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# Disaster and Recovery: The Effects of Post-Disaster Aid on Economic Development

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Disaster and Recovery:  
The Effects of Post-Disaster Aid on Economic Development

Submitted in partial fulfillment  
of the requirements for the  
Murray State University Honors Diploma

Joshua Drouin

May/2017

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## Introduction

International aid play major roles in modern politics. Many in donor nations view them as wasteful expenditures that hurt the donor nation, and others view them as corrupt industries that do not actually aid the receiving nation (Hassan, *The State Capture Onset in Ethiopia: Humanitarian Aid and Corruption*, 2013). Substantial research has been focused on these two questions, but what about instances of non-corruption? What are the effects of aid that reaches the intended recipients at the desired magnitude? The Samaritan's Dilemma, put forth by James M. Buchanan, illustrates a relationship between a "donor" and a "parasite" (Buchanan, 1975). In a Samaritan's game, the donor chooses between being charitable or not, and the parasite chooses whether to work or not. Throughout the game, if the donor chooses to be charitable, the parasite finds it much more advantageous to not work. This is often the statement used by those opposing welfare, but what if we apply this to a nation or society at large? The effects of not working at a societal level can be easily translated into a lack of industry or a decline in industry, either by direct loss or through attrition.

The loss of industry emanates from a crowding out issue. Consider an example in which a charity is willing to come to an area to build houses. Likely, there is someone with the skills and ability to build houses locally; their level of quality may be lower than the charity's, but these local builders are capable. The charities add an issue for local businesses, the charities will do the work for free, or at a significantly reduced cost. Let's assume that the local builders were building houses at a given rate, and then charities arrive and are willing to build houses free or at a reduced rate. Who are the local consumers likely to choose? The free option more than likely. Thus, the local builders lose out on sales. If this trend continues, the local builders may be crowded out by the

charities. Similarly, a business may not start up if it believes a charity may simply show up and undercut it. Remember, this is assuming good intentions and without corruption.

To make a blanket statement about charities is erroneous and does not account for the various types of charities and aid. Infrastructure or education based charities, such as those put forth by Wydick, et Al., show an increase in schooling levels and salary levels in future years (Wydick, Glewwe, & Rutledge, 2013). Improved and increased education is one of the most important aspects in improving an economy in the long-run. Their research suggests that child sponsorship charities achieve this. Thus, not all charities limit the economic output or potential output of an area. Similarly, infrastructure charities, e.g. those that dig wells, likely do little harm in the way of stunting economic growth. While there is little evidence to directly suggest this, one can surmise that by increasing levels of infrastructure, we can expect a decrease in transaction costs, and time spent gathering water, for example, and thus an increase in utility. All of these considerations are important when discussing the effects of charities and aid. We must ensure our focus is on the charities that can potentially cause harm. Thus, charities discussed herein will be primarily donation based and certain serviced based charities; i.e. charities that simply send clothing or other miscellaneous goods, or those that travel to location and perform a service that a local populace could do on its own.

We examine empirically the effects of how international aid impacts the economic development of developing nations. Contrary to our initial presumptions, we actually show how aid simultaneously helps and hurts local economies. Local industries cannot compete with the lower or free cost services and goods that charities provide, and thus are crowded out. This lack of local industry results in a lack of jobs and employment in these areas, subsequently resulting in little salary or monetary growth. These areas, lacking an industrial base of their own, cannot afford

to purchase goods since they have nothing beyond an export oriented economy, and, thus suffer from scarcity for the goods they themselves cannot produce. However, aid does appear to spur on the development of infrastructure and allows for forward linkages and growth potential. Thus, aid is a complicated tool that results in short term losses in exchange for long-term potential, and since aid is not permanent, the negative effects will eventually dissipate.

## Literature Review

The theoretical framework for this issue is laid out perfectly by Calmette & Kilkenny (Calmette & Kilkenny, 2002). They illustrate how aid, in times of calamity or disaster, skew the incentives of the local populace. They outline that even in times of disaster, despite developing nations needing assistance, the long-term effects of foreign aid involvement can often do substantial harm to the local economy. Their research further examines the effects of situations caused by moral hazard, incomplete information, and adverse selection. They highlight issues of who charities should help and how much. Oftentimes, charity involvement is necessary, but many issues such as moral hazard or adverse selection make it difficult to assign aid to the correct country. They conclude that these excess costs are borne heavily by the neediest of nations. They highlight issues of exploitation resulting from charity involvement, but also help lay some of the framework for optimal charity involvement.

An example involves the Australian aid program, specially aid to Papua New Guinea, Heinecke et al. is primarily an indictment of a failing aid program, but throughout, the article outlines the reasons for a failing program (Heinecke, Dollery, & Fleming, 2008). Namely, they expound upon which circumstances aid fails. Fragile states, especially, are subject to aid harming their growth and development. They primarily focus on political institutions, governance

mechanisms, and issues of corruption, but they nonetheless highlight the issues with sending large amounts of aid to fragile states. By focusing on macro-level issues, they highlight the difference between aid being sent to fragile versus more stable states. This difference underscores our claim that developing nations are potentially negatively impacted by aid.

One alternative perspective is the notion put forth by Nowak-Lehmann D. et al. (D., 2009). Their analysis pertained to both the short and long term effects of aid with Germany as the donor nation and around seventy-seven recipient nations, all primarily developing nations. They sought to answer the question of whether aid is effective or not for the donor nation. They contradict old findings that the benefits were large, about \$4/\$1 ratio of dollars earned/dollars donated. Their empirical study resulted in a positive ratio, but a much smaller magnitude, around \$1.5/\$1 on the high end. Their premise is rooted in that the increased aid to developing nations increases the chances that the donor nation is the primary exporter of goods. This finding subsequently implies that by receiving a return on donation investments, donations must be beneficial.

Since we have already discussed aid in terms of an investment, (Agosin & Machado, 2005) we now discuss foreign direct investment (FDI) in terms of its effect on crowding out. “If FDI enters the sectors where there are competing domestic firms, it may take away investment opportunities that were open to domestic entrepreneurs prior to the foreign investments” (Agosin & Machado, 2005, p. 151). Their research highlights the crowding out of domestic investment due to the large volume of FDI. They lay out the theoretical framework for improving FDI in order to help promote domestic investment. Similarly, donations, aid, and charity work can result in the same issues laid out here. The purpose of FDI, is the return for the investor, for this reason, the benefits and returns of FDI may be more to the investor, than the benefits the recipient receives. Similarly, as we stated earlier, many donation groups view aid as avenues for returns at a macro-

level. For example, donating large sums may garner favor in the recipient nation, or, if the aid is used for infrastructure, then the donors may be able to capitalize upon the increased infrastructure. Thus, it is not a far stretch to see that the issues arising from FDI can also be created, in varying magnitude, with charities. The authors outline how even in a best-case scenario, FDI has left the recipient nation unchanged, whereas it is more likely that it has done the developing nation harm, by stunting domestic growth. These same results were replicated and noted in (Fahinde, Abodohou, Mohiuddin, & Su, 2015). These authors note that various types of investment, FDI and development assistance all negatively contribute to growth in various countries in west Africa. Their “results show that ODA [developmental aid] have a lasting crowding-out domestic investment” (Fahinde, Abodohou, Mohiuddin, & Su, 2015, p. 245). These authors then go on to show how these countries could develop better absorption rates and should improve technological gains, but this diverts from the scope of this discussion. Their initial findings still speak to the issue brought forth by many of the authors above. While crowding out is not a perfect comparison for charities, donations, and aid, we can note the similarities in the incentives they create and the outcomes they perpetuate. Thus, it is noteworthy to discuss them in similar context.

Beyond simply charities and aid that help during normal times, we should also consider aid in times of natural disaster. Cohen and Werker point out that “The addition of humanitarian aid to the model produces a bailout effect: governments underinvest in disaster prevention when they know that they will be bailed out in the event of disaster” (Cohen & Werker, 2008). The issues of governmental dependencies continue to propagate in the face of humanitarian aid. These issues are once again on a macro-level and focus more on governmental actions, but it does imply a long-standing issue about the dependency on foreign aid. In fact, this illustrates very closely with the issue we are intending to study. A recipient country may under-invest in disaster prevention or

repair if they believe that an international organization will simply step in to assist them in times of need. Thus, the firms that could have been created in these recipient nations are not created, or are defunded. By not funding their own agencies and firms, these recipient nations are seeing a decrease in employment and job possibilities. One could argue that this should allow the workers who would normally be working in disaster relief jobs to find work in a new industry. The issue here is twofold. First, if this issue of crowding-out local industry pervades the entirety of the market, there may not be any jobs to fill. Secondly, since many of these nations are developing nations, there are intrinsically not many jobs to be filled. These authors conclude that while aid during disaster times can help smooth shocks and prevent collapse of certain markets and areas, it also distorts incentives and may lead to a larger disaster fallout.

While not the focus of this study, a conversation about charity actions in developing countries could not be complete without discussing the impact of corruption. The study by Hassan (2013) about the effects of charity and aid in Ethiopia outlines how aid has been captured by ruling parties and rarely reaches those in need. The scope of Hassan's work goes beyond the intentions of our study, but it is nonetheless important to lay out further issues regarding aid that is not carefully considered. Throughout his work, the author points to the misuse of aid funding by the ruling elite in order to repress and subjugate the lower classes. This is a very common and well-reviewed area, charity corruption. This is not the focus of our work, and this is included to differentiate between what we are attempting to study.

Little research has been done regarding the effects of charities on economic development and crowding out. The issues revolving around FDI are similar to the ones we have found regarding charities. Both of these, FDI and charities, result in a crowding-out effect that drives away and suppresses domestic investment and growth. Thus, in order to promote domestic growth, steps

need to be taken by the international community and charities to curb unnecessary and frivolous aid. Ultimately, the crowding out results in local areas being uncompetitive with respect to the global market. The lack of jobs and opportunities results in a cycle of poverty and aid that hinder any group's rise above it. While some articles show that aid during times of natural disasters is beneficial in that it helps to smooth shocks to the markets, it nonetheless skews incentives domestically. This skewing results in fewer domestic firms being hired by the governments to prepare or repair after a disaster hits. The model laid out by Calmette & Kilkenny illustrates optimum aid levels in order to prevent skewed incentives in times of disaster. Our work analyzes empirically the effects of charities in various developing nations in order to illustrate the effects of not only Buchanan's *Samaritan' Dilemma*, but also the effects of those with respect to the aforementioned framework. We focus largely on the 2004 tsunami in Indonesia and utilize this as a case study. By utilizing the tsunami as a natural experiment, we can observe both time-series and cross-sectional data.

## Underlying Theory and Questions

There are several effects we seek to examine. The first is moral hazard. Oftentimes, if persons are aware of safety precautions, or some form of insurance, they take more risks than they otherwise would. The second is crowding out, which is often referred to with respect to interest rates and government spending. The underlying principle behind this effect, however, is that the actions of larger institutions, such as governments or charities, often replace the actions of private firms and individuals. In our paper, we are examining two primary instances of crowding out: first, the effects of foreign aid and how it distorts the incentives of developing nations to prepare for disasters, which is also viewed as a moral hazard. Second, we examine the hindrance on local firms

post-disaster due to the large influx of charitable actions. Third, we examine the effects of externalities regarding various regions and the aid they receive.

We have determined four core questions that we seek to answer with our data. Do developing nations, when faced with tools to preempt natural disaster, such as a tsunami warning, inadequately prepare due to the known existence of foreign aid and relief? Are local firms and businesses crowded out, due to incoming relief aid? How does aid affect different regions of a nation with various proximities to the disaster? Are there externalities?

First, we examine whether nations prepare insufficiently for disasters. This could be viewed as a moral hazard issue; since these nations know relief aid will come in the event of a disaster, they may choose to inadequately prepare. This is a simplistic view, however. No doubt moral hazards such as these occur, but we are neglecting a substantial fact: cost and amount of funding. It costs hundreds of millions of dollars to create warning systems, and often, many developing nations need this funding for a myriad of other purposes. They must choose between using this money to help prevent a high cost, but low probability disaster, or investing in growth of their industries. The low probability of these disasters skews the cost, and, subsequently, the perceived need by these nations. Therefore, we can see how the existence of foreign aid potentially enables these nations to divert their scarce resources into other areas of the economy. Nations may wish to invest in the profitable areas, and forego the less developed regions. For example, they may choose to improve a factory that has hundreds of jobs and is a major exporter, over protecting areas with subsistence farming.

The skewed cost of a disaster is evident in the aftermath of the 2004 Indonesian tsunami, when, in 2006, they began the process to construct an early warning system. According to Transportation Minister Hatta Radjasa, "Part of the funds will originate from the state budget and

the rest from foreign aid,” and the total cost around \$142 million, reported Roy Tupai (2006). Indonesia could not shoulder the burden alone, and required this foreign assistance in order to prepare. This still puts a large burden on Indonesia. This is after the tsunami, meaning a preemptive warning system, before the 2004 tsunami, would have been harder to encourage support. One of the major issues is quantifying the cost of a disaster. Due to the low probability, and more importantly, the fact that it could occur nearly anywhere, significantly hinders considerations of its cost. The public, and subsequently the leaders, may be reluctant to spend such a large price for something that may not ever happen, but after the event, the nation has witnessed the cost and, thus, may be more inclined to prepare. Nevertheless, a moral hazard may exist, and we seek to examine whether aid does distort funding. One final note on moral hazard. One way our analysis on this topic would be more conclusive, is comparing two disasters in the same nation. Having seen the destruction of the first disaster, a nation may better understand the costs and better prepare. Ultimately, this final note is left as speculation, but if another disaster occurs, it could be utilized to answer many questions.

Second, are local businesses and firms crowded out by relief workers and aid? This question is not one answered so much in pure aid terms. We must examine the impact of boots on ground, or actual relief workers in country. This question can best be summed up in an anecdote. After the 2004 tsunami in Indonesia, many NGOs and charities came to help with disaster relief. Oftentimes, these organizations lack manpower, but have funding. Thus, they hire local persons and simply direct and pay for the relief effort. In the anecdote, these NGOs paid western wages and attracted many individuals to them for pay. This pulled local individuals away from local industries. The absence of labor hurt the local firms, and when the NGOs left, the economy had been hurt, despite the relief workers. The anecdote is not the proof, but the inspiration for the

question. We want to examine whether this effect actually occurs. Do local firms, when faced by stiff competition from NGOs, lose out on labor, and subsequently profits, ultimately deciding to close? By examining growth rates before and after disasters we can view the variations in trends of job growth

Lastly, how do these and other effects impact various regions in a nation. Specifically, we want to examine areas affected by the disaster, and compare them to nearby regions, and more remote regions. Utilizing this data, we can control for various national policies that could potentially confound our results, but we can also measure effects of spillovers. By observing these differences, we can potentially observe cross-region crowding out, where business in regions unaffected by the disaster still lose business to NGOs and charities. This will also allow us to observe whether the effects of aid are localized, or if they have national benefits or detriments. For example, does improving infrastructure in the disaster zones have a positive externality to nearby regions? These spillover effects can lead to more long-term growth in a nation despite the disaster.

Ultimately, we want to examine relief and foreign aid surrounding various natural disasters. We want to examine the potential moral hazard of over-relying on aid, inadequate disaster preparedness, the potential crowding out of local firms by international organizations and charities, and whether there are any externalities, or spillover, for non-affected regions. By answering these various questions, we can arrive at a comprehensive view of aid and its effects. This data could then be useful in calculating appropriate aid measurements or styles; by improving the efficiency of aid, we can increase the welfare of a nation without exacerbating any latent issues.

## Methods and Analysis

Our analysis focuses largely on Indonesia due to the large amount of data available. By utilizing the 2004 tsunami as an event study, we are able to examine the various regions affected and unaffected, both before and after, in order to obtain a more holistic view of the disaster and the aid. While our initial desire was to include various nations and disasters, the limited availability of data has restricted our study to only Indonesia. Nevertheless, the dataset we have for Indonesia is very thorough. We have over two hundred variables for the nearly 550 districts in Indonesia. With this level of data, we thought it best to focus our efforts in order to understand it in more depth. The granularity of this data allows us to examine the local effects of the tsunami and aid on more than national level data would allow. We have defined minor impact districts as those districts either adjacent to a major impact district, or in line with the Tsunami, but at a greater distance. This description is somewhat loose with regard to damage, but it allows us to differentiate between nearby regions and regions on the other side of Indonesia. While the effects of disaster and aid may be catastrophic, it may only marginally effect a nation at large, but may be devastating to a local populace. Therefore, by utilizing this data over some other nations we examined, we believed we could get to the root of the issue and avoid any unnecessary noise.

We first began breaking down the data by category, such as poverty rate or unemployment figures, and by three different years. The tsunami occurred on 26th of December 2004, thus, we selected the years of 2003, 2006, and 2011. By selecting years both before and several years after, we can gauge long term trend changes in various economic variables; also, by selecting 2006 we can observe the effects of the vast amounts of aid that come in. The categories we selected are largely based upon the availability of data, as a substantial amount of data was not recorded in 2003 or 2006, thus limiting our options. Nevertheless, utilizing infrastructure expenditure and

various GDP expenditures we can observe various conditions and situations. We also assigned dummy variables for the years and whether the area experienced a major impact, a minor impact, or no impact at all. All of the economic data was gathered through the World Bank and its various databases. Utilizing all of these variables, we have arrived at some interesting results to answer our aforementioned questions.

Lastly, there are some limitations in the data that we have. Due to lack of aid data at the regional level and the lack of aggregated charitable aid, in both monetary and humanitarian forms, we must tread carefully in reaching our conclusions. The aid data that we have is for national levels only. We were unable to find these values for provincial or regional levels and had to simply resort to national level data. For this reason, examining a cross section of a specific year is difficult and potentially deceiving. We attempted to compensate for the limitation by assigning the same aid level to each region. We chose this option since the changes in aid were the important aspects of the data. When examining one year alone, however, we have no change in this variable and, thus, the calculations return an error. Also, when examining time-series data, this variable is more accurate, but also creates an endogeneity issue, since areas with higher poverty are likely to receive higher levels of aid, for instance. We have attempted to mediate this problem by lagging the aid received by a year, due to the natural lag of receiving money before actions and repairs actually occur. This does not remove the endogeneity issue entirely, but it does help to mitigate it.

In terms of non-monetary aid, finding data for this from the myriad of different sources, such as charities and church groups, would be nearly impossible. For this reason, due to the nature of a natural disaster and the aid it will encourage, we assume that the aid data we do have acts as a signaling tool for non-monetary aid. Vast swaths of aid were donated and many organizations sent workers to help with the disaster. For this reason, we can safely assume that both monetary

and non-monetary aid increased and decreased at roughly similar rates. Working from these assumptions and compensations we begin analyzing our data and our aforementioned questions.

Finally, for various economic figures such as unemployment and labor information, a majority of regions in Indonesia did not begin recording these figures until 2007. For this reason, the first two years we have selected, 2003 and 2006, do not contain any of these figures. We have attempted to compensate for this shortcoming by utilizing the available figures and attempting to find a correlation between the labor figures in 2011 and other variables that are also available in 2003 and 2006. By repeatedly utilizing these variables, we hope to use them as signals to compensate for the lack of labor figures in the 2003 and 2006 time sets, in other words, we are attempting to find an instrumental variable. For example, various GDP expenditures, which are available in 2003 and 2006, also strongly correlate with unemployment in the 2011 set. For this reason, we use these GDP expenditures as a rough tool to somewhat show changes in unemployment, even when the actual unemployment figures are not available.

### *Moral Hazard*

The first question we sought to answer was whether governments under-prepare for natural disaster due to known existence of foreign aid. We began examining this by focusing on 2003, since this was before the disaster, and observing the amount spent on infrastructure and the GDP expenditure on construction. We focus on these variables primarily due to their intrinsic nature toward lasting investments, such as buildings and infrastructure. Typically, in order to make a building or an infrastructure system disaster resistant, the cost is quite high. For this reason, we should expect both of these variables to be higher. Since these variables represent a nation's or region's expenditure on buildings and infrastructure, if they are markedly high, we would assume that a substantial amount of funds is being supplied in order to not only construct areas, but

construct them well. This could also account for areas of large growth, which is why we have utilized various other expenditure types as control variables.

One limitation of the data is evident here. Since aid data is not at the regional level like the rest of the economic data, we are unable to utilize it as a variable in our regression. However, we have attempted to compensate for this issue by examining instead the infrastructure and construction expenditure in 2003 on the various districts. We are unable to ascertain whether aid has any direct impact, but the data does seem to imply a different answer altogether. Our regressions actually seem to imply that the region's proximity to the disaster, mattered very little in terms of infrastructure and construction expenditure. Instead, we have found that it is the economic strength of the region that influences the expenditure amount. In other words, the only thing that significantly affected the expenditure amounts, was the wealth of region, and how developed it was, as you can see in Table 1.

This shows that nations choose to build up areas that have higher economic value, and forego areas with less. This makes sense. A developed region has positive externalities for the entire nation. It provides jobs, provides goods to export, attracts investors, increase tax revenue, and brings a myriad of other positive effects. An impoverished area, on the other hand, struggles to sustain itself, and brings little in terms of national improvement. Thus, when faced with limited resources and being able to only protect one region, nations will choose the developed one because it provides a greater return for the nation. Similar to how one cares little about planning for retirement if one is struggling to make ends meet today, impoverished areas have little to protect that will yield a national return. Nations may be less inclined to prepare for disasters in areas that hold little value. They may instead focus their funding and preparation on areas that hold a strong economic value.

This conclusion is more of an educated inference, however, due to the obvious endogeneity issue of high income areas and more infrastructure spending. The high-income areas are growing and expanding much quicker than others, and have a substantial incentive for further expansion, whereas lower income areas will inherently receive less. This is in terms of raw infrastructure expenditure, completely irrelevant of disasters. For this reason, however, we can somewhat extend the logic to disaster situations. Nations do not expressly underprepare because of foreign aid; they merely prepare certain areas more than others, based upon the value of that region. One final impact of this decision-making process, is the mostly inherent randomness of natural disasters. While some areas are marginally more at risk than others, overall any coastal region is at risk of a similar disaster. Hence, since nations cannot feasibly prepare all regions, they must prioritize which regions are more important.

Foreign aid may play a role in their decision, though. Due to the existence of foreign aid, they may choose to not invest in poorer areas and instead use their finite resources to expand and protect areas of much more importance. Thus, aid may actually encourage nations to expand their growth in their best and burgeoning sectors, and get more of a national return than if they had spent this preparing a poorer sector. Ultimately, aid allows nations to redirect their funds toward districts that will have higher economic return, due to the comfort that aid will be provided to the poorer areas in the event of a disaster.

### *Crowding Out*

The second question we sought to answer was whether aid, both workers and funding, crowds out local workers, business, and investment. We first begin by examining the poverty rate. We spoke about the endogeneity issue early, but, nonetheless, the results are noteworthy. As one can observe on Table 2, noting the potential endogeneity issues, we note that

overall aid tends to correlate with high poverty rates, and as expectantly, those areas hardest hit by the tsunami also exhibit higher levels of post-disaster poverty. Even when controlling for regional variations of wealth, such as household expenditure and GDP expenditure rates, we still note an increase in poverty with response to aid. Not included below, due to not being statistically significant, our regressions show that by 2011 the hardest hit areas exhibit a reduction in poverty, but again, this was not significant. We make the assumption here that aid is going to the hardest hit districts. Since this is where the most damage occurred, it makes sense the charity groups and the various types of aid would prioritize these regions over others. For this reason, we expect the effects of aid on majorly impacted districts to be much greater than any other region. One final note to remember is that we have lagged our aid data. The aid data that is being tested is one year before the other economic figures. This helps to somewhat mediate the endogeneity issue, since the aid influx occurred before the changes in poverty that we are testing.

Second, as you can observe from Table 3, when we restrict the regression to non-majorly effected areas, we still note an increase in the poverty rate. This restriction allows us to rule out part of the endogeneity issue brought about by the aid data. We can assume that a vast majority of aid went to the majorly effected regions, and yet the aid that did go to other regions still has a negative impact. For every one percent increase in aid, we note a (.6) percent increase in poverty. Utilizing these statistics, we can observe how increases in aid actually appear do some harm over time to jobs. We also note that various independent variables in the above regressions also correlate strongly with unemployment rates.

However, this view is not comprehensive. One consistent theme throughout every single regression and analysis we performed, is that electricity rates always correlate very strongly and positively with growth indicators. Thus, when we observe Table 4, we actually can see that over

time, electricity rates in effected areas trends upward. Looking only at the time variable is misleading. Noting the 2011 coefficients on both major and minor impact districts, we note that both of these express an increase. This implies that over time, since these are the areas that likely received the most in foreign aid, these districts have seen a marked increase in electricity rates. As stated, electricity rates correlate strongly with growth indicators. Therefore, we should see that growth should be occurring in these areas since, by 2011, both levels grow well beyond their initial points.

Therefore, combining the results of the above reports, we note that aid helps in certain ways, but hurts in other. Aid does appear to crowd out workers and business, hindering investment, savings, and monetary growth. This ultimately leads to higher levels of poverty and an increasing poverty gap. At the same time, aid also helps rebuild vital infrastructure and bring electricity and clean water to not only the areas that lost it, but also to new areas. Contrary to our initial presumptions, aid does appear to hurt in the short run, but help in the long run. By helping to rebuild infrastructure, and bring it to new areas, new forward linkages are investments that encourage future growth and development. They unfortunately do this by forgoing backward linkages. By utilizing foreign aid and workers, an influx of aid displaces a myriad of workers and hinders labor growth, thereby hurting the regions in the short term. Ultimately, to observe the long-term we would require more data, many years beyond that which we have. Nevertheless, it is hopeful to see that aid does indeed appear to help in the long-run.

### *Spillovers and Externalities*

Rarely does an event only effect those directly involved. Oftentimes, we have repercussions and consequences that effect those nearby. This concept is also applicable involving

disasters and the recovery. The damage done to the roads in one area, may hinder travel through that region and ultimately hurt the economy of a region unaffected by the disaster. Alternatively, creating new infrastructure may encourage new developments in nearby regions, due to a greater availability.

In order to observe this effect, we actually refer back to tables 2 and 3. Table 3 restricts the regression to only minor impact and no impact regions, the major impact regions are excluded. This allows us to observe the areas that likely did not receive the bulk of the aid. As we can see from above, aid does still appear to correlate with poorer regions. While the endogeneity issue is still present, it is less noticeable here. In the previous crowding out discussion, due to the limitations of data and since we were discussing the hardest hit regions, confounding results are borne due to aid likely going to areas that were hardest hit and needed the relief the most. In this instance however, these areas in question were not badly damaged and suffered far less than the majorly affected regions. For this reason, the endogeneity issue somewhat diminishes. Since the hardest hit regions likely received the most aid, the minor impact districts likely received very little, relatively speaking. With this consideration noted, by observing Table 3, we still note the positive correlation between aid and poverty rates.

This appears to suggest that the aid spillover effects are also positive, but small. While we discussed earlier that aid hurts the majorly affected regions in the short term, it ultimately creates forward linkages and promoting future growth. A similar story can be told for the minor impact districts. When observing Table 3, we note an increase in poverty. However, when observing Table 5, we note a positive, yet insignificant, correlation between aid and electricity rates in minor impact and no impact districts. However, we note a substantially positive and significant growth in minor impact districts in 2011 relative to earlier years. Observing the coefficient on minor impact, we

note that in 2003 and 2006, minor impact districts were much lower than unaffected districts. Yet, once the aid has been distributed and utilized, i.e. in 2011, we note a substantial growth of electricity rates in minor impact districts. The issue is, whether this was purely a result of aid, or if some other factors were at play. For this reason, it is safer to state that the spillover effects appear to emulate that of the crowding out question above. We note an increase in poverty rates with the influx of aid, but also appear to have an increase in electricity rates, leading to forward linkages and the potential for growth; however, due to the limitations of the data, we cannot attribute aid as the key factor here.

In terms of the fidelity and consistency with our data, we performed a few various actions to test for any issues. First, we performed heteroskedasticity tests for each regression output, and the results were consistent with all of those below. Since the Huber-White outputs were very similar to our findings, we have elected to not include them. Similarly, we used a correlation matrix with the major variables that were used, and it did display some collinearity between a few variables. Thus, we re-ran the regressions with one removed, but the results were once again very similar. Throughout both tests the coefficients never changed, the R-squared values remained roughly the same, and the T-statistic also remained roughly the same. Thus, we feel confident in the consistency with our results.

## Results

Contrary to our initial presumptions, aid does appear to promote long-growth and development. When examining our three issues, each time we arrive at a somewhat unexpected conclusion. As we stated earlier, we anticipated that aid would displace workers and local business by crowding out their potential. We approached this by using aid data as a signaling tool around

the 2004 tsunami. As we have stated also, there are limitations in the data. First and foremost, we have neither the numbers for charity involvement, nor the figures for non-monetary aid. We have attempted to compensate for this by utilizing foreign developmental aid as a signaling tool. Secondly, the aid data that we have is only at the national level, whereas the rest of economic data is at the provincial level. This creates some issues when running regressions and drawing conclusions from them. Since we cannot know where the aid went, we must make the assumption that a majority of it went to the hardest hit areas. While this is a limitation, this assumption we make is not unreasonable. Despite some of these drawbacks, we have nonetheless arrived at some interesting conclusions.

With regard to the moral hazard question, it appears that nations do not underprepare for disasters, so much as they only prepare those areas that are important. By observing the amount of funding toward infrastructure and construction, the most important expenditures for minimizing the damage from disasters, we observe that the funding amounts had no relation to the magnitude of the impact of the disaster. Since each region has arguably the chance of being hit by a disaster, we observe that areas with high level of development are the ones being prepared for disasters. There are two important considerations to note here. One, is an endogeneity issue brought about by the expenditures. Areas with higher levels of development almost always have higher infrastructure expenditure. Regardless of the level of risk a region is for disaster, we often observe wealthier areas getting more development.

Secondly, an inherent part of infrastructure development is ensuring that it is resistant to disaster. Since making resilient infrastructure costs more than poorly constructed infrastructure, we can conceptualize resilient infrastructure is a normal good. Therefore, the wealthier areas may

spend more on infrastructure because of the growing demand for it. By the same token, they are likely developing it to be resilient since they are wealthier. Hence, despite the former issue of endogeneity, we can still draw conclusions from what we have available. With all of these considerations, we have arrived at the conclusion that governments do not underprepare for disasters because of foreign aid. They instead focus their limited resources on the areas that have the highest economic return. They continually invest and secure the areas that benefit the nation. Furthermore, foreign aid likely does play a role in reinforcing this behavior, but it is a good thing. Since resources are scarce, a nation can spend its money on expanding and protecting a wealthy area that ultimately benefits the whole nation, or spend its money protecting an area of the nation that brings little benefit and directing funds away from the wealthier areas. Foreign aid allows nations to focus more heavily on the more developed regions, and as these regions grow, they will benefit the nation as a whole.

With regard to the crowding out issue, it appears that aid may hurt in the short-run, but does appear to help in the long-run. From our results above, we note that aid appears to correlate with higher levels of poverty, regardless of magnitude of impact. As we have stated, there is the issue of endogeneity here, which is why we cannot state the first part above with certainty. For example, if a business owner lost his house and business, he probably will care more about his house than the profits of his business. Due to this inherent limitation, we cannot draw any substantial conclusions from aid and the poverty amounts. If we had regional aid levels of data, we could observe the effects of aid on areas that were not hit by the tsunami and see if they had any crowding out; however, we do not have that data.

Nevertheless, we were able to find some interesting results from the data. We note a significant and positive correlation with aid and electricity rates. Throughout a myriad of regressions, electricity rate has always correlated with higher levels of development. Thus, we appear to observe that aid data and workers are making substantial repairs and developments in infrastructure. This is typically one of the goals of aid, so it is encouraging to see that it correlates. In terms of development and growth, this is imperative. Increases in infrastructure creates forward linkages that not only assists those present, but also encourages new business and persons to enter the area. Hence, aid appears to not only repair the infrastructure in an area, but also brings more than was there before the disaster, and subsequently prepares areas for substantial future growth. Combining both of these factors above, we note that aid creates forward linkages at the expense of backward linkages. Aid improves the infrastructure of areas, but does so without spurring local workers and builders to be the ones to improve it. This is consistent with the work of James Buchanan (1975), the findings by Agosin & Machado (2005), and the results from Fahinde et al. (2015).

Lastly, with regards to the spillover effects, we note a similar trend as the crowding out issue above. Throughout our regressions, we note almost an identical trend as the one above. This is partially due to the limitations of the data, resulting in the same confounding variation as above. This aspect is one of the weakest in terms of correlation. Nevertheless, we do note a slight positive correlation between aid and electricity rates in non-major impact districts. This could partially be explained due to how infrastructure is designed. For example, repairing and improving the electricity lines in only one district does little good unless you repair all of the lines back to the power plant. Thus, we should see more comprehensive improvement. Ultimately, without regional aid data, this question is even harder to answer than the former.

## Conclusion

Ultimately, we do note a positive impact between aid and development involving natural disasters in Indonesia. Despite the limitations in the data, we do note that aid encourages nations to invest in their most profitable districts, and that aid may crowd out workers, but helps to build up the infrastructure which will invariably lead to long-run growth. More could be done on this topic, however. Our original intention was to include more nations in this study, but due to more aid limitations, we decided to abandon those and focus our efforts on Indonesia. The major limitation of any similar study will be data availability. The World Bank has been an amazing source of our data, but even it has limitations. One thing of note, for the good, is that a vast majority of regions in Indonesia did not record data for years before 2007, but have since started. This will hopefully make any future endeavors much easier, and much more fruitful.

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## Tables

Key of Variables	
Variable	Description
GDP_T_H_R	GDP Expenditure of the Tourism, Hotel, and Restaurant industry
GDP_CONS	GDP Expenditure of the Construction industry
MONTHLY_HEALTH_EXP_PER_C	Monthly Per Capita Household Health Expenditure
MONTHLY_EDUC_EXP_PER_CAP	Monthly Per Capita Household Education Expenditure
HOUSEHOLD_EXP_PER_CAP	Household Expenditure per Capita
INFRASTRUCTURE_EXPEND_	Infrastructure Expenditure
ELECTRICITY_RATE	Percentage of people with access to electricity
SAFE_WATER_RATE	Percentage of people with access to safe water
MAJOR_IMPACT	Dummy variable: Did the region suffer a major impact from the Tsunami
MINOR_IMPACT	Dummy variable: Did the region suffer a minor impact from the Tsunami
IF_2003/IF_2006/IF_2011	Dummy variable: 1 if the data variable was in 2003/2006/2011 respectively
TIME	1 for 2003; 4 for 2006; 9 for 2011
AID	Net developmental aid to Indonesia
POP	Population

Table 1

### The effects of various figures on Infrastructure Expenditure in 2003

Dependent Variable: LOG(INFRASTRUCTURE_EXPEND_)				
IF_2003=1				
Variable	Coefficient	t-Statistic	Prob.	
C	12.00948	4.354663	<b>0.0000</b>	
LOG(GDP_T_H_R)	0.394660	9.022918	<b>0.0000</b>	
LOG(MONTHLY_EDUC_EXP_PER_CAP)	-0.206477	-1.336419	<b>0.1823</b>	
LOG(MONTHLY_HEALTH_EXP_PER_C)	0.054526	0.319138	<b>0.7498</b>	
LOG(HOUSEHOLD_EXP_PER_CAP)	0.702131	2.422940	<b>0.0159</b>	
MAJOR_IMPACT	-0.099322	-0.257227	<b>0.7972</b>	
MINOR_IMPACT	-0.058942	-0.203887	<b>0.8386</b>	
R-squared	0.285273			
Adjusted R-squared	0.272078			
F-statistic	21.61981			
Prob(F-statistic)	0.000000			

Table 2

<b>The effects of various figures and aid on the Poverty Rate</b>				
Dependent Variable: POVERTY_RATE (In percent, e.g. 15%=15.0)				
Variable	Coefficient	t-Statistic	Prob.	
C	106.0719	4.958019	0.0000	
LOG(POP)	0.826795	1.825610	0.0682	
LOG(GDP_CONS)	0.953764	3.787234	0.0002	
LOG(GDP_T_H_R)	-1.743039	-4.928480	0.0000	
LOG(INFRASTRUCTURE_EXPEND_)	0.478238	2.028251	0.0428	
LOG(HOUSEHOLD_EXP_PER_CAP)	-12.23986	-9.852943	0.0000	
LOG(MONTHLY_EDUC_EXP_PER_CAP)	-0.824610	-1.278207	0.2014	
LOG(MONTHLY_HEALTH_EXP_PER_C)	1.372628	2.197759	0.0282	
ELECTRICITY_RATE	-0.179566	-11.87731	0.0000	
MAJOR_IMPACT	5.262932	3.751977	0.0002	
MINOR_IMPACT	1.179354	0.937715	0.3486	
TIME	1.062493	8.727932	0.0000	
LOG(AID)	2.795338	3.890777	0.0001	
R-squared	0.500711			
Adjusted R-squared	0.494972			
F-statistic	87.24772			
Prob(F-statistic)	0.000000			

Table 3

<b>The effects of various figures and aid on the Poverty Rate in Minor and No Impact Regions</b>				
Dependent Variable: POVERTY_RATE (In percent, e.g. 15%=15.0)				
IF MAJOR_IMPACT=0				
Variable	Coefficient	t-Statistic	Prob.	
C	102.2697	4.737089	0.0000	
LOG(POP)	1.026116	2.255959	0.0243	
LOG(GDP_CONS)	0.997938	3.950466	0.0001	
LOG(GDP_T_H_R)	-1.814255	-5.106473	0.0000	
LOG(INFRASTRUCTURE_EXPEND_)	0.413605	1.739413	0.0822	
LOG(HOUSEHOLD_EXP_PER_CAP)	-12.03335	-9.612316	0.0000	
LOG(MONTHLY_EDUC_EXP_PER_CAP)	-0.964364	-1.484549	0.1379	
LOG(MONTHLY_HEALTH_EXP_PER_C)	1.537108	2.456612	0.0142	
ELECTRICITY_RATE	-0.182533	-12.06829	0.0000	
SAFE_WATER_RATE	0.018251	1.305147	0.1921	
TIME	1.055180	8.603451	0.0000	
LOG(AID)	2.833101	3.905193	0.0001	
R-squared	0.501602			
Adjusted R-squared	0.496650			
F-statistic	101.2835			
Prob(F-statistic)	0.000000			

Table 4

<b>The effects of various figures and aid on the Electricity Rate</b>				
Dependent Variable: ELECTRICITY_RATE (In percent, e.g. 15%=15.0)				
Variable	Coefficient	t-Statistic	Prob.	
C	-101.7571	-2.918969	0.0036	
LOG(POP)	-2.003820	-2.535582	0.0114	
LOG(GDP_T_H_R)	5.995800	9.372294	0.0000	
LOG(INFRASTRUCTURE_EXPEND_)	-1.810867	-3.812306	0.0001	
LOG(MONTHLY_HEALTH_EXP_PER_C)	17.00558	18.04490	0.0000	
MAJOR_IMPACT	2.576335	0.647696	0.5173	
MINOR_IMPACT	-14.89479	-4.633733	0.0000	
IF_2011*MAJOR_IMPACT	8.136850	1.386879	0.1658	
IF_2011*MINOR_IMPACT	12.06025	2.185020	0.0291	
TIME	-2.662091	-12.73320	0.0000	
LOG(AID)	1.934176	1.295407	0.1954	
R-squared	0.515075			
Adjusted R-squared	0.510813			
F-statistic	120.8753			
Prob(F-statistic)	0.000000			

Table 5

<b>The effects of various figures and aid on the Electricity Rate in Minor and No Impact Regions</b>				
Dependent Variable: ELECTRICITY_RATE (In percent, e.g. 15%=15.0)				
IF MAJOR_IMPACT=0				
Variable	Coefficient	t-Statistic	Prob.	
C	-103.7955	-2.943003	0.0033	
LOG(POP)	-1.952606	-2.444519	0.0147	
LOG(GDP_T_H_R)	6.094805	9.434019	0.0000	
LOG(INFRASTRUCTURE_EXPEND_)	-1.877535	-3.911511	0.0001	
LOG(MONTHLY_HEALTH_EXP_PER_C)	17.03720	17.92389	0.0000	
MINOR_IMPACT	-15.01326	-4.654181	0.0000	
IF_2011*MINOR_IMPACT	12.05335	2.176458	0.0297	
TIME	-2.660933	-12.65620	0.0000	
LOG(AID)	2.002266	1.325518	0.1853	
R-squared	0.519199			
Adjusted R-squared	0.515746			
F-statistic	150.3706			
Prob(F-statistic)	0.000000			