing effect the Covid-19 pandemic will have on remittances and specific differences in response from each country included in this model. The third limitation is the evolving distribution of remittances sent via formal versus informal channels presents another confounding factor that should be explored in greater depth. Of note is the reliance on one paper to support the predictive values of the hypothesized impact of the incentive policy. While lending support of the need for greater studies for policies of this type, the uncertainty associated with only utilizing one paper supports maintaining a skeptical eye on the predicted results.

In closing, the synthetic control method is an important tool to develop empirical models for policies that have recently been implemented and hence have no measurable impacts. This paper designs a comparative case study using the synthetic control method which can be deployed to rigorously measure and evaluate the impact of Bangladesh's novel incentive policy that is blind to outcomes and mitigates researcher bias.

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## **Appendix:**

### **#plausibility**

This paper utilized a recent study conducted in 2020 in Pakistan to develop a plausible hypothesis. The paper produced minimum and maximum potential results attributed to fee reduction policies and both were utilized to construct plausible predictions for this paper. While Pakistan is not Bangladesh, the geographical, cultural, and economic similarities of the two countries create a significant overlap that a reasonable domain of applicability seems to apply in using that paper to inform the results of this paper.

### **#context**

The broader remittances context as a global phenomenon that has significant importance as a financial mechanism was established. The specific poverty realities and the literature which reviewed the potential impact of remittances on poverty was explored and used as motivation for the importance of this work. Similarly, the lack of agreement on remittances potential influence on economic development was also explored. The potential still exists but given the lack of conclusive supporting evidence this outcome may not be achievable, despite its importance. Ultimately it is the poorest citizens of Bangladesh who stand to be most beneficially served by the positive result sought by the policy and under study by this paper. Lastly, the novelty of this policy and the use of the synthetic control method to study remittances was established as an important context for dedicating time and energy into this study.

### **#testability**

The specific predicted outcomes presented in this paper provide numerical values that can be tested. The specific values of the results will provide further evidence towards the any scaling effects associated with transaction cost reduction policies.

### **#psychologicalexplanation**

The theory and microeconomic discussion of this paper that exposed the decisional axis between altruism and sel-interested behaviors that motivate remitting behavior are strong psychological explanations. When these individual psychological tendencies are aggregated across millions of

remitters and billions of dollars of transactions, there is emergent (scaling) properties that facilitate greater inflows than would be possible when operating on a single level. A potential hypothesis is the impact on the recipient side of remittances. The safety, security, and success associated with a family receiving funds from their migrant family member could conceivably lead to social dynamics within communities that motivate elevated giving from other migrant family members. So as greater remittances are sent, exponential scaling effects could transpire.

### **#purpose**

The purpose of this paper is to design a study that has the best opportunity to come to a causal effect conclusion. It also has the secondary purpose of predicting an answer to the question of what the actual effect size might be based upon the literature. This will help future researchers refine their predictions and understanding of the factors that influence changes in remittance inflows. That refined knowledge could conceivably be used to determine what levels of institutional investment from central banks or governments is warranted given known scaling effects.

### **#gapanalysis**

The lack of literature on synthetic control methods to evaluate causal effects on remittance influences was a clearly identified gap within the literature. Given that there are only two known remittance incentive programs that have both been implemented within the last two years, there is a gap in research of the effect of those policies. Lastly, studies that are blind to outcomes with regards to recently adopted policies also seemed to be lacking within the literature. Further emphasizing the importance of blind studies to mitigate researcher bias is a worthy goal within the social sciences space and this paper identified that important gap and attempted to contribute work that brings to fill that gap.

### **#dataviz**

Produced several data visualizations to help understand the relationship between real and synthetic Bangladesh. One of the strengths of the synthetic control method is the intuitive visual information from the synthetic methods. These visual tools provide clear evidential support to analyze assumptions, initial conditions, and outcomes.

## **#modeling**

The synthetic control method generates a synthetic model based upon pre-treatment data that is used to generate outcome data in the post-treatment time period that can be used to measure causal effect sizes. This paper evaluates how well the model performs in the pre-treatment period to ensure the design is strong and it tests multiple parameters of the model to stress test for any bias or unmeasured predictor values that might have confounding effects on the models performance.

## **#controlgroups**

The synthetic control group uses control groups in its empirical study design. The control groups are aggregate units, countries, that are weighted to generate a close match to real bangladesh. The control group is vital to a causal effect analysis as it creates a counterfactual history for real Bangladesh. Given the control units did not experience a policy treatment of an incentive program, they represent the economic conditions under which Bangladesh had not experienced treatment, thus generating a comparable unit to measure policy effect size. The transparency in selection of control units is a stronger method than regression analysis to allow readers the opportunity to scrutinize the predictors selected and the weighting of the constituent countries used to generate the control unit. This technique is critical to opening up the model and study design to scrutiny on the integrity and potential biases associated with this work.

## **#observationalstudy**

This paper used historical data from 2005 through 2019 to design an observational study.

## **#optimization**

The synthetic control method uses optimization techniques to determine which countries within the donor pool should be selected for weighting and what those weights should be. The

optimization algorithm seeks to minimize the gap between real Bangladesh and synthetic Bangladesh across all seven predictors used in the analysis. A genetic algorithm is used to search for the optimal fitness of the final weighted solution. Genetic algorithms are relatively newer techniques used to overcome the challenge of modeling techniques that only find local extrema. The limitation in the optimization program is in the input values. The selection of donor countries and the predictors ultimately constrains the algorithm's ability to find the best possible match to Bangladesh.

### **#thesis**

This paper is a graduate program thesis. The written communication went through multiple phases of drafts and feedback to ensure its formatting was professional, adhered to APA guidelines and was appropriate to the expectations of the graduate program. The specific hypothesis was articulated in multiple locations within the document and had delineating titles to help ensure the main points of the thesis were clearly communicated to the reader.

### **#sourcequality**

Data was gathered from the World Bank Data Bank which is an aggregator of global macroeconomic data for all nations. The data was verified on multiple occasions with macroeconomic data reported by the central banks for those nations. Of the papers that were selected for the literature review, papers with many citations in reputable journals were selected for inclusion and analysis. Papers that also appeared to have the best opportunity to have validity within the context of Bangladesh were also selected.

### **#professionalism**

Follow established guidelines to present yourself and your work products professionally. (H) MC Part of effective communication involves presenting yourself and your work in an appropriate and professional manner. To communicate effectively, consider the norms for presenting yourself to others, including tone, forms of address, and the use of slang or informal speech. Always proofread written work for errors, properly attribute quotations, ideas, data and other sources, and follow conventional practices regarding attribution and formatting for the type of communication you are crafting. Different academic disciplines have different formatting

conventions, and it is important to use the expected standards. More broadly, ensure that your approach to communication, whether verbal or written, meets or surpasses the expectations relevant to the context.

### **#litreview**

A literature review was conducted on this paper. Each section of the literature review was specifically selected to contribute to the overall argument. The contextually important role of remittances was first analyzed to demonstrate why this topic is worthy of study. Then a review of the determinants selected for analysis was conducted to provide validity to the choices of data used to support the argument. Next research that supported the theoretical underpinnings of the causal mechanism believed to be at play for influencing the outcomes of interest. Lastly I looked at the potential confounder of Covid-19 given the immediacy and relevancy of this factor on results and future analysis

### **#rightproblem**

The synthetic control method has specific data and event requirements that allow its strengths to be maximized and hence provide greater confidence in the accuracy of its results. This paper utilized a recent policy, that has limited instances of similar policy implementation. This creates a useful environment to identify control units for a comparison that isn't confounding by similar treatments. Secondly, given that it was at the national scale, aggregate data was available on an annual basis for all countries with relatively easy access and processing. Lastly, the potential economic and poverty effects associated with remittances elevate the importance of this financial mechanism for influencing change within low and middle income nations. So the importance of better discerning causal effects within this space has the ability to further refine and improve nations' abilities to minimize poverty and improve economic development.