

Final report

The economic impacts of Ebola on firms in Sierra Leone

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Project Report:
The Economic Impacts of Ebola on Firms in Sierra Leone¹

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1. Introduction and Motivation

In 2014, Sierra Leone was hit by the emergence of Ebola, a deadly and terrifying disease. In an effort to control the spread of the disease, national and international agencies took drastic action: land borders were closed; several international airlines stopped service to the country; cordons were placed around particularly affected districts; schools were closed for nine months; and bars, nightclubs and restaurants were restricted for over a year. The economic consequences of the fear and disruption caused by the outbreak have been hard to estimate, not least because Sierra Leone simultaneously suffered a reduction in the price of iron ore, one of its main exports. Few would contest, however, that the economic impacts were substantial. In previous work, we used nationally representative household surveys to document how hours worked fell for those in informal employment and that nonfarm household businesses were badly hit during the worst of the crisis (Fu *et al.*, 2015).

However, little is known about how formal sector firms reacted to the crisis. As in other low income countries, formal sector firms represent a relatively small fraction of employment in Sierra Leone (91% of the labor force is self-employed), but a much higher proportion of taxes and exports (corporate tax alone makes up 11% of tax revenues). In this paper, we characterize these firms (their size, sales, persistence and employment patterns). We also document what information these firms are, and are not, willing to disclose. Finally, we examine how these firms acted during a year of crisis. While we hope that Ebola crises will remain rare, crises of other kinds including exchange rate crises,

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political crises, and natural disasters are unfortunately all too frequent. A common thread to many of these crises is uncertainty and disruption, which may have direct effects on firms' abilities to plan and operate. Firms may also suffer indirect effects if consumers or small firms respond to uncertainty and disruption by increasing savings, reducing investment, and/or cutting back on discretionary purchases.

Bowles *et al.* 2016 is the one other paper we are aware of that attempts to look at the impact of the Ebola crisis on formal firms, in this case in Liberia. Compared to baseline levels of activity, they estimate that by the height of the crisis firms experienced falls in employment ranging from 13 to 47%; an overall closure rate of 12% (although they do not have data on pre-crisis closure rates as a comparator); and a fall of 30 to 49 percentage points in the likelihood of winning a contract. The county of Montserrado, where the capital Monrovia is located, was the hardest hit. There are two limitations of these data. First, the data come from an organization that works with local firms interested in connecting with large buyers including government and foreign buyers. This means that the firms studied are not representative of all registered firms, and in particular, are unlikely to include large established firms that already work with government and foreign firms. The second drawback is that they collected data only on this limited number of outcomes (employment, firm closure, and contracts won).

The set of firms in our data, by contrast, comes from the National Revenue Authority's (NRA) register of all tax paying firms, so is representative of the population of medium and large tax paying firms in Sierra Leone (with some caveats for firms that we could not locate or those that did not complete the survey). For the largest firms, we attempted to collect data on employment, revenues, costs, trade and liquidity for all firms, providing a unique picture of the development of this important sector during a crisis. For medium sized firms, we chose a random sample to collect the same detailed data on. Note that while we reached firms through contacts provided by the NRA, the data comes from private surveys and is not official data, so does not generate incentives to underreport sales or over report costs.

The main finding of this paper is twofold: formal sector firms in Sierra Leone suffered falls in sales of close to 25% at the height of the Ebola crisis; while at the same time, the response of firms in terms of employment was muted. As costs did not decline, it

is likely that firms had to increase their borrowing substantially. Whether this was through formal credit from banks or through trade credit or failure to pay bills (including taxes) we are unable to tell. In particular, firms were reluctant to tell us about the loans they took out during this period. While we do not have a very large sample of exporting firms (our sample does not contain any of Sierra Leone's large iron ore mines, which represent 13% of the country's exports), we find little evidence of a fall in exports during the period. In addition, we find little evidence that trade disruptions interrupted imports for the firms in our sample. This reinforces our earlier finding of little changes in the number of ships entering and exiting Freetown (Glennerster and Suri 2015), although it is contrary to press reports at the time. One story of trade disruption we heard at the time was that importers were finding it hard to get credit to purchase imports. The combination of falling sales and no decline in costs that we document here makes this plausible, although we cannot see this playing out in lower levels of imports, at least for these formal sector firms.

Our finding of little firm response along the margin of employment stands in sharp contrast to those from Bowles *et al.* who found large drops in employment in Liberian firms. There are several reasons why our results may differ. As mentioned, we are working with a very different sampling frame, one that is more representative of the population of firms and likely includes relatively larger firms. Second, we used different empirical strategies: Bowles *et al.* measure how firms responded in more and less affected counties (separating out Montserrado), whereas we look just at the time path of outcomes around the Ebola crisis. We do this for two reasons: the economic impacts of Ebola worked mainly through mechanisms not directly related to numbers of Ebola cases; and the vast majority of firms had their primary location in Freetown, the capital of Sierra Leone. Note also that outside Liberia's capital, Bowles *et al.* do not find a systematic relationship between the disease burden and the economic effects on firms. Third and finally, the outbreak was different in Sierra Leone than in Liberia: Monrovia was affected sooner and more intensely than Freetown, which may explain why Bowles *et al.* find large effects on employment and we do not.

Our finding that firms in Sierra Leone held on to their workforce in the face of substantial declines in sales suggests that large firms can potentially play an important stabilizing role in the midst of economic crises. It also raises questions, however, about the

constraints these firms are under which prevent them from adjusting their costs even in the midst of sharp changes in revenues.

The rest of this paper is organized as follows. Section 2 sets out some background on the Ebola crisis, in particular the timing of the outbreak and the responses to it. It maps out likely pathways through which the crisis could impact the economy in general and formal sector firms in particular. Section 3 explains our data and section 4 covers the results. Section 5 briefly concludes.

2. Background on the Ebola Crisis

The first cases of Ebola in West Africa were recorded in December 2013 in Guinea in a remote region close to the border of eastern Sierra Leone and northern Liberia. The first cases in Sierra Leone were documented in May of 2014 (World Health Organization 2014). The number of cases rose steadily and at the end of June, the first cases outside the eastern districts started to appear. In July, cases spread rapidly across the country and reached Freetown. This, combined with the experience of Liberia (which was a few weeks ahead of Sierra Leone in the development of the epidemic) and the first western deaths from the disease, suddenly galvanized action on the national and international level. On July 31, the President of Sierra Leone announced a state of emergency. The districts of Kailahun and Kenema, where the disease had first entered the country, were placed under a cordon with only approved transport allowed. Activities and places where people congregated were shut down. This included schools, bars, and restaurants. Schools were to stay closed for the next nine months. Several airlines responded to the crisis by ending regular flights to the country, there were reports of ports turning back ships that had entered any of the three affected countries (although these reports were likely exaggerated as our evidence suggests), and many organizations evacuated international staff.

<Figure 1>

By the beginning of September, the international community had started to prepare a response, with its own potential economic implications. The World Bank provided emergency lending to the government, and international nongovernmental and governmental agencies started to provide health assistance including establishing centers to test and treat individuals. Through the fall as the crisis response became more organized,

local people were hired for a number of Ebola related tasks including to inform communities of the best ways to prevent the spread of the disease, to aid in the care of infected patients, and to appropriately dispose of the bodies of victims who had died.

In considering the economic implications of the crisis, there are four major potential channels. The first, and likely least impactful, is the direct effect of the disease on the work force of the country. In total, it is estimated that 3,956 people died from the outbreak.² While this number is large, and documents a devastating loss of human life, it represents only 0.06% of the population and is thus unlikely to have direct economic implications outside the health sector, where death rates were particularly high.

The second is the impact of measures taken to prevent the spread of the disease, in particular the closing of bars, restaurants and schools. (For a period, the hours at which people could visit markets was restricted but this measure was only in place relatively briefly). These restrictions likely had their biggest impact on the informal economy. While some bars and restaurants are registered, the majority are not. Nevertheless, there were likely knock-on effects, for example to the large formal sector local brewery. The disruptions most likely to disproportionately affect the formal private sector were the imposed restrictions on trade, much discussed at the time. It is unclear how much formal sector firms rely on trade over land borders (which were closed) and how much shipping and air freight were affected. (In separate work we attempted to track whether the number of ships entering and exiting Freetown's deep harbor was impacted by the crisis and found relatively little evidence of change during this period).

The third mechanism of economic impact likely worked through fear and uncertainty. A natural, and logical, response to uncertainty is to increase precautionary savings, which can depress economic activity. Add to this a fear of contact with others and we would expect a decline in discretionary purchases ranging from having one's hair done to taking a trip to visit family. Again, much of the impacted firms are likely to be in the informal sector, but trade may be particularly badly hit by these responses to a crisis.

The fourth and final mechanism through which the crisis might impact the economy is positive, and results from an inflow of money and people, like disaster relief workers,

² Data from CDC accessed on April 6, 2017. <https://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/case-counts.html>

responding to the crisis. This response came only with a substantial lag, picking up in mid to late fall of 2015.

3. The Data

i. Data Collection

We collected data via a series of in-person interviews with managers of firms. We sampled firms from administrative data provided by the National Revenue Authority (NRA) on large and medium tax paying firms. For large tax payers, we limited the target set of firms to those that appeared in the NRA data for 2014, the year of the Ebola crisis (this excluded 19 firms that appeared in the NRA data only in 2013 or 2012, reducing the target population from 204 to 185). We initially endeavored to survey this entire population of large tax payers. After early data collection efforts, however, we decided to exclude a few key sectors (financial, mining and telecoms). For financial firms, we developed a separate survey instrument for the banks, which was completed by 8 major banks. Most of the mining firms went out of business during 2014, but mainly due to the sharp drop in commodities' prices, and the small number of large telecoms were difficult to get data from. For medium tax payers, we drew a random sample of 210 firms from the population of 864 firms appearing in the NRA 2014 administrative data. The firms in our survey represent 0.2 percent of the labor force in Sierra Leone. However, their annual sales are equivalent to over 9% of GDP.

Firms are known to be more difficult to interview than households in developing countries, and this proved true in Sierra Leone. Table 1 summarizes response rates. Overall, we have 257 completed surveys for a raw response rate of 65%, which compares reasonably well to the literature on medium- and large-scale firms.³ If we limit to those firms we made contact with (dropping non-targeted sectors, non-firms, and those we could not locate), the cooperation rate is 84%.

<Table 1>

³ Bandiera et al, 2017 survey manufacturing firms in Brazil, France, Germany, India, United Kingdom, and the United States and get a response rate of 17%. Bloom et al, 2015 report on a survey of firm management practices in 21 countries. Response rates varied from 21% in Japan to 68% in Italy and Sweden with an average of 45%.

The survey covered five main areas. The first section asked firms for general information, which included their primary sector of business, primary products and services provided, date when operations started, and other record-keeping information. Subsequent sections asked specific questions about monthly values of: revenues (e.g. value of total sales), costs (e.g. total number of employees across all locations and total cost of goods sold), imports and exports (e.g. whether firm trades, and if so, the value of imports and/or exports), and liquidity (e.g. whether the firm took out a loan on a given month).

The first round of surveying began in early 2015. We designed the survey to facilitate a straightforward before / after comparison of monthly values to explore how business changed with the onset of the Ebola crisis. To avoid survey fatigue and recall error, we focused data collection fairly tightly around the timing of the epidemic and did not ask firms for a lengthy historical record. Specifically, we asked firms to detail monthly figures from April 2014 (a few months before the epidemic), through January 2015 (the last complete month before survey work commenced). To help control for seasonality and heterogeneity across firms, we collected exactly comparable data for the period one year prior (April 2013 through January 2014).⁴ For example, we compare how monthly sales in 2014 changed with the onset of Ebola, while controlling for each firm's level and fluctuation in sales over the same months in 2013. A second subsequent round of surveying (for a different set of firms) included figures up through September 2015.

After the in-person interviews, surveys were scanned using handwriting recognition technology. For the effective sample of 257 completed surveys, Figure 2 summarizes data availability by month for the main outcome variables collected: number of employees, total value of monthly sales, total costs of goods, loan applications in a given month, total value of exports, and total value of imports.⁵ Employee, sales, and costs of goods figures are reported and available for over 50% of all surveyed firms, whereas trade and loan application figures are not reported for most firms. Availability across month only drops in 2015, and mainly because not all firms were asked to provide information for this period of time. Reassuringly, firms were not less likely to report figures during the Ebola outbreak

⁴ Notice thus that our estimates exclude the months of February and March in both years.

⁵ Data is not available when surveyed firms do not disclose the figures or when the handwriting recognition technology fails to recognize the figures.

than in other periods. Most surprisingly, a large majority of firms did not disclose figures on loan applications, suggesting that firms are reluctant to freely disclose sensitive figures about their finances.

<Figure 2>

ii. Summary Statistics

Table 2 presents some basic summary statistics for the main characteristics of these 257 firms, along with a breakdown of these characteristics by firms' taxpayer size (as classified by the NRA). Panels A and B include some general firm information and basic summary statistics for sales and goods. They show that the average firm, even among these registered tax payers, is relatively small scale, although many of them have been in operation for quite some time. Most firms (85.2%) have only one location, have operated in Sierra Leone for an average of 15 years, and have an average of 20 employees. Their average sales at the beginning of the sample are around 725 million Leones per month, or over 165,000 US dollars (in 2013). The dispersion of these monthly sales is relatively large across firms, with a standard deviation of 4,919 million Leones. Large taxpayers have an average of two locations per firm, and on average have three more years in operations if compared to medium taxpayers. As expected, large taxpayers also have a higher average of monthly sales and a larger number of employees.

<Table 2>

Although the average firm is relatively small, most firms (89.54%) keep financial records, and so firm size should not be associated with measurement error through poor record-keeping practices. When collecting sales and cost data, surveyors asked to see these records, which helps to provide reassurance as to the quality of the data collected. Finally, only about half of the firms either import or export products. This, and the lower response rate to our questions on imports and exports, constrains the study of the impact of Ebola on international commerce.

Figure 3 includes a breakdown of firms by sector (as reported by the firms in the survey using nine different categories).⁶ Most firms operate in trading sectors, with 21% of firms reporting to be in the retail/wholesale business, and 41.6% reporting to be in

⁶ Firms could report one out of 9 sectors of business: financial, telecom, manufacturing, mining, retail/wholesale, construction, hospitality/tourism, agribusiness, or general trading/other.

general trading or other business. A total of 12.5% of firms did not report a sector of operation, and the other seven sector categories do not include more than 7% of firms each. As explained previously, we expect the outbreak of Ebola to impact different sectors in different ways, although studying differential effects across firm sectors will be constrained by this small share of firms in sectors outside of trade. Because of this, when looking at differential impacts across sectors, the main sector comparison will be between trade (retail, wholesale, or general trade/other) and non-trade businesses.

<Figure 3>

As early evidence of the impact of Ebola on firms' sales and costs, Figure 4 includes a word cloud with the 10% most common words included in comments about sales and cost fluctuations in 2014. When asked to explain the factors driving changes in sales between 2014 and 2013, 59 firms included comments, and over 55% of firms included the word "Ebola" in these comments (see Panel C of Table 2).⁷ As seen from Figure 4, "Ebola" is the most common word included in these comments, with other common words including terms related to the Ebola crisis (e.g. "outbreak", "disease", etc.) and words that would negatively describe sales (e.g. "drop", "bad", etc.). In contrast, the most common words used to describe changes in costs include relatively generic terms, like "book", "plastic", and "receipt". This would suggest that sales were more impacted by the Ebola crisis compared to costs, although this is further explored in the next section.

<Figure 4>

4. Empirical Estimates

i. Empirical Specifications

For each outcome of interest, we estimate two separate econometric models. The first specification to study the impact of Ebola on firm outcomes is the following:

$$y_{imt} = \alpha \text{Ebola Occurrences}_{mt} + \eta_i + \gamma_m + \theta_t + \varepsilon_{imyt} \quad (1)$$

where y_{imt} is the outcome of firm i on month m of year t . The main outcome of interest is monthly sales (measured in million Leones), as this is the area that firms reported was most strongly impacted by the outbreak. We also estimate effects on costs and trade. $\text{Ebola Occurrences}_{mt}$ is a continuous variable measuring the monthly average of new

⁷ A manual inspection of the comments revealed that most firms reported that they saw a drop in sales because of the Ebola outbreak, with only one firm mentioning that Ebola did not impact its sales.

weekly Ebola cases. The terms η_i , γ_m , and θ_t include firm, month (e.g. September), and year fixed effects (respectively), and ε_{imy} represents the residual term. Standard errors are clustered at the firm level. The identifying variation for model (1) comes from the steep increase in Ebola occurrences between July 2014 and December 2014, with α capturing the change in monthly sales coincident with new Ebola occurrences, and after accounting for firm, month, and year variation that is absorbed by the relevant fixed effects. We drop the 5% most extreme outcome values (bottom 2.5% and top 2.5%) to address measurement error.⁸

Our second model is a refined version of model (1) that removes seasonal trends and addresses heterogeneity in firm size by normalizing outcomes by their value in the previous year:

$$\frac{y_{imt}}{y_{im2013}} = \beta \text{Ebola Occurrences}_{mt} + \eta_i + \theta_t + u_{imy} \quad (2)$$

Using sales as an example, the outcome variable is now measured as sales in a given month in 2014 divided by the sales of that same month in 2013 (an Ebola-free year). Other terms remain as measured in model (1). We drop the month fixed effects as normalizing with respect to the same month in the previous year should address seasonal variation. Given these changes, β in Model (2) is interpreted as the percentage change in sales due to an increase in Ebola occurrences, relative to the sales during the same month of 2013.

ii. Estimated Impacts of Ebola on Sales

Figure 5 shows the average of monthly sales and the monthly average of new weekly Ebola cases. As is apparent in the figure, the normal seasonal variation in sales makes it hard to disentangle trends. However, calculating the average for the drop in sales (as measured by the change in sales for a given month if compared to the same month of the previous year) suggest an average sales drop per firm of 15.52 million Leones (almost 2,000 US dollars) during the Ebola peak of July 2014 through December 2014. This

⁸ Outcome variables are subject to measurement error because of error when filling the survey or when capturing the data from the surveys. We implemented this process for each outcome variable separately, so that firm-month-year observations dropped in one regression can be included in another one if the latter outcome is not too extreme.

represents around 9% of the average total sales per firm made during the same period of 2013, which averaged 177 million Leones per firm.

<Figure 5>

Table 3 reports the regression results for model (1) using sales (in million Leones) as the outcome variable. Column (1) depicts the results of model (1) using Ebola occurrences (measured in 100s) as the sole regressor, and shows a negative although not statistically significant relationship between new cases and sales. After adding all the relevant fixed effects in model (1), column (2) shows a statistically significant relationship, with an increase in 100 Ebola cases resulting in a statistically significant drop in sales of almost 5 million Leones, or around a 2.75% drop in output if compared to the mean sales with zero Ebola occurrences (the intercept from column 1). This entails a 13.3% average drop in monthly sales in the peak of the crisis (November 2014), when the monthly average of weekly new cases reached a high of 485 infections. Column (3) shows model (1) after adding a three-month lag, and this results in a negative relationship between both of the Ebola measurements and sales, although their impact on sales is not significant.

<Table 3>

Columns (4) and (5) implement model (1) after replacing the Ebola occurrences measurement with a dummy equal to one for the crisis period (July through December 2014) and post crisis period (January through September 2015), with the excluded category being the pre-crisis months of January 2013 through June 2014. This shows an average drop in monthly sales of 13.7 million Leones, or almost 10% of the average sales when there are no new infections. The post crisis estimate for the drop in monthly sales is close to 9%, which is economically important although not statistically significant. Column (5) interacts these crisis dummies with a dummy equal to one when firms' primary sector of business is trade, and does not show statistically significant differences in sales across sectors. As explained previously, this does not entail that the Ebola outbreak did not have a differential impact across sectors, as a refined version of this specification would need to have more firms per sector category so as to include interactions with more sectors.

We next present results for our second empirical approach, which normalizes sales by their value in the same month of the previous year. Figure 6 shows the normalized sales and Ebola occurrences during the period of study, with a clear drop in sales between July

2014 and December 2014, the peak of the Ebola crisis. Interestingly, sales drop an average of 15% below their 2013 counterpart on December 2014, but for the most part match or even surpass the 2013 sales levels beginning January 2015. This suggests a temporary shock on business, with a rapid and relatively sustained recovery after the peak of the crisis.

<Figure 6>

Table 4 presents the regression results for model (2). Columns (1)-(3) report different specifications and all show a statistically significant drop in sales of 2.5% per each 100 case increase in the monthly average of weekly Ebola cases. Column (1) only includes the measure of Ebola occurrences as a regressor, and shows that the average of monthly sales per firm when there are no new Ebola occurrences is 100.5%, or almost the equivalent of the 2013 level. This supports the validity of the identification strategy, as sales in non-Ebola months remain close to their 2013 counterparts, and suggests that other shocks are not likely to systematically affect sales during the period of study. This estimate for β is unchanged after including a three-month lag measure for Ebola (Column 3), and entails a 10% drop in average weekly sales per firm in the peak of the crisis on November 2014, when the monthly average of weekly cases reached 485. Similar to table 4, Column (4) shows the specification using dummies for crisis and post crisis periods, and shows an average and statistically significant drop of 5.5% in monthly sales during the crisis period. Column 5 suggests that the drop in sales is mainly focused on the trade sector, with an economically important (although not statistically significant) average drop in sales of 8.2%.

<Table 4>

To explore potential heterogeneity in impacts across different types of firms, Figures 7 and 8 replicate the approach of Figure 6, but split sales by sector and taxpayer size, respectively. In Figure 7, there is no clear difference in the impact of Ebola for general trading and retail firms, compared to firms in other sectors. As noted earlier, this is not too surprising given that these are not the sectors one might expect to be more directly impacted (like restaurants, which have only a few observations in our data). Trends for large and medium taxpaying firms look similar to each other in Figure 8. Again, earlier research suggests that small firms (which are not in our sample) were more strongly impacted; and

the results here do not support the idea the impacts vary by size among the medium and large scale firms in our data.

iii. Estimated Impacts of Ebola on Costs

We now turn to estimates of the impact of the outbreak on firm costs, focusing on employees and costs of goods. As anticipated by the lack of references to Ebola in respondent comments about drivers of differences in cost between 2013 and 2014 (recall Figure 4, panel B), we find little evidence of impacts in these areas.

Figures 9 and 10 show no evidence of a firm response to Ebola along the margin of laying off employees. The trend line for total employees (in Figure 9) and workforce size as a percent of 2013 values (Figure 10) appear markedly flat. Regression counterpart estimates in the first three columns of Tables 5 and 6 similarly provide little evidence of changes in the number of employees during the crisis. Given the sizeable drop in sales, this suggests some rigidity in the formal sector that prevents firms from flexibly responding to changes in the business environment.

<Figures 9 and 10>

<Tables 5 and 6>

Figures 11 and 12 similarly show little impact of Ebola on costs of goods sold (COGS). While the trend line in the raw value of costs jumps around a bit in Figure 11, it is distinctly flat in the normalized value of Figure 12. This trend line holds steady around 115%, suggesting that costs in 2014 were on average 15% higher than the previous year. Columns 4 through 6 in Tables 5 and 6 show no apparent increase in costs associated with the crisis period. The only statistically significant estimates are for the post-crisis period, where it appears that costs in 2015 were substantially higher than in 2013.

<Figures 11 and 12>

iv. Estimated Impacts of Ebola on Trade and Liquidity

Our data is quite limited in what it can tell us about the potential impacts of Ebola on trade and liquidity. For trade, only half of the firms in our sample reported engaging in any international trade, and of those who did, fewer than a quarter (half) of them shared information with us about the value of their exports (imports). This generates too few

observations to rigorously evaluate potential impacts of the crisis. For illustrative purposes only, Figures 13 through 16 present our basic models 1 and 2 in graphical form for exports and imports separately. As expected given the small samples sizes, these trend lines are quite noisy and reveal no robust relationship between the crisis and levels of imports or exports. While this is consistent with little impact of the outbreak on the volume of ships coming in and out of West African ports in Glennerster and Suri (2015), we do not over interpret these estimates given the data availability limitations.

<Figures 13,14,15,16>

Disentangling the impact of Ebola on the banking sector is challenging not least because of the shock that falling commodities prices had on mining companies during 2014. January 2014 saw the start of a steep decline in iron ore prices, which continued through January 2016. For most other firms in our survey the first quarter of 2014 does not look sharply out of line with previous quarters. For banks, however, we see an increase in loans and a rise in cash deposits in the first quarter of 2014. Thus, the interpretation of the impact of the Ebola crisis depends on what we use as the basis for comparison: the same time in previous years, or the first quarter of 2014. Compared to 2012, cash deposits are up (potentially due to precautionary savings during uncertainty), but compared to the first quarter of 2014 they are lower, with no significant impact for the crisis period in our regression results (Table 8). Cash deposits rise even further in the post crisis period. Figure 18 shows the fluctuations experienced in 2014, and underscores the fact that Ebola was not the only major crisis to hit Sierra Leone in 2014.

A similarly complex pattern emerges when we examine bank lending. The finding, reported above, that formal sector revenues fell sharply while costs remained constant suggests that we would expect to see outstanding bank loans increase during the crisis. Outstanding loans (deflated by the outstanding loans on 2012 for the same month) are higher after the Ebola outbreak, although this difference is not statistically significant in our regression results. Again, the rising trend in both pre-crisis and post-crisis loans depict a complex picture (Figure 21). Unfortunately, our data do not distinguish loans to different sectors, so we cannot see whether the rise in loans is to mining companies, formal sector firms failing to repay loans even after their revenues get back on track, or government borrowing.

5. Conclusions

In this report we detail the pattern of employment, revenue, and costs experienced by formal sector firms during the Ebola crisis of 2014 in Sierra Leone. The coverage of large firms sets this work apart from previous studies, as does the detail and breadth of the data collected. Our findings suggest that the response of these firms to the crisis was different in many ways from the response of small informal businesses in Sierra Leone (Fu *et al.*, 2015) and smaller formal firms in Liberia (Bowles *et al.* 2016). We find that these larger tax paying firms appear to play a stabilizing role in the Sierra Leone economy. Similar to other sectors, medium to large formal sector firms saw a substantial fall in revenues during the crisis (down 25%). However, they do not respond by cutting costs or cutting workers. Indeed, employment, hours, and wages are remarkably constant month-to-month before, during, and after the crisis. While our data on trade needs to be treated with some caution because only a quarter of our sample report on imports and exports, we find little evidence of substantial disruptions to the ability of these medium to large firms in sourcing imports or exporting. These estimates are thus not consistent with the alarmist stories prevalent at the time about other countries refusing to trade with Ebola-affected countries.

We believe the results presented here are of broader interest in two ways. First, they are suggestive of the role of medium and larger scale firms as shock absorbers in an economy. Second, they raise questions about the constraints that these firms face that explain their lack of flexibility in response to a very substantial (though temporary) decline in revenues. These results are, for example, suggestive of constraints in the labor market. Firms appear to be unwilling to let workers go even in the face of collapsing sales, presumably because of costs associated with layoffs and/or concerns that they will find it difficult to recruit equivalently skilled labor if and when revenues pick up again.

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6. Tables

Table1. Firm Sample

Status	Number of Firms	%	% (All Firms)
<i>Panel A. Surveyed Firms</i>			
Done	257	86.82	65.06
Incomplete	39	13.18	9.87
Subtotal:	296	100	74.94
<i>Panel B. Not Surveyed Firms</i>			
Refused	10	10.10	2.53
Not Contactable	39	39.39	9.87
Non-targeted Sectors	41	41.41	10.38
Not Firms	9	9.09	2.28
Subtotal	99	100	25.06
All Firms	395		100

1. Not contactable firms include firms that closed, were not at the contact address, not available, or outside of Freetown.

Table 2. Summary Statistics

	N	Mean	SD	Mean by Firm Type:	
				Large (N=91)	Medium (N=161)
<i>Panel A. General Information</i>					
Firm Has One Location (%)	247	85.02	35.76	70.45	93.51
Firm Locations	245	1.518	1.945	2.093	1.214
Years Since Operation (01/2014)	234	15.6	10.13	17.58	14.55
Firm Keeps Financial Records (%)	239	89.54	30.67	93.1	88.44
Firm Imports/Exports (%)	181	49.72	50.14	43.28	52.73
<i>Panel B. Sales and Costs</i>					
Monthly Sales (Mn. Leones-04/2013)	194	724.9	4919	1854	158.4
Total Employees (04/2013)	234	20.31	57.45	39.2	9.815
Wages as % of Sales (04/2013)	176	28.08	48.9	25.69	29
COGS as % of Sales (04/2013)	139	8.933	19.42	10.31	8.138
Power Costs as % of Sales (04/2013)	172	8.192	30.52	7.368	8.758
<i>Panel C. Other Variables</i>					
Ebola Comments (All)	257	12.84	33.52	6.593	16.77
Ebola Comments (If Comment)	59	55.93	50.07	28.57	72.97

Note. Total sample of 257 firms. Variation of N from missing/no response. 5 firms were not linked to a taxpayer status.

Table 3. Sales and Ebola Occurrences

	Dep. Variable: Sales (Million Leones)				
	(1)	(2)	(3)	(4)	(5)
New Ebola Cases (100s)	-2.279 (2.116)	-4.829*** (1.767)	-2.232 (2.787)		
Lag New Ebola Cases (100s)			-4.303 (3.900)		
Crisis Period (07-12/2014)				-13.69** (6.547)	-21.85** (9.842)
Crisis Period & Trade Sector					11.95 (11.74)
Post Crisis (01-09/2015)				-8.989 (6.398)	-6.477 (7.798)
Post Crisis & Trade Sector					-3.680 (9.399)
Intercept	174.7*** (14.97)				
Month F.E.	No	Yes	Yes	Yes	Yes
Year F.E.	No	Yes	Yes	Yes	Yes
Firm F.E.	No	Yes	Yes	Yes	Yes
N	5031	5031	5031	5031	5031
R-squared	0.000	0.834	0.834	0.834	0.834

Note. Standard errors in parentheses. * p<0.10 ** p<0.05 *** p<0.01. Clustered errors by firm

Table 4. Detrended Sales and Ebola Occurrences

	Dep. Variable: % Sales (Relative Sales in 2013)				
	(1)	(2)	(3)	(4)	(5)
New Ebola Cases (100s)	-2.560*** (0.811)	-2.476*** (0.883)	-2.366* (1.236)		
Lag New Ebola Cases (100s)			-0.210 (1.871)		
Crisis Period (07-12/2014)				-5.545* (3.234)	0.0265 (7.076)
Crisis Period & Trade Sector					-8.168 (7.826)
Post Crisis (01-09/2015)				4.521 (3.685)	4.807 (6.739)
Post Crisis & Trade Sector					-0.654 (8.016)
Intercept	100.5*** (2.771)				
Year F.E.	No	Yes	Yes	Yes	Yes
Firm F.E.	No	Yes	Yes	Yes	Yes
N	2305	2305	2305	2305	2305
R-squared	0.004	0.300	0.300	0.298	0.298

Note. Standard errors in parentheses. * p<0.10 ** p<0.05 *** p<0.01. Clustered errors by firm

Table 5. Costs and Ebola Occurrences

	Dep. Variables:					
	(1)	Employees (2)	(3)	Costs of Goods (Million Leones) (4)	(5)	(6)
New Ebola Cases (100s)	-0.101 (0.0967)			-0.00246 (0.0360)		
Lag New Ebola Cases (100s)	-0.0341 (0.0467)			0.0154 (0.0473)		
Crisis Period (07-12/2014)		-0.354 (0.330)	-1.090 (0.715)		-0.0196 (0.0763)	0.0152 (0.119)
Crisis Period & Trade Sector			1.198* (0.725)			-0.0573 (0.112)
Post Crisis (01-09/2015)		0.112 (0.262)	-0.494 (0.491)		0.256*** (0.0704)	0.323** (0.127)
Post Crisis & Trade Sector			0.943* (0.528)			-0.108 (0.144)
Month F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes
N	6109	6109	6109	4167	4167	4167
R-squared	0.967	0.967	0.967	0.920	0.920	0.920

Note. Standard errors in parentheses. * p<0.10 ** p<0.05 *** p<0.01. Clustered errors by firm

Table 6. Detrended Costs and Ebola Occurrences

	Dep. Variable (Relative to 2013):					
	% Employees			% Costs of Goods		
	(1)	(2)	(3)	(4)	(5)	(6)
New Ebola Cases (100s)	0.0249 (0.0357)			0.235 (0.157)		
Lag New Ebola Cases (100s)	-0.0311 (0.0243)			-0.430* (0.232)		
Crisis Period (07-12/2014)		0.0725 (0.101)	0.108 (0.142)		0.723 (0.504)	1.233 (0.937)
Crisis Period & Trade Sector			-0.0581 (0.197)			-0.807 (1.103)
Post Crisis (01-09/2015)		-0.0223 (0.191)	0.205 (0.204)		1.675*** (0.573)	1.942** (0.963)
Post Crisis & Trade Sector			-0.353 (0.342)			-0.428 (1.195)
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes
N	3118	3118	3118	2024	2024	2024
R-squared	0.944	0.944	0.945	0.850	0.849	0.849

Note. Standard errors in parentheses. * p<0.10 ** p<0.05 *** p<0.01. Clustered errors by firm

Table 7. Cash Deposits and Ebola Occurrences

	Dep. Variable: Cash Deposits (Bn. Leones)			
	(1)	(2)	(3)	(4)
New Ebola Cases (100s)	0.00740 (0.00547)	-0.000667 (0.00570)	-0.000494 (0.00814)	
Lag New Ebola Cases (100s)			-0.0593 (0.585)	
Crisis Period (07-12/2014)				-0.220 (2.260)
Post Crisis (01-12/2015)				2.592*** (0.650)
Intercept	5.529*** (0.466)			
Month F.E.	No	Yes	Yes	Yes
Year F.E.	No	Yes	Yes	Yes
Firm F.E.	No	Yes	Yes	Yes
N	747	747	516	747
R-squared	0.005	0.440	0.440	0.440

Note. Standard errors in parentheses. * p<0.10 ** p<0.05 *** p<0.01. Robust standard errors.

Table 8. % Cash Deposits (Relative to 2012) and Ebola Occurrences

	Dep. Variable: % Cash Deposits (Relative to 2012)			
	(1)	(2)	(3)	(4)
New Ebola Cases (100s)	-0.105 (0.0851)	-0.246** (0.118)	-0.114 (0.149)	
Lag New Ebola Cases (100s)			-21.87 (17.23)	
Crisis Period (07-12/2014)				-48.04 (60.04)
Post Crisis (01-12/2015)				246.6*** (34.02)
Intercept	334.5*** (20.45)			
Year F.E.	No	Yes	Yes	Yes
Firm F.E.	No	Yes	Yes	Yes
N	531	531	483	531
R-squared	0.001	0.273	0.260	0.270

Note. Standard errors in parentheses. * p<0.10 ** p<0.05 *** p<0.01. Robust standard errors.

Table 9. Standing Loans and Ebola Occurrences

	Dep. Variable: Standing Loans (Bn. Leones)			
	(1)	(2)	(3)	(4)
New Ebola Cases (100s)	-0.0463 (0.0469)	0.0226 (0.0434)	0.0808 (0.0610)	
Lag New Ebola Cases (100s)			-10.13 (6.580)	
Crisis Period (07-12/2014)				26.56 (19.41)
Post Crisis (01-12/2015)				-5.736 (7.859)
Intercept	35.05*** (7.502)			
Month F.E.	No	Yes	Yes	Yes
Year F.E.	No	Yes	Yes	Yes
Firm F.E.	No	Yes	Yes	Yes
N	734	734	510	734
R-squared	0.001	0.787	0.713	0.788

Note. Standard errors in parentheses. * p<0.10 ** p<0.05 *** p<0.01. Robust standard errors.

Table 10. % Standing Loans (Relative to 2012) and Ebola Occurrences

	Dep. Variable: % Standing Loans (Relative to 2012)			
	(1)	(2)	(3)	(4)
New Ebola Cases (100s)	0.219 (0.170)	0.0706 (0.187)	0.223 (0.230)	
Lag New Ebola Cases (100s)			-26.24 (25.45)	
Crisis Period (07-12/2014)				96.26 (77.14)
Post Crisis (01-12/2015)				237.0*** (41.12)
Intercept	248.9*** (22.87)			
Year F.E.	No	Yes	Yes	Yes
Firm F.E.	No	Yes	Yes	Yes
N	498	498	464	498
R-squared	0.004	0.188	0.182	0.191

Note. Standard errors in parentheses. * p<0.10 ** p<0.05 *** p<0.01. Robust standard errors.

7. Figures

Figure 1. National Sierra Leone Ebola Occurrences During Crisis Period

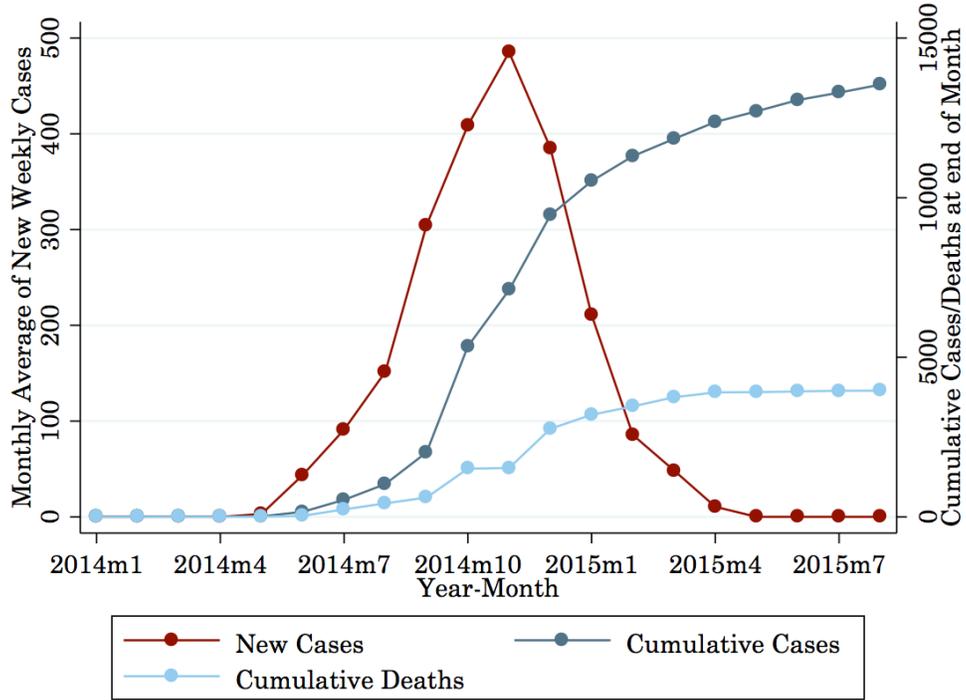


Figure 2. Data Availability for Relevant Variables

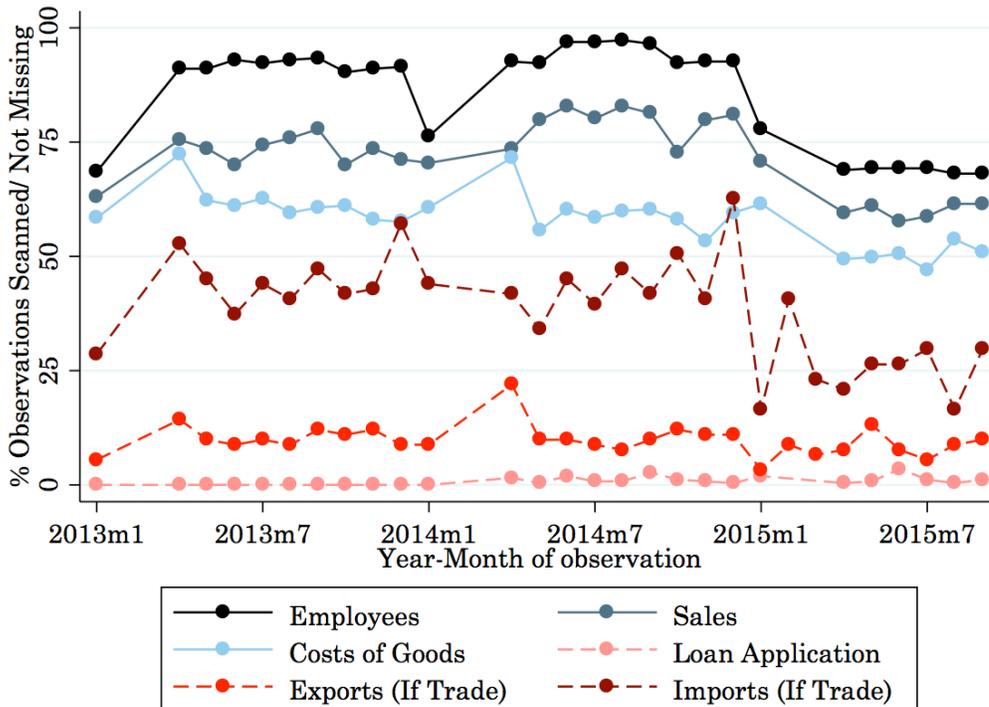


Figure 3. Distribution of Firms By Sector

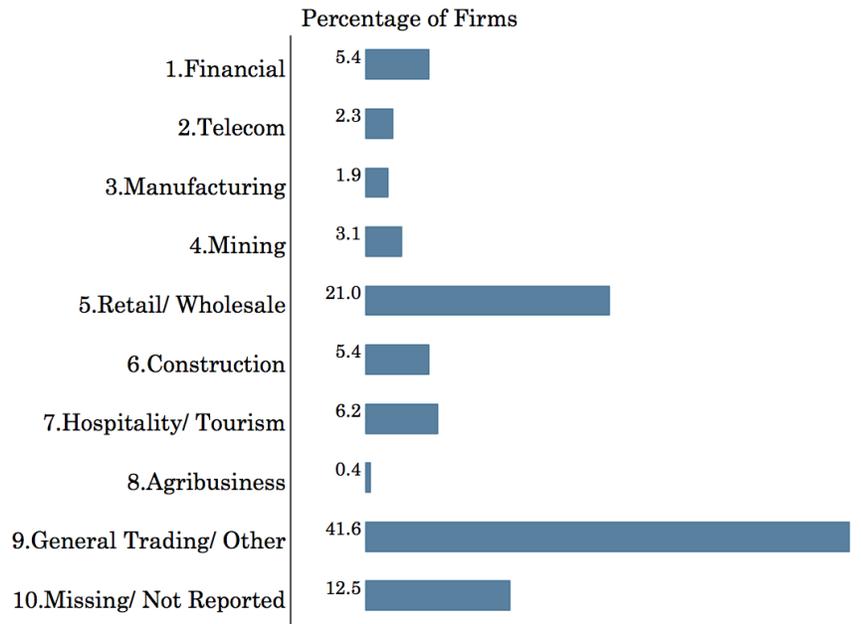


Figure 4. 10% Most Common Words- Sales and Costs Comments (2014)



Note. Comments from question asking respondents to explain differences in sales/costs between 2013 and 2014.

Figure 5. Monthly Sales (in Million Leones) and Monthly Ebola Occurrences

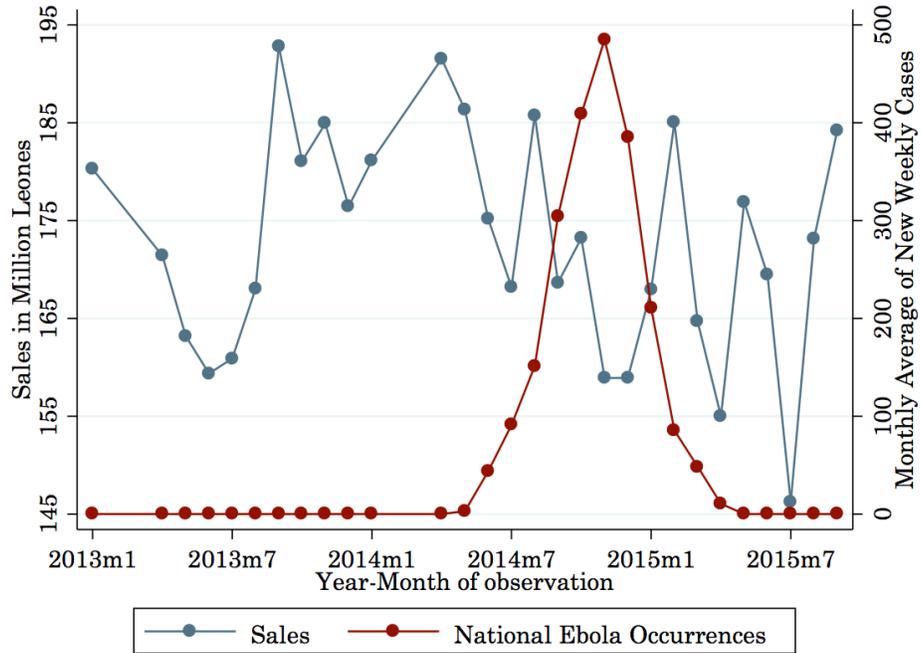


Figure 6. % Sales (Relative to Same Month 2013) and Monthly Ebola Occurrences

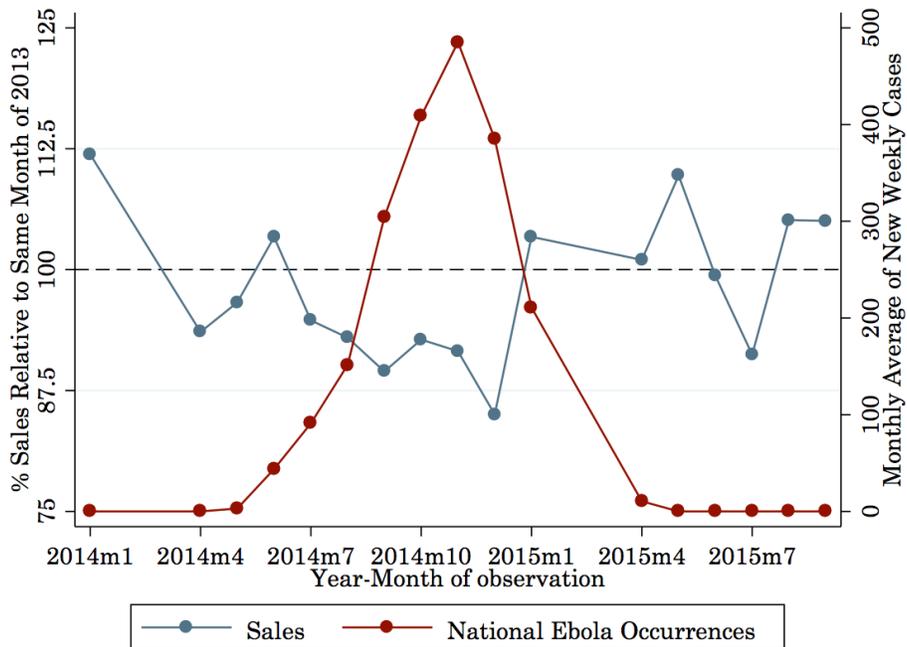


Figure 7. % Sales by Sector and Monthly Ebola Occurrences

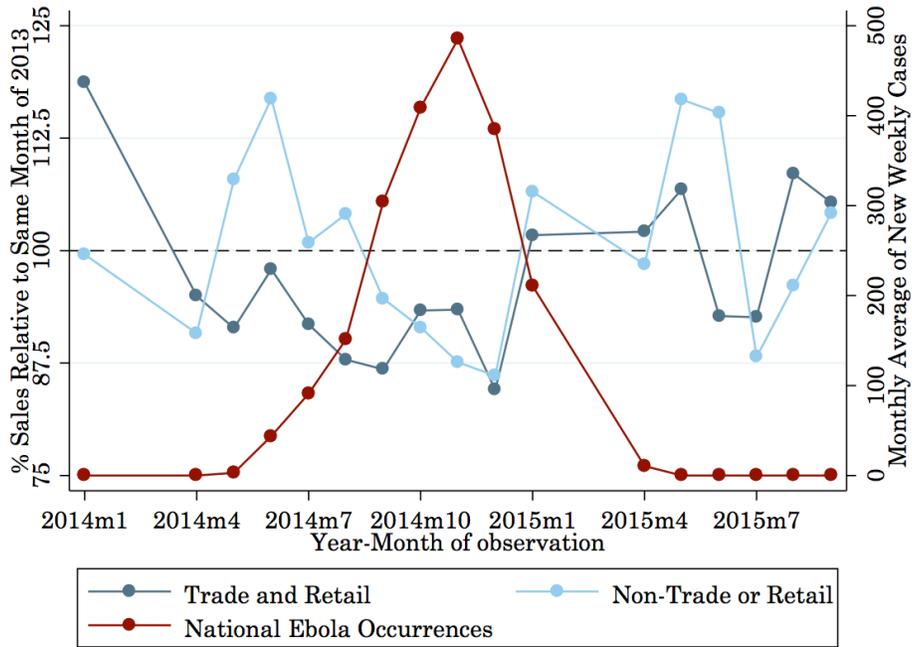


Figure 8. % Sales by Taxpayer and Monthly Ebola Occurrences

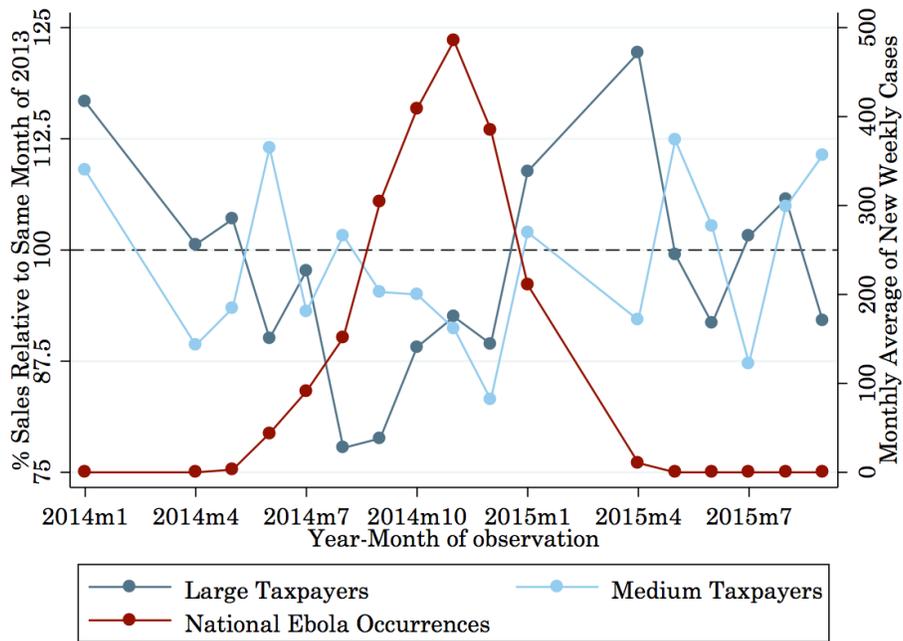


Figure 9. Employees and Monthly Ebola Occurrences

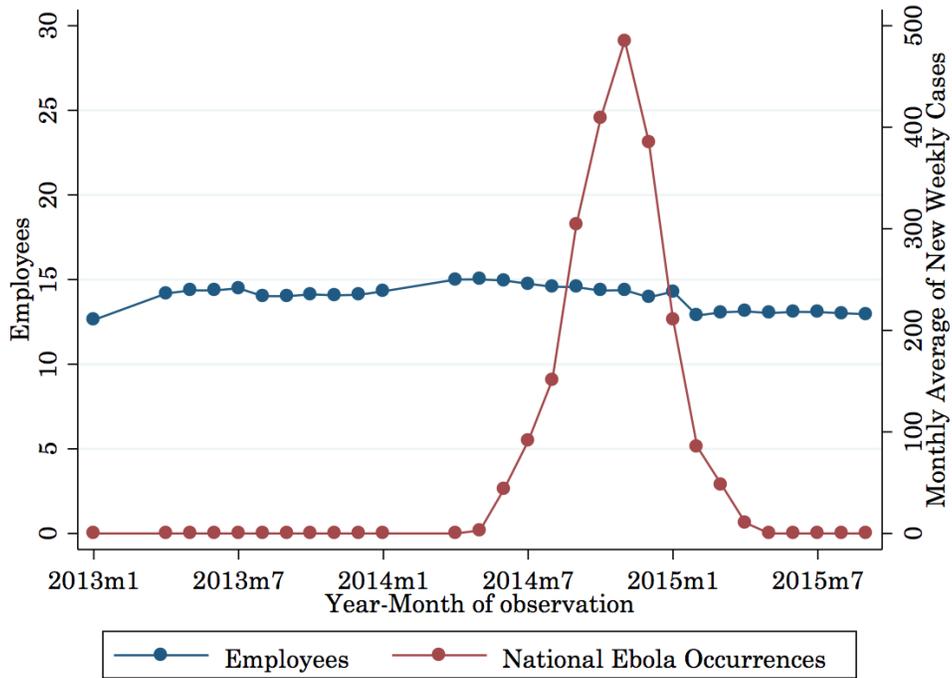


Figure 10. % Employees (Relative to Same Month 2013) and Monthly Ebola Occurrences

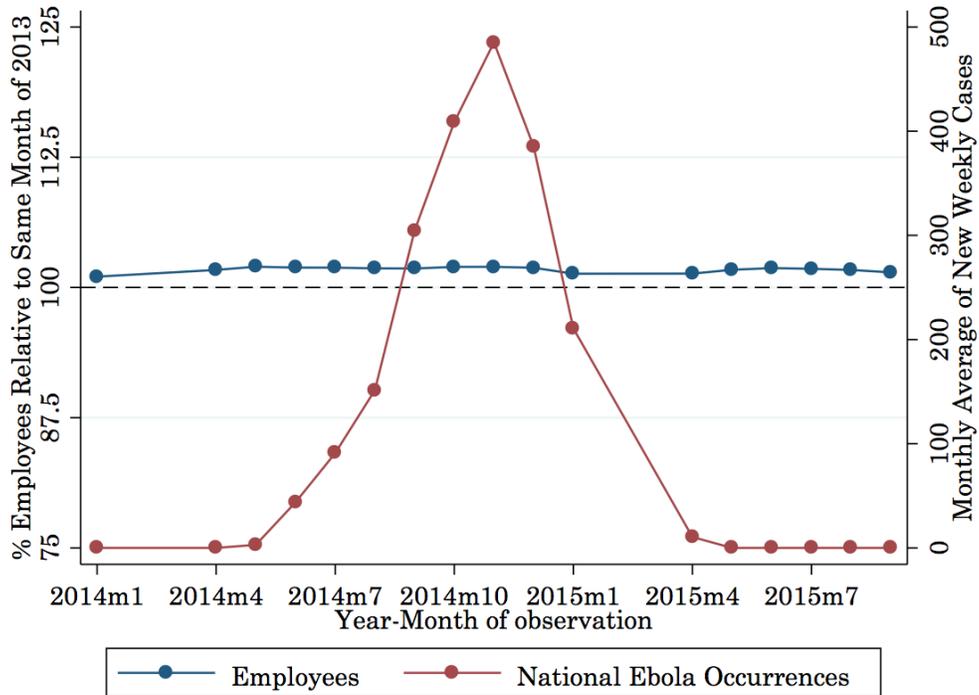


Figure 11. Costs of Goods and Monthly Ebola Occurrences

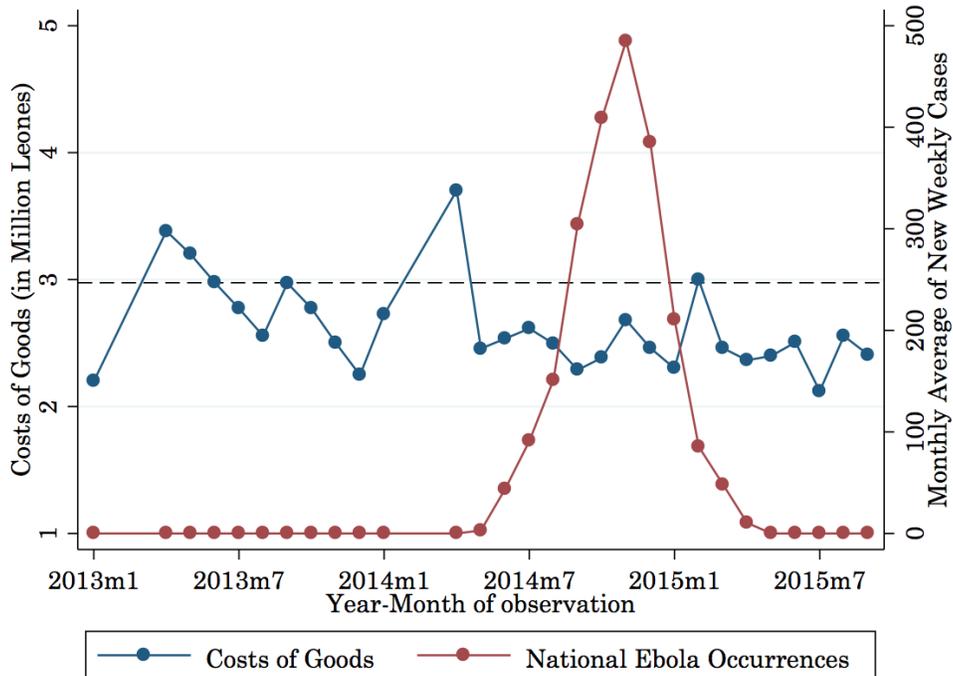


Figure 12. % Costs of Goods (Relative to Same Month 2013) and Monthly Ebola Occurrences

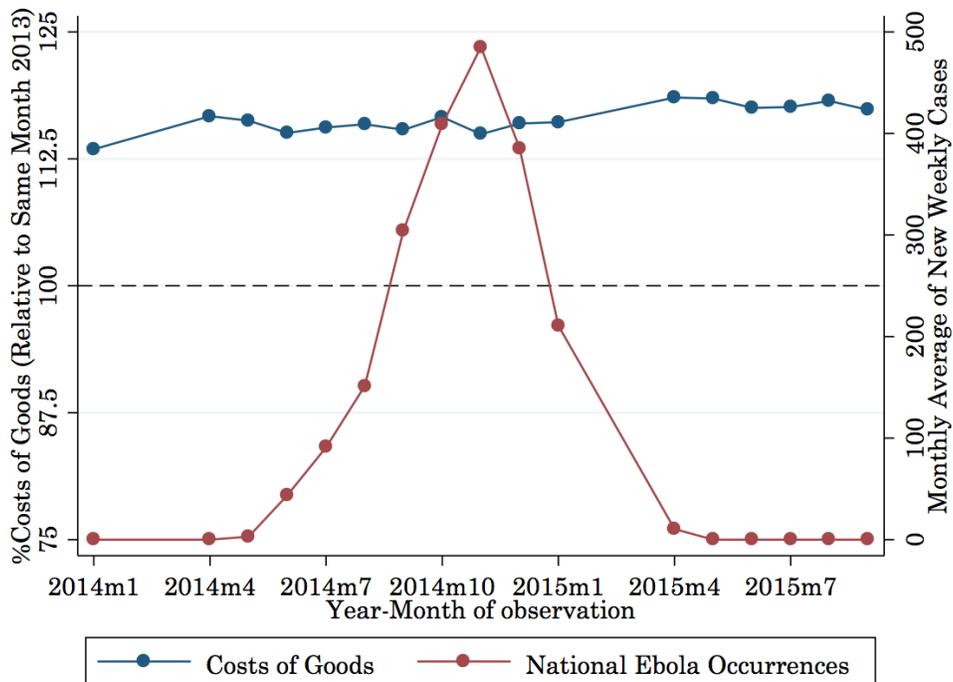


Figure 13. Exports (in Million Leones) and Monthly Ebola Occurrences

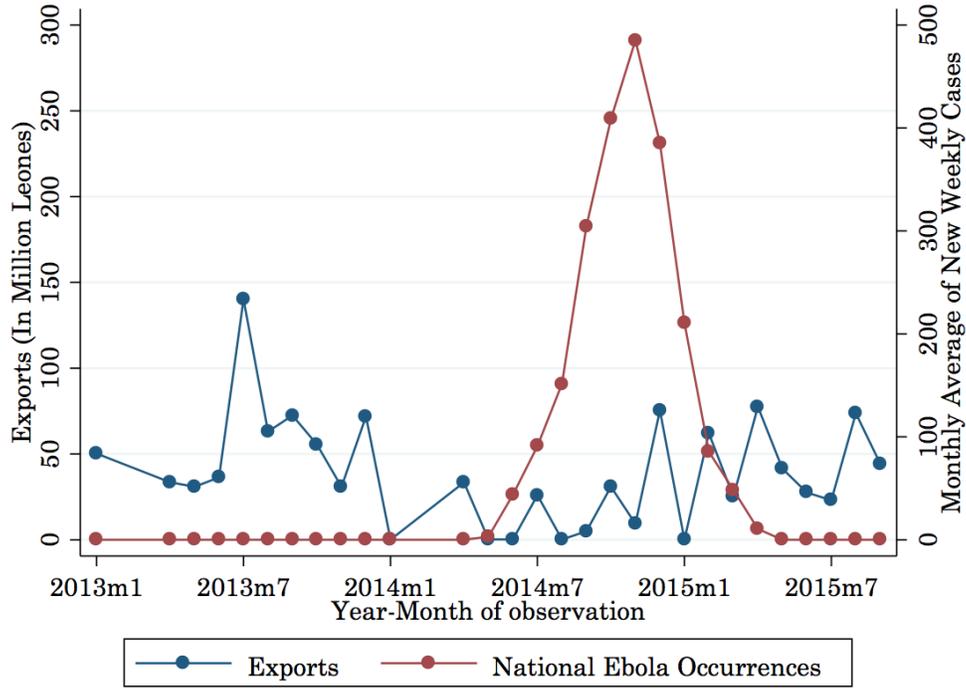
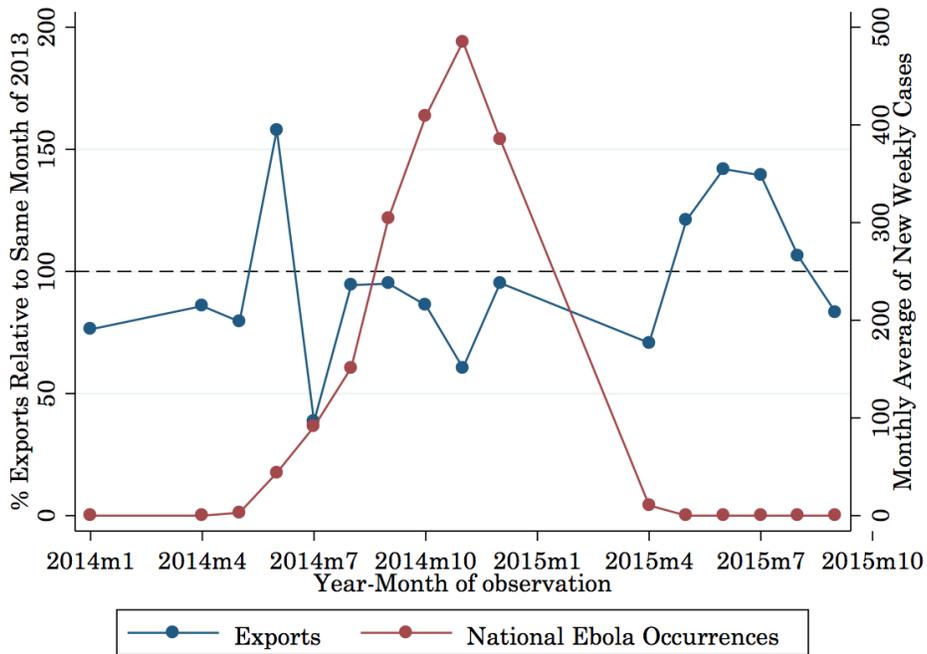


Figure 14. % Exports (Relative to Same Month 2013) and Monthly Ebola Occurrences



Note. Note change in scale (for Exports) with respect to non-trade graphs.

Figure 15. Imports (in Million Leones) and Monthly Ebola Occurrences

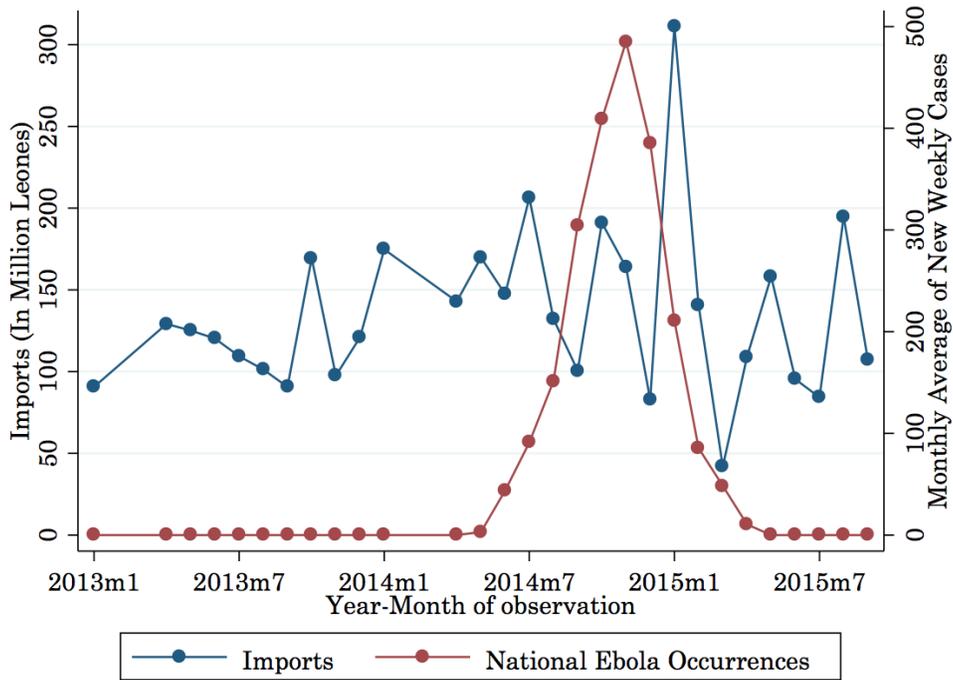
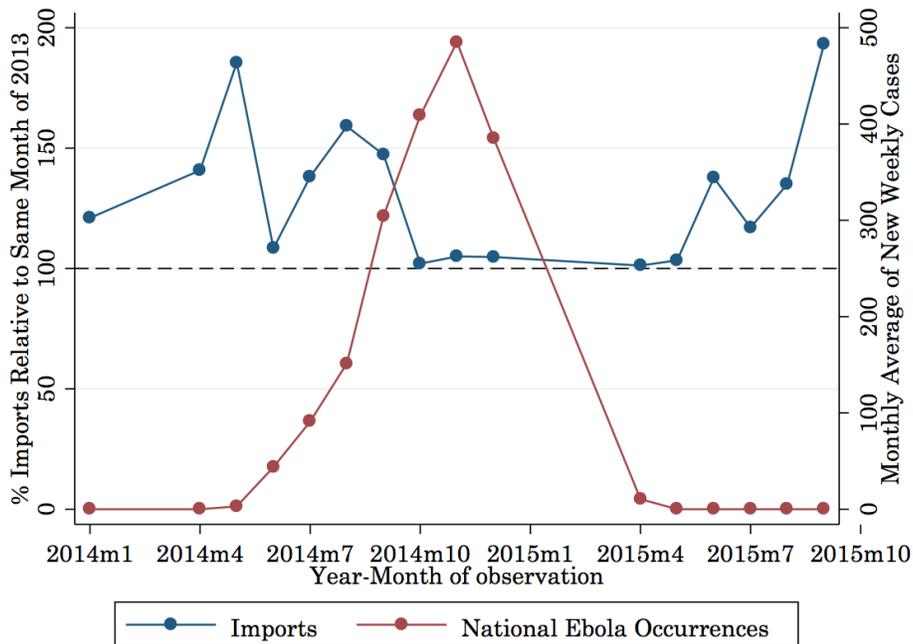


Figure 16. % Imports (Relative to Same Month 2013) and Monthly Ebola Occurrences



Note. Note change in scale (Imports) with respect to non-trade graphs.

Figure 17. Data Availability for Relevant Variables- Bank Survey

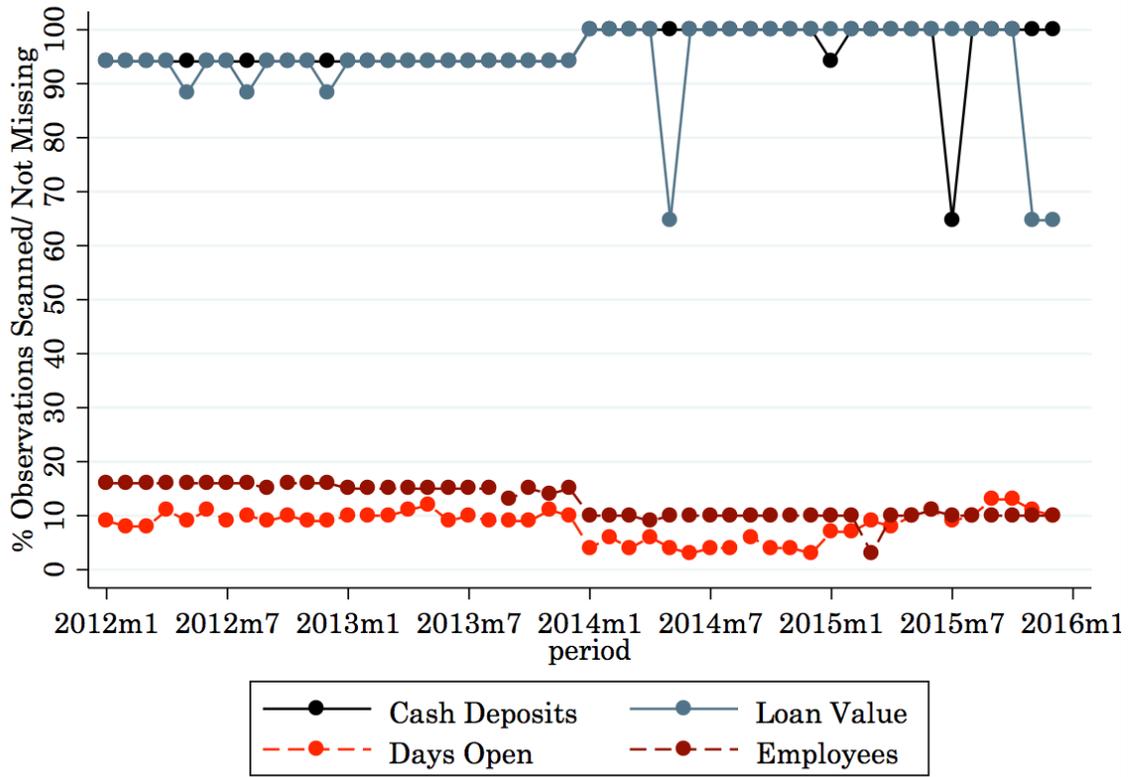


Figure 18. Cash Deposits and Monthly Ebola Occurrences

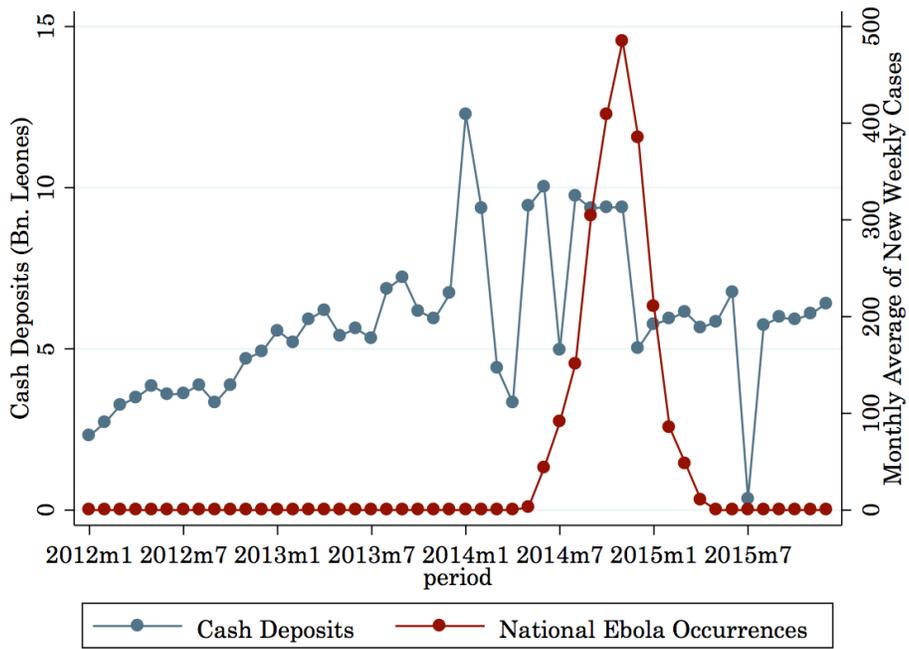


Figure 19. % Cash Deposits (Relative to 2012) and Monthly Ebola Occurrences

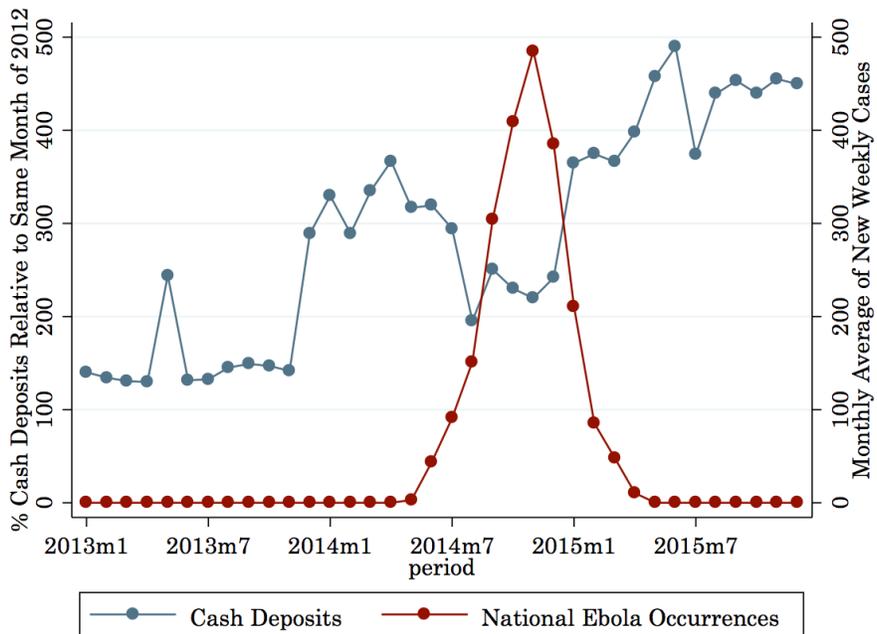


Figure 20. Value of Standing Loans and Monthly Ebola Occurrences

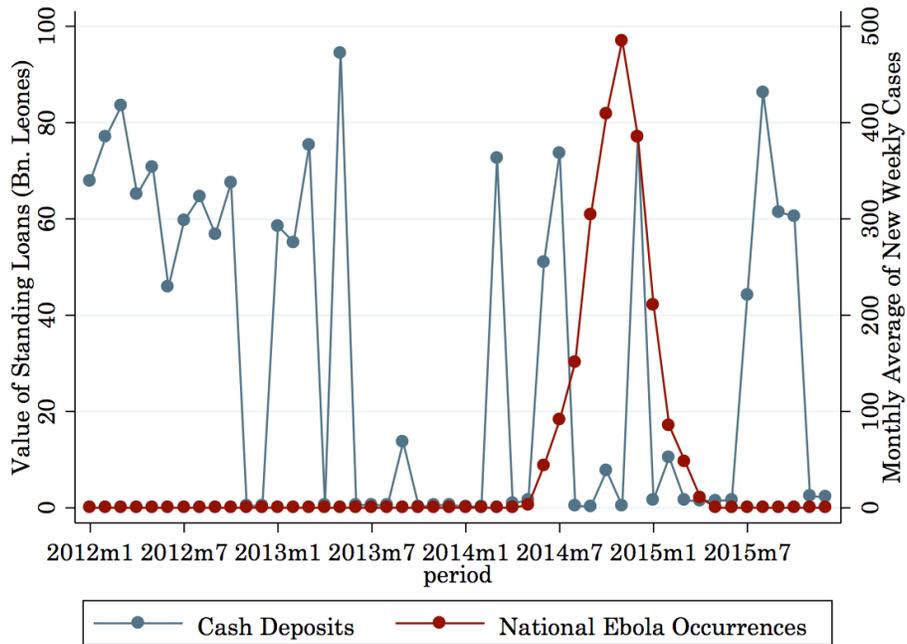
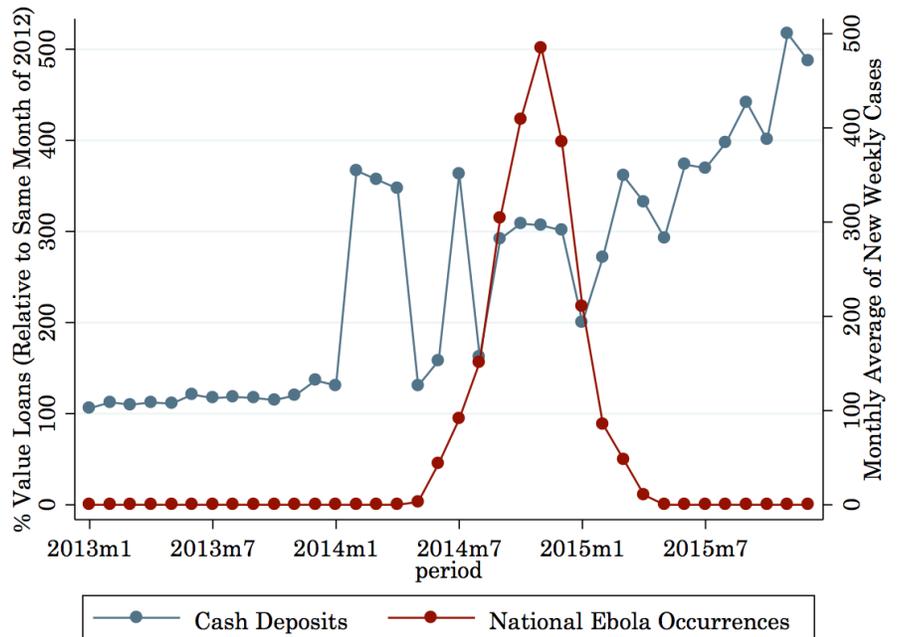


Figure 21. % Standing Loans (Relative to 2012) and Monthly Ebola Occurrences



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