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Remittances, Cryptocurrency, and Insurance:
Using Cryptocurrency Volatility Insurance to Realize Gains for Developing Economies

In this paper (Section I), I discuss the importance of the global remittance industry to developing economies, and I discuss the current high cost of sending remittances. I then introduce the concept of cryptocurrency. I discuss the technology behind cryptocurrency, and how the use of cryptocurrency can reduce the cost and time of sending remittances. Next (Section 2), I highlight the high price volatility associated cryptocurrency-based remittance methods, and I discuss how this high price volatility is an impediment to cryptocurrency adoption. To find a solution to this impediment (Section 3), I then lay out an insurance scheme that, if implemented, could help increase cryptocurrency adoption by allowing cryptocurrency users to mitigate risks imposed by high price volatility. I then detail how increased cryptocurrency adoption allowed through such an insurance scheme can have a positive impact on developing economies (Section 4). Next (Section 5), I share and describe a technology solution to assist the implementation of this insurance scheme.

Section I:
What are remittances, what is cryptocurrency, and how are they related?

Remittances are peer-to-peer transfers of funds that an "expatriate sends to their country of origin via wire, mail, or online transfer."[1] This financial sector is a $500bn a year industry, and, according to the World Bank, the "average global cost of sending remittances is 7.68% as of June 2015."[2,3] Fixed fees for sending remittances make sending small amounts of money even more costly; according to the Overseas Development Institute, "Africa's diaspora pays 12% to send $200."[4] These high fees accumulate from multiple intermediaries - banks and money transfer operators on both the sending and receiving end of the transaction - that each takes a fee in the remittance transfer.

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1 "Remittance Definition | Investopedia." Investopedia. N.p., 23 June 2005. Web. 02 Apr. 2016. <http://www.investopedia.com/terms/r/remittance.asp>.

2 "Why Bitcoin Faces an Uphill Battle in the Remittance Market." CoinDesk RSS. N.p., 31 Mar. 2014. Web. 02 Apr. 2016. <http://www.coindesk.com/why-the-future-of-bitcoin-remittance-businesses-isnt-certain/>.

3 "De-Banking Is Spreading: Commonwealth Investigates Using Digital Currencies to Solve Problems." Brave New Coin. N.p., n.d. Web. 02 Apr. 2016. <http://bravenewcoin.com/news/de-banking-is-spreading-commonwealth-investigates-using-digital-currencies-to-solve-problems/>.

4 Anderson, Mark. "Bitcoin Shakes up Remittances as Poorer People Offered Digital Deals." The Guardian. Guardian News and Media, 18 Aug. 2014. Web. 02 Apr. 2016. <http://www.theguardian.com/global-development/2014/aug/18/bitcoin-remittances-market-digital-cash>.

The recent development of cryptocurrencies, decentralized digital currency "made possible by certain principles of cryptography," has provided a potentially disruptive alternative to current money transfer methods.[5] Cryptocurrencies work by combining cryptography with a distributed, digital ledger of all transactions that take place using the cryptocurrency. This digital ledger is commonly referred to as the "blockchain." When *Individual A* wants to transfer funds to *Individual B*, computers with access to this digital ledger confirm that the transfer from *Individual A* to *Individual B* has successfully occurred. This confirmation is achieved by computers with access to the digital ledger solving a complex cryptographic puzzle associated with each transaction. This puzzle-solving process is called "mining." The complex cryptographic puzzle for each transaction can only be solved once, and this one-time solution feature guarantees that cryptocurrency transactions are each authentic and cannot be fraudulently duplicated. The units of available cryptocurrency increase through this mining activity, as each "miner" is rewarded by receiving cryptocurrency units in exchange for the digital work their computer(s) has done to verify transactions on the digital ledger. This cryptocurrency reward is paid for by expanding the supply of cryptocurrency units, rather than the money sender paying this cryptocurrency reward to the respective miner. This distributed ledger technology is important, as it allows cryptocurrency transfers to avoid the need for institutional banks. Instead of having transfers verified by institutional banks that charge a transfer fee, the sender can use cryptocurrency transfers to avoid this transfer fee.

To fully appreciate the potentially disruptive alternative to current money transfer methods, it is important to first outline what current money transfer methods are available. One of the older forms of money transfer is that of the "money order." Money orders first gained popularity in Great Britain in the late 1700's, and they are often a product of postal mail companies. Money orders typically work via the sender paying the sum of money he wishes to transfer to his local post office; the local post office then gives him a receipt for the amount he paid. The post office then delivers this amount in cash to the payer's specified recipient. Often several identification checks such as a photo and signature are requested of the payment recipient. A confirmation that the money has been collected by the recipient is then sent to the payer. Money orders have declined in popularity due to the risk of theft and human error associated with these physical transfers.

Although still available as a money transfer option, money orders have been followed by the "wire transfer" method of sending money. International wire transfers are coordinated by intermediate organizations such as the Society for Worldwide Interbank Financial Telecommunication (SWIFT). These intermediate organizations are formed as cooperative societies of member banks, and they are used to establish and maintain a protocol for international fund transfers. SWIFT publishes eight to eleven digit codes to identify banks as well as other codes to identify transaction types. These payment order codes allow international banks to accurately and digitally send money back and forth to specified accounts. The actual settlement of associated funds is not handled by

[5] "What Is Cryptocurrency?" CCN Financial Bitcoin Cryptocurrency News. N.p., 16 Sept. 2014. Web. 02 Apr. 2016. <https://www.cryptocoinsnews.com/cryptocurrency/>.

SWIFT, and fund settlement is carried about by intermediary clearing houses. While wire transfers provide a faster and more secure international money transfer method compared to money orders, the use of multiple intermediaries to verify and clear these electronic transfers results in a large transfer fee.

Unlike wire transfers, cryptocurrency transfers can be sent peer-to-peer without having to pass through multiple intermediates or be validated by multiple clearinghouses. Avoiding these costly and time-consuming operations allow cryptocurrencies to provide a much cheaper and faster alternative for international money transfer. Transfers with the popular cryptocurrency Bitcoin take an average of 10 minutes rather than days (as is the case with today's non-digital currency wire transfers), and "most of the digital remittance operators claim they are at least 45% cheaper" than today's non-digital currency transfer fees.[6] Throughout this paper I will compare cryptocurrency-based remittance methods to non-cryptocurrency based remittance methods. Cryptocurrency-bases remittance methods refer to digital transfer methods used to transfer digital cryptocurrency. Non-cryptocurrency based remittance methods refer to digital transfer methods of non-digital currency through wire transfer protocols.

Remittances are "dominated by transfers from developed countries to developing [countries]," and reducing the cost of these transfers through cryptocurrency-based remittance methods can result in billions of added capital for developing economies.[7] However, one issue with cryptocurrencies is their extremely high price volatility. This makes holding these cryptocurrencies a risky practice for remittance senders and receivers around the world. In just a few days, the value of the remittance sender's cryptocurrency holdings could significantly drop. This loss could cancel any potential savings the sender would have realized by using cryptocurrency-based remittance methods. Additionally, this loss may have catastrophic financial impact on the remittance sender's family who receives this remittance and depends on these funds for living expenses.

Section 2:
What are the risks associated with cryptocurrency-based remittance methods, and how are they an impediment to cryptocurrency adoption?

Compared to non-cryptocurrency based remittance methods, cryptocurrency-based remittance methods have the benefits of (a) lower transfer costs and (b) increased speed in sending remittances. However, one impediment that is preventing remittance senders from realizing these benefits is the high volatility of cryptocurrency prices. When storing their cash assets in cryptocurrency, these assets are subject to high price volatility. For example, from May 1st, 2014 to May 1st 2016 Bitcoin – the largest cryptocurrency in terms of market capitalization - showed a standard deviation in the percent change in daily prices from 30 days prior of +/-17.80%. For some 30 day periods, the percent change in daily price from 30 days prior was a decrease in price of

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6 "Bitcoin Might Be The Next Big Thing In The Remittance Market." TechCrunch. N.p., n.d. Web. 02 Apr. 2016. <http://techcrunch.com/2015/05/25/bitcoin-might-be-the-next-big-thing-in-the-remittance-market/>.

7 "Bitcoin Might Be The Next Big Thing In The Remittance Market."

approximately 40%. This high price volatility makes holding and using cryptocurrency an unfavorable option to risk-averse individuals.

The "risk-aversion" of these individuals is often held due to little to no savings, little to no credit, and little to no disposable income. A fluctuation in the value of this individual's cash assets of -/+17.80% over a month's time could have disastrous consequences for the remittance sender's family. Imagine a Ghanaian remittance sender sending 1,000 GHS to Ghana to cover monthly living expenses for his family. The monthly budget of 1,000 GHS is allocated as follows: 500 GHS will be allocated for food expenses; 200 GHS will be used for housing expenses; 200 GHS will be used for tuition fees; and 100 GHS will be used for transportation fees. For simplification in this example, we will round the standard deviation of +/- 17.80% in 30-day percent change in cryptocurrency value to +/- 20.00%. If this remittance sender suffers a 20.00% decrease in the value of his cryptocurrency holdings, his family suffers a 20.00% reduction in their monthly budget. What is this family to do? They cannot rely on savings or credit, and therefore they must cut their budget. However, what budget items is this family to cut? Does the family decrease food consumption by 40.00% (200 GHS/ 500 GHS food budget)? Does the family give up their home and live on the street? Does the family stop sending their child to school? Does the family cease all but free transportation? As one can see, the high fluctuations of cryptocurrency make it difficult to use cryptocurrency-based remittance methods, particularly for families operating on tight budgets.

However, what if this Ghanaian remittance sender could hold cryptocurrency assets and limit his risk exposure to negative price fluctuations in this cryptocurrency? If this was possible, this remittance sender could enjoy the lower costs and speed of cryptocurrency-based remittance methods without having to be exposed to the high price volatility of cryptocurrency. An insurance policy could allow this remittance sender to limit his risk exposure to negative price fluctuations of his cryptocurrency holdings; in the following section, I will describe how such an insurance policy can be constructed.

Section 3:
How can losses imposed by high price volatility be mitigated by insurance? How would such insurance policy be structured and priced?

Limiting the remittance sender's risk exposure to price fluctuations can be achieved through an insurance policy. In this section, I will discuss how such a policy is structured and how this policy is priced.

The insurance policy that will be priced has the following features:

(1) The contract has a term of 30 days. Once the premium (R) is paid and the insurance contract is signed, the policy holder has the value of their cryptocurrency holdings at the time the contract is signed insured for 30 days.

(2) In the event of a loss in the value of cryptocurrency holdings, the policy holder will be paid the full value of this loss by the insurance writer.

(3) In the event of a gain in the value of cryptocurrency holdings, the policy holder will not receive payment from the insurance writer. The policy holder will enjoy the gains in the value of their cryptocurrency holdings.

(4) In both the event of a loss and in the event of a gain in the value of cryptocurrency holdings, the policy holder experiences a loss of the price of the insurance premium, R, paid to purchase the policy.

To price this insurance contract, I downloaded daily price of Bitcoin, the world's most widely used cryptocurrency in terms of total transaction value, as priced in Ghanaian Cedis (GHS) from the website "CoinDesk.com." CoinDesk is the world's largest Bitcoin exchange, in terms of total value exchanged through the site. I downloaded the prices from April 1st, 2014 to May 1st, 2016. Starting from May 1st, 2014, I then measured the percentage change in prices from 30 days prior. For example, I measured the percentage change in the price of Bitcoin in Ghanaian Cedis (GHS) on May 1st, 2014 compared to April 1st, 2014. I then calculated the percentage change of prices from 30 days prior from each day between May 1st, 2014 and May 1st, 2016 inclusive.

With these two years of data on 30-day percentage change in Bitcoin prices, I calculate a measure of volatility for the 30-day percentage change in Bitcoin prices. To do this, I approximate the distribution of Bitcoin price values with a two-point distribution. Each possible scenario has an equal probability (50%) of being the mean plus or minus one standard deviation from this mean. I make this approximation for purposes of simplicity. This simplicity allows me to quickly approximate whether or not such as insurance policy is possible without having to rely on more precise yet time-consuming, insurance-pricing methods.

To get a measure of the volatility of the 30-day percentage change in Bitcoin value over this two year period, I calculated the average of these 732 data points. The average 30-day percent change in Bitcoin value was 1.32%. I then calculated the deviation of each 30-day percentage change in Bitcoin value from the average. I then squared each of these values and divided each of these values by the average 30-day percentage change in Bitcoin value. I then had the variance of the 30-day percentage change in Bitcoin value, and this variance was 3.12%. To get the standard deviation of the 30-day percentage change in Bitcoin value, I calculated the square root of the variance, and this value for the standard deviation was 17.80%.

Additionally, it must be noted that this percent change in the price of Bitcoin is being calculated off of a rising mean price of Bitcoin of 1.32% over a 2 year period. I calculated the amount of 30 day periods in the 732 day two-year period to be 24.4 periods. By dividing the two year rise in mean price of Bitcoin of 1.32% by the number of 30 day periods during these two years, I found the average rise in the mean value of Bitcoin to be (1.32%/24.2) 0.05% during each 30 day period. Thus, each standard deviation of 17.80% in percentage change in Bitcoin price is fluctuating around an increasing mean of Bitcoin value of approximately 0.05% every 30 day period. This increase in the value of Bitcoin is considered in my calculations below.

To calculate the price of the insurance policy, I assumed that the value of Bitcoin the remittance sender wants to insure is 100 GHS. I also assume that the remittance sender has a risk averse utility function of $u(x) = \sqrt{x}$, where x is the payoff in GHS.

Below are the calculations for the remittance sender's possible situations and expected utility in 30-days if this remittance sender does not purchase an insurance policy.

Remittance sender's situation without insurance:

Probability of a loss: 50%
Payoff in the event of a loss (GHS):
100 (Starting value of currency) -17.80 (Standard Deviation of price volatility) + 0.05 (Change in mean) = 82.25
Utility of payoff in the event of a loss: $\sqrt{82.25}$

Probability of a gain: 50%
Payoff in the event of a gain (GHS):
100 (Starting value of currency) +17.80 (Standard Deviation of price volatility) + 0.05 (Change in mean) = 117.85
Utility of payoff in the event of a gain: $\sqrt{117.85}$

Expected Utility without insurance:

$$Eu_{without\ insurance} = (0.5)\left(\sqrt{82.25}\right) + (0.5)(\sqrt{117.85})$$

Below are the calculations for the remittance sender's possible situations and expected utility in 30-days if this remittance sender does purchase an insurance policy.

Remittance sender's situation with insurance:

Probability of a loss: 50%
Payoff in the event of a loss (GHS):
100 (Starting value of currency) – 17.80 (Standard Deviation of price volatility) + 0.05 (Change in mean) + 17.75 (Insurance payment to remittance sender to cover his loss) – R (Variable for insurance premium) = 100 - R
Utility of payoff in the event of a loss: $\sqrt{100 - R}$

Probability of gain: 50%
Payoff in the event of a gain (GHS): 100 (Starting value of currency) + 17.80 (Standard Deviation of price volatility) + 0.05 (Change in mean) – R (Variable for insurance premium) = 117.85 – R
Utility of payoff in the event of a gain: $\sqrt{117.85 - R}$

Expected Utility with insurance:

$$Eu_{with\ insurance} = (0.5)\left(\sqrt{100 - R}\right) + (0.5)(\sqrt{117.85 - R})$$

To determine the maximum price of the insurance premium that the remittance sender is willing to pay, the expected utility of the remittance sender with insurance must be greater or equal to the expected utility of the remittance sender without insurance. If the expected utility was greater without an insurance policy than with an insurance policy, there would be no reason for the

remittance sender to purchase an insurance policy. The calculations to determine this maximum premium are detailed below:

$$Eu_{with\ insurance} \geq Eu_{without\ insurance}$$

$$(0.5)\left(\sqrt{100-R}\right)+(0.5)\left(\sqrt{117.85-R}\right) \geq (0.5)\left(\sqrt{82.25}\right)+(0.5)\left(\sqrt{117.85}\right)$$

$$(0.5)\left[\left(\sqrt{100-R}\right)+\left(\sqrt{117.85-R}\right)\right] \geq (0.5)\left[\left(\sqrt{82.25}\right)+\left(\sqrt{117.85}\right)\right]$$

$$\left[\left(\sqrt{100-R}\right)+\left(\sqrt{117.85-R}\right)\right] \geq \left[\left(\sqrt{82.25}\right)+\left(\sqrt{117.85}\right)\right]$$

$$\left(\sqrt{100-R}\right)+\left(\sqrt{117.85-R}\right) \geq 19.93$$

$$\left(\sqrt{117.85-R}\right) \geq 19.93-\left(\sqrt{100-R}\right)$$

$$\left(\sqrt{117.85-R}\right)^2 \geq \left[19.93-\left(\sqrt{100-R}\right)\right]^2$$

$$117.85-R \geq 19.93^2-(2)(19.93)\left(\sqrt{100-R}\right)+100-R$$

$$\frac{117.85-100-19.93^2}{-(2)(19.93)} \leq \left(\sqrt{100-R}\right)$$

$$9.52 \leq \left(\sqrt{100-R}\right)$$

$$9.52^2 \leq \left(\sqrt{100-R}\right)^2$$

$$90.63 \leq 100-R$$

$$90.63-100 \leq -R$$

$$-9.37 \leq -R$$

$$9.37 \geq R$$

While there is a maximum premium for which the remittance sender is willing to purchase an insurance policy (as featured above), there is also a minimum premium for which the insurance writer is willing to sell an insurance policy to a remittance sender. This minimum premium is R, such that the expected profit of the insurance writer is greater than or equal to zero. If the profit was lower than zero, the insurance writer would lose money by selling these insurance policies and would not engage in policy writing activities. Please note that this minimum premium R is only factoring in the costs (to the insurance company) of payments to insurance policy holders in the event that the policy holders experience a loss. For simplicity and since the costs of operating such an insurance company are unknown, this minimum premium R is not considering the operating costs (payroll, office rent, office supplies, utility bills, etc.) of the insurance writer that sells these contracts.

To consider profitability of insurance writer:

Probability of remittance sender experiences a loss: 50%
Insurance writer payoff when remittance sender experiences a loss (GCH):
R (Insurance premium) - 17.75 (Payment to insurance holder)

Probability of remittance sender experiences a gain: 50%
Insurance writer payoff when remittance sender experiences a gain (GHS):
R (Insurance premium)

Expected profit of insurance writer (GHS): $[(0.5)(R-17.75)]+[(0.5)(R)]$

Minimum insurance premium R (GHS) for insurance writer to make profit or break-even:

$$[(0.5)(R-17.75)]+[(0.5)(R)]\geq 0$$

$$(0.5)(R-17.75\ +R)\geq 0$$

$$R-8.88\ \geq 0$$

$$R\ \geq 8.88$$

The possible values of R that both (a) allow the remittance sender's utility to be higher with insurance than without insurance and (b) allow the insurance company to make profit or break-even are then:

$$9.37\geq\ R\ \geq 8.88$$

To put these values of R in terms of a percentage of the original value of Bitcoin insured, these values of R must simply be dived by 100 GHS. This is important as it allows R to be priced in percentage terms of the original value of Bitcoin insured. This pricing allows insurance writers to price insurance policies for *any* amount of Bitcoin that the remittance sender wishes to insure. Possible R prices in percentage terms of the original value of Bitcoin insured are as follows:

$$9.37\%\geq\ R\ \geq 8.88\%$$

Section IV:
How can increased cryptocurrency adoption allowed through such an insurance scheme have a positive impact on developing economies?

The calculations provide an exciting result. To appreciate this result, we make the following estimates and assumptions:

(1) Most of the costs associated with cryptocurrency-based remittances are in the operating costs of non-cryptocurrency remittance infrastructure that still needs to be utilized if the cryptocurrencies are to be converted into the home currency of the remittance receivers. For example, if the remittance sender uses cryptocurrency-remittance methods to send remittances to Ghana, only the costs of the transfer will be minimized. The "last mile" costs which make up the majority of cryptocurrency-based remittance costs still apply whether a cryptocurrency or non-cryptocurrency denomination is being used in the international transfer. The remittance sender will still need to pay for the infrastructure and labor costs of the remittance company associated with converting the cryptocurrency to GHS and placing this GHS into the hands of the remittance recipient. If cryptocurrency can be used as a means of exchange with vendors in the remittance receiver's home country, the cryptocurrency will not have to be converted into the currency of remittance receiver's home country. There will be no need for the physical exchange of cash to deliver these remittances to the receiver. Fees associated with this conversion then do not have to be incurred. Accordingly, cryptocurrency-based remittance costs for the transfer and collection can be minimized zero. The only cost then associated with sending cryptocurrency-based remittances will be the cost of protecting the value of one's cryptocurrency holdings from losses due to high price volatility. **As such, it is assumed that cryptocurrency can be used as a means of exchange with vendors in the remittance receiver's home country.**

(2) The current average cost of non-cryptocurrency based remittance methods for sending $200 to Africa is 12%. **It is assumed that the average monthly remittance transfers for an individual remittance sender do not *significantly* exceed $200.** "Significantly" is defined as an amount over $200 that decreases the cost of sending the non-cryptocurrency remittance by more than 3.12% percentage points. If the average cost of non-cryptocurrency remittances drops by more than 3.12% percentage points, then sending non-cryptocurrency remittances will on average cost less than the cost of sending cryptocurrency-based remittances of 8.88%. This cost of 8.88% is the calculated minimum price that insurance writers will accept for insuring against losses in cryptocurrency holdings due to price volatility. Note that this minimum price is not considering operating expenses of the insurance writer. Additionally, note that this minimum price uses the assumption detailed above in point (1), that the only cost of sending cryptocurrency remittances for the remittance sender will be equal to the cost of insuring the sender's cryptocurrency holdings against losses from cryptocurrency price volatility.

Using the assumptions above, we arrive at the exciting result that all prices within range of calculated insurance premium prices - that both (a) deliver greater utility to the remittance sender when he has insurance versus

when he does not have insurance and (b) allow the insurance company to maintain profitability – are lower than the current average price to send $200 of non-cryptocurrency remittances to Africa of 12%. This result is exciting in the sense that, if the previous assumptions hold, a remittance sender can enjoy the lower costs and speed of cryptocurrency-based remittance methods *while also* protecting himself from the risk of loss from cryptocurrency price volatility at a price cheaper than what he is currently paying to send non-cryptocurrency remittances. Accordingly, considering the previous assumptions hold, this insurance policy allows the remittance sender to send remittances both faster and more cheaply with cryptocurrency-based remittance methods than with non-cryptocurrency based remittance methods.

It is important to note that assumption (1), that remittance receivers are able to use cryptocurrency as a means of exchange with local vendors, is a major hurdle for the implementation of such an insurance policy. Without remittance receiver's using cryptocurrency, there is no reason for local vendors to hold cryptocurrency digital wallets and accept cryptocurrency as payment. There is no incentive as local vendors will not have cryptocurrency spending customers. Without local vendors holding cryptocurrency digital wallets and accepting cryptocurrency as payment, remittance senders will not use cryptocurrency-based remittance methods as these methods will be more costly than non-cryptocurrency-based remittance methods. Cryptocurrency-based remittances will be more expensive if local vendors do not accept cryptocurrency as payment, as remittance senders will have to pay for insurance to protect their cryptocurrency holdings against price volatility and for converting their cryptocurrency to their home country's currency for their family to use with local vendors.

Thus, in order for gains from cryptocurrency-based remittance methods to be realized, remittance senders must use cryptocurrency-based remittance methods and local vendors must accept cryptocurrency as payment simultaneously. Perhaps this coordination can occur by incentivizing local vendors to accept cryptocurrency as a method of payment. Perhaps these vendors can be paid a premium as well as their costs of (a) their own time invested in setting up and learning how to use a cryptocurrency digital wallet and (b) insurance to protect their own cryptocurrency holdings can be paid for by a development bank. If local vendors then accepted cryptocurrency as payment, remittance senders would then be able to use cryptocurrency-based remittance methods. The remittance senders would then only need to purchase insurance to protect the value of their cryptocurrency holdings and they would not need to pay for converting the transferred cryptocurrency into the local currency of their home country. Remittance senders would then be incentivized to use cryptocurrency-based remittances methods, as they could send remittances via these methods more cheaply than via non-cryptocurrency based remittance methods.

It is important to note that the gains from such an incentive payment would not only be a cheaper remittance sending method for remittance senders. If this was the only gain achieved, a development bank could more simply distribute funds to remittance senders of equal amount to what the remittance senders would save if the above assumptions held and they used cryptocurrency-based remittance methods. However, a cheaper remittance

sending method for remittance senders would not be the only gain from a population in a developing country that widely uses cryptocurrency. Mobile banking products such as savings accounts, credit, and other insurance policies could be more widely used among a population that more widely uses cryptocurrency through their mobile phone. By spurring a wider adoption of cryptocurrency-based remittance methods, a development bank could also spur a wider adoption of modern banking products among the populations of developing economies; Economic gains from a wider adoption of modern banking products could thereby also be realized by developing economies.

Section V:
How can technology be used with this insurance policy?

Calculated insurance premium prices - that both (a) deliver greater utility to the remittance sender when he has insurance versus when he does not have insurance and (b) allow the insurance company to maintain profitability – range from:

$$9.37\% \geq R \geq 8.88\%$$

However, as previously stated, the minimum premium price that allows an insurance company to have profits greater or equal to zero of 8.88% does not factor in the costs of operating such an insurance company. Worker's wages, office rent, and office supplies all have to be paid in order to sustain such an operation. Thus, in order to offer competitive premiums as close to 8.88% as possible, an insurance company is incentivized to make operational costs as low as possible. One way to lower operational costs is to automate workflows.

The following insurance premium calculator for protection against loss of Bitcoin holdings due to price volatility over a 30 day period has been created to help automate said workflows.[8] The insurance premium calculator and accompanying code can be found at the following link:

djm559.nyuad.im/bitcoin

This was built using the Coindesk.com API for daily Bitcoin prices. Each day, the two years of data on Bitcoin prices from the current date are pulled from the API. The standard deviation of Bitcoin price volatility as calculated in Section III is then recalculated for an up-to-date insurance premium price based on the most recent price volatility data. To further automate workflows and further minimize operational costs of this insurance company, further additions could be made to this insurance premium calculator. Additions include (a) an automated process for payment to be made to purchase the insurance premium and (b) an automated process for insurance contracts to be sent to the purchaser of the insurance policy.

[8] I owe great credit to NYUAD '18 Computer Science Major Zane Mountcastle for helping me set up this web application, getting the API to function, and teaching me how to translate the math of Section III into a format readable by a computer. He is great!