Landmines and Spatial Development
Appendix VII
An "Errors-in-Surveys" Approach*

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Abstract

This Appendix provides additional evidence of the "errors-in-surveys" approach that we use to assuage concerns related to strategic central planning and prioritization. First, the Appendix gives descriptive evidence and summary statistics about the identification design that exploits mistakes across the three Mozambique-wide surveys (1994, 2001, and 2007) to advance on causation. Second, it reports two-stage-least-squares panel estimates that approximate the correlation between local development and the component of landmine clearance stemming from inaccuracies (false negatives) of the preceding surveys. Third, the Appendix reports panel estimates showing that the actual clearing of hazardous threats in localities connected to the transportation network and localities hosting local agricultural markets is especially strong; this applies both when we look at interventions in areas that surveyors had correctly identified as potentially hazardous and in areas that the surveys did not pinpoint as contaminated. Moreover, the cancellation of suspected hazardous areas, due to inaccuracies, rumors, and mistakes (false positives) does not map into increases in regional development, alleviating concerns of demining teams targeting areas with growth potential. Forth, the appendix shows that the relationship between development and market access retains significance, when we isolate variation in market access stemming only from demining interventions in unexpected (not-in-surveys) hazardous areas.

*Additional material can be found at www.land-mines.com

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Contents

1 Identification Idea. An "Errors-in-Surveys" Approach

1.1 Overview

To minimize concerns regarding centralized prioritization, we develop an identification strategy that exploits variation in clearance driven by the inaccuracies in the three countrywide (level 1) surveys that guided demining in each period.

(i) The 1994 SHAMAN, conducted by the HALO Trust for the United Nations, served as the basis for clearance in the first period $(1994 - 2000)$.[1]

(ii) The Mozambique Landmine Impact Survey (MLIS) was carried over between January 1999 and August 2001 by the Canadian International Demining Corps and Paul F. Wilkinson & Associates Inc (CIDC) with funding from the Canadian government. It provided guidance for clearance during the second phase $(2001 - 2007)$.

(iii) The 2008 Baseline Survey collected information on the remaining threats as of $2007 - 2008$ from the various demining operators, guiding clearance during the final period $(2008 - 2015)$.

All three surveys contained both types of errors. First, a multitude of suspected hazardous areas (SHA) upon visitation turned out to be known to the locals as non-contaminated areas [type I error, "*false positives*"]. Demining operators "cancelled" these Suspected Hazardous Areas (SHAs) when they visited them for clearance, as they were based on wrong tips, rumors, erroneous information, and inaccurate maps. Second, the surveys failed to identify many contaminated areas [type II error, "*false negatives*"].[2]

1.2 Survey Type I and Type II Errors by Period

Table 1 - Panel *A* tabulates SHA interventions that took place in the first phase (1994-1999).[3] A total of $1,746$ demining interventions were conducted between $1994 - 2000$. 831 took place in SHA

[1] There were seven clearance operations in 1992 and 1993, mostly conducted by the United Nations team at end of 1993. We discuss the treatment of these interventions in Section 1.3

[2] The self-evaluation of United Nations Development Program in Mozambique on landmines describes vividly the issue of "false negatives": "*after using LIS as the basis for its 2002-2006 plan, IND starts receiving operator reports of excessive numbers of contaminated areas and many unrecorded sites. IND has no real picture of contamination and thus how long clearance will take*".

[3] We only have 7 demining interventions in 1993. Five interventions do not appear in any of the following surveys and we treat them as unexpected. Two cleared locations are reported in SHAMAN: 1) Changara visited by the surveyor on the 13th February 1994. The surveyors team reports the area already cleared by the NPA (that found 2 AP mines); 2) Vila Nova da Fronteira visited by the survey team on the 28th February 1994. In the SHAMAN entry clearance of 1 AP from NPA is reported. In both cases, the surveyor team stated that "*Undoubtedly other mines exist in this area but exact sites could not be determined in the survey.*". We treat these two interventions as "expected".

identified by the 1994 SHAMAN. 258 of these 831 interventions led to actual clearance; the remaining 573 records indicate "cancelled" SHA, since upon visiting the area deminers realized that locals were already using it. This large rate of type-I error (false positives) is telling of the conditions under which the 1994 SHAMAN took place. There are 915 interventions in SHA that were not spotted as suspected by the SHAMAN. 804 led to actual clearance, with the remaining 111 corresponding to "cancelled" SHA.

Table 1 - Panel B looks at the second phase of demining (2001-2007). Our database records $3,789$ interventions during this period. 945 (25%) denote cleared SHAs, identified as hazardous by the LIS 2001. An additional 293 SHA, pinpointed by the 1994 SHAMAN, were also cleared. Type-I error was considerable: 793 of the total of $1,738$ SHA recorded in the 2001 LIS were actually not contaminated and hence reclassified as "canceled" when demining operators visited the area. Type-II error was sizable, as $1,730$ clearance interventions took place in areas neither identified by the 2001 LIS nor by the 1994 SHAMAN.

Table 1 - Panel C reports statistics for the third phase of demining with a total $3,883$ interventions during 2008-2015. Reflecting the better quality of the $2007-2008$ Baseline Survey, Type-I error was small; only 6% of the recorded SHA got cancelled. Nonetheless, type-II error was considerable. $1,147$ clearance interventions took place in areas not known to the deminers in the beginning of 2007. In the final phase, 66% of clearance occurred in expected/surveyed SHA and 33% in unexpected/non-surveyed ones.

Table 1: **Survey Errors by Period**

	Panel A. Period I: 1992-2000		
	Cleared	Cancelled	Total
Surveyed/Expected	258	573	831
Non-Surveyed/Unexpected	804	111	915
Total	1062	684	
	Panel B. Period II: 2001-2006		
	Cleared	Cancelled	Total
Surveyed/Expected	1238	793	2031
Non-Surveyed/Unexpected	1730	28	1758
Total	2968	821	
	Panel C. Period III: 2007-2015		
	Cleared	Cancelled	Total
Surveyed/Expected	2247	377	2624
Non-Surveyed/Unexpected	1147	112	1259
Total	3394	489	

Notes: This Table reports the number of i) Surveyed/Expected Cleared Suspected Hazardous Areas (SHAs), ii) Surveyed/Expected Cancelled SHAs, iii) Non-Surveyed/Unexpected Cleared SHAs, and iv) Non-Surveyed/Unexpected Cancelled SHAs by period: 1994–2000 (Panel A), 2001–2006 (Panel B), and 2007–2015 (Panel C).

1.3 Preliminaries

In this subsection we study how SHA recorded in the nationwide surveys compare to those that were not. We first discuss cross-sectional similarities/differences between cleared SHAs recorded in the surveys (expected) and unexpected ones. Second, we discuss differences on the timing of clearance in each period of the two types of interventions.

1.3.1 Cross-sectional Similarities

We look at the universe of interventions that led to clearance of contamination ($H_{i,t}^{S,A}$ and $H_{i,t}^{NS,A}$), a total of $7,424$ interventions, and ask whether location characteristics differ between expected-surveyed and eventually cleared SHA and clearance operations in areas not recorded in any countrywide survey (unexpected). Figures 1a-1e plot test of means across various location-specific features, alongside standard error bands clustered at the district level. Figure 1a gives unconditional estimates; Figure 1b includes (10) province constants; Figures 1c and 1d add 139 admin-2 and 374 admin-3 fixed effects, respectively, so as to better account for differences across administrative units; Figure 1e reports within-locality comparisons, being the closest to our analysis in the paper.

There are some differences between suspected and eventually cleared SHA and unexpected ones. Unexpected SHA are found further away from trails in 1973, civil war events, and commercial points (cantinas). This is consistent with the idea that the nationwide surveys missed contaminated areas further away from trails and areas where contamination was likely less severe. Yet, differences weaken and turn insignificant when we account for regional features at an increasingly finer level. There is no differential pattern in the relative presence of "unexpected" SHA in terms of proximity to international borders, the main transportation nodes as of 1973 (railways, paved and unpaved roads), navigable rivers and big cities, once we account for locality fixed effects (as we do in the empirical analysis). The variable big city corresponds to the log distance of each locality's centroid to the nearest city among Maputo, Beira and Nacala.

1.3.2 Similarities in the Timing of Clearance

We then examine whether the timing of clearance differs between SHAs identified in the preceding surveys and unexpected SHAs. Table 2 reports the mean and median years of clearance at the intervention (columns (1)-(3)) and at the locality level (columns (4)-(6)) in each of the three phases of demining. There are no major differences on the year of clearance in all three demining phases. For

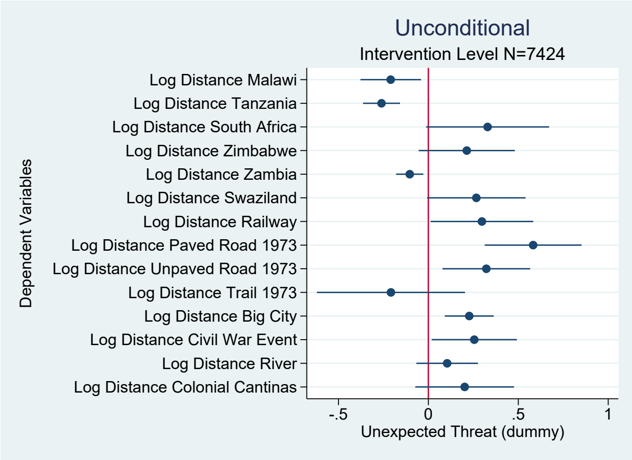

Figure 1a

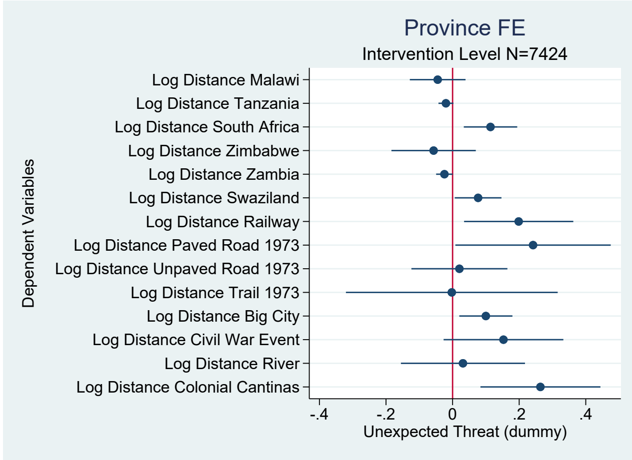

Figure 1b

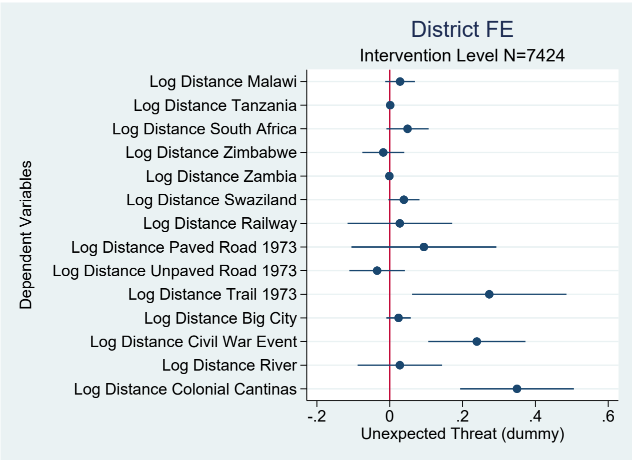

Figure 1c

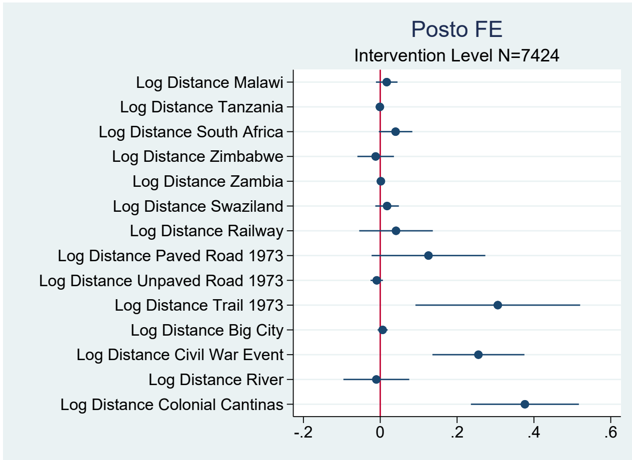

Figure 1d

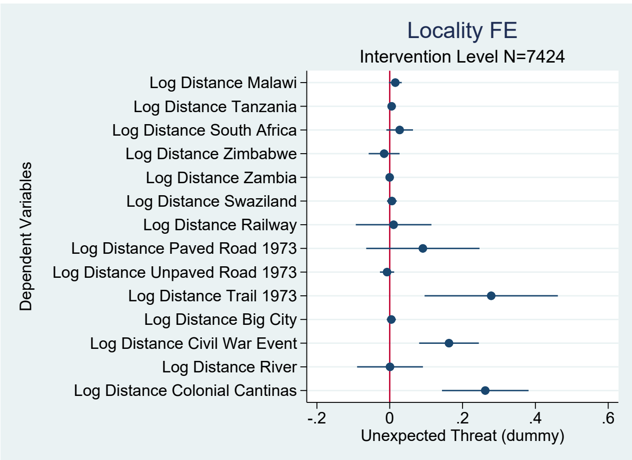

Figure 1e

Figure 1: **Cross-Sectional Differences Interventions in Surveyed (Expected) Cleared (Suspected Hazardous Areas) SHAs and Non-Surveyed (Unexpected) Cleared SHAs**. Figures 1a-1e plot test of means across various locational features between Surveyed/Expected Cleared SHAs and Non-Surveyed/Unexpected Cleared SHAs. Figure 1a reports unconditional estimates; Figure 1b includes (10) province constants; Figures 1c and 1d add (139) admin-2 and (374) admin-3 fixed-effects, respectively. Figure 1e adds locality (855) fixed-effects. Standard error bands are clustered at the District (admin-2) level.

example, during the second period, clearance of the median SHA identified by the nationwide surveys took place in 2004, the same year for the SHA which the deminers did not know about beforehand. This pattern is consistent with our interviews with deminers that the unexpected SHA came to their attention while en route to clearing known (identified in the preceding surveys) SHA.

Table 2: **Timing of Clearance by Demining Period**

	Intervention Level			**Locality Level**		
	Mean (1)	Median (2)	Obs (3)	Mean (4)	Median (5)	Obs (6)
	Panel A. ***Period I: 1992-2000***					
Surveyed/Expected Cleared	1997.78	1998	258	1997.46	1998	13
Non-Surveyed/Unexpected Cleared	1997.85	1998	804	1997.82	1999	78
	Panel B. ***Period II: 2001-2006***					
Surveyed/Expected Cleared	2003.51	2004	1,238	2004.12	2004	136
Non-Surveyed/Unexpected Cleared	2003.88	2004	1,730	2004.51	2005	360
	Panel C. ***Period III: 2007-2015***					
Surveyed/Expected Cleared	2011.31	2012	2,247	2010.52	2011	371
Non-Surveyed/Unexpected Cleared	2010.92	2011	1,147	2011.4	2011	331

Notes: This table reports the mean and the median of the year of full clearance for Surveyed/Expected Cleared SHAs (Suspected Hazardous Areas) and Non-Surveyed/Unexpected Cleared SHAs at the intervention level (columns (1)-(3)) and locality level (columns (4)-(6)).

2 Baseline Panel Estimates

2.1 OLS Estimates

The paper (Table 3) reports OLS estimates associating regional development, as reflected on satellite imagery on light density at night, to three types of interventions: (i) clearance operations of areas, (correctly) identified by surveyors as potentially contaminated. (ii) Clearance of sites that were not pinpointed as suspected hazardous areas (SHA). These reflect Type-II survey errors (false negatives) that could not have been part of any centralized strategic prioritization. (iii) in areas that were recorded as suspected for contamination by preceding surveys, which the operators cancelled once they visited the sites and locals were using the land. These reflect Type-I survey errors (false positives). Table 3 in the main paper shows that luminosity increases significantly upon clearance; this applies also for hazardous areas that were not suspected for contamination in the surveys, minimizing, therefore, concerns of strategic prioritization. In contrast, the mere reclassification of SHA into cancelled does not correlate with development, assuaging concerns that demining teams targeted areas with high growth (potential), as in this case luminosity would have increased. The non-significance further alleviates concerns that demining occured alongside other aid projects, a pattern that our interviews and readings suggest not being the case.

2.2 2SLS Estimates

A related approach to the one we report in Table 3 in the main body is to isolate the part of cleared SHA coming from the clearance of unexpected hazardous areas using a two-stage-least-squares (2SLS) approach. Table 3 Panel A reports 2SLS panel specifications, where total clearance, the independent variable in the second-stage, is instrumented with clearance of SHA not recorded in any of the preceding surveys (unexpected). For comparability, Panel *B* gives the OLS estimates (as reported in Table 3). This approach exploits "mistakes" (false negatives) in the location and timing of SHA to advance on causation.[4] The first stage fit is strong, as roughly half of all clearance operations regard SHA that were not included in the surveys (Table 1). The 2SLS estimates are positive and highly significant. The estimate in (4) suggests that the likelihood that the locality is lit increased by roughly 9.4 percentage

[4]Chodorow-Reich, Coglianese and Karabarbounis (2018) employ a related identification strategy to quantify the role of unemployment benefits on employment. Their creative approach exploits the errors on real-time unemployment rates, as reflected in data revisions, that shape federal receipts for unemployment insurance. Their IV strategy relates measurement error on actual, realized ex post, unemployment to unemployment benefits and in turn on employment.

points when it is cleared by contamination; this is comparable to the 8.3 percentage point increase implied in OLS estimation. When we instrument the log number of SHA with the log number of unexpected (not in the surveys) SHA, the estimate is 0.053, similar to the 0.058 OLS estimate.

Table 3: **Land Mine Removal and Local Development. 2SLS Specification Estimates**

	Panel A. Two-Stage Least-Squares Estimates			
	Log Luminosity		Lit	
	(1)	(2)	(3)	(4)
Cleared Threats	0.413***		0.053***	
	(0.108)		(0.012)	
	[0.094]		[0.119]	
Cleared (dummy)		0.807***		0.094***
		(0.217)		(0.023)
		[0.088]		[0.101]
Number of Localities	1,187	1,187	1,187	1,187
Locality FE	Yes	Yes	Yes	Yes
Time x Province FE	Yes	Yes	Yes	Yes
F-stat (Excluded Instrument)	5,333	985	5,333	985
Observations	4,748	4,748	4,748	4,748
	Panel B. OLS			
	Log Luminosity		Lit	
	(1)	(2)	(3)	(4)
Cleared Threats	0.469***		0.058***	
	(0.098)		(0.011)	
	[0.107]		[0.129]	
Cleared (dummy)		0.755***		0.083***
		(0.182)		(0.020)
		[0.082]		[0.088]
Number of Localities	1,187	1,187	1,187	1,187
Locality FE	Yes	Yes	Yes	Yes
Time x Province FE	Yes	Yes	Yes	Yes
R-squared	.241	.238	.224	.22
Observations	4,748	4,748	4,748	4,748

Notes: Panel A reports panel fixed effects 2SLS estimates associating luminosity with landmine clearance, instrumenting the latter with its Not Surveyed/Unexpected Cleared SHAs (suspected hazardous areas) component. For comparability, Panel B reports panel fixed effects OLS estimates associating luminosity with landmine clearance. The dependent variable in columns (1)-(2) and (5)-(6) is the log of luminosity plus the half of the minimum positive value of luminosity. The dependent variable in columns (3)-(4) and (7)-(8) is an indicator that takes the value of one if the locality appears to be lit. Columns (1)-(4) focus on 4 years that correspond to the three main phases of landmine clearance, 1992, 1999, 2007 and 2015. Cleared Threats is the logarithm of one plus the number of accumulated cleared suspected hazardous areas (SHAs) instrumented with Unexpected Cleared Threats (the logarithm of one plus the number of cumulated not surveyed/unexpected cleared suspected hazardous areas (SHAs) in the locality in given year (period)). Cleared is an indicator variable the takes the value of 0 when the locality is contaminated and becomes 1 the year and for all subsequent years that the locality is landmine free; the indicator equals zero for all localities that were not contaminated. Cleared is instrumented with Unexpected Cleared, which is an indicator variable that takes the value of 0 when the locality is contaminated by not surveyed/unexpected cleared SHAs and becomes 1 the year (or period) and for all subsequent years (or periods) that the locality is free from not surveyed/unexpected SHAs; the indicator equals zero for all localities that were not contaminated. Standard errors in parentheses are clustered at the district (admin 2) level and standardized "beta" coefficients [in brackets]. ***, **, and* indicate statistical significance at the 1%, 5% and 10% level, respectively.

3 Heterogeneity

We re-examined the uncovered heterogeneity distinguishing between clearance of SHA, as recorded in the nationwide surveys, and clearance of SHA that surveyors missed that are unlikely to be part of any central plan of coordination. Table 4 gives the panel estimates, mirroring Section 6.2 of the main body.

3.1 Connectivity

Table 4 columns (1)-(2) report panel OLS estimates that examine heterogeneity with respect to localities' connectivity. As in the main paper, we distinguish between connected to the main transportation network and non-connected localities. Clearance boosts economic activity in connected localities. The coefficient on the indicator that takes the value one, when a locality connected to the transportation infrastructure is fully cleared, is positive and highly significant. This applies both when we look at clearance of SHA recorded in the surveys and at cleared SHA that we not part of the surveys. The magnitudes are comparable. Turning now to localities non-connected to the transportation network, the specifications suggest no relationship between clearance and luminosity.

Table 4: **Land Mine Removal and Local Development. Expected and Unexpected. Heterogeneity Colonial Transportation**

	Colonial Transportation		**Colonial Agricultural Markets**	
	Log Luminosity	Lit	Log Luminosity	Lit
	(1)	(2)	(3)	(4)
Expected Cleared Connected	0.798***	0.095***		
	(0.238)	(0.025)		
	[0.067]	[0.079]		
Unexpected Cleared Connected	0.633***	0.069***		
	(0.190)	(0.019)		
	[0.064]	[0.068]		
Expected Cleared Non Connected	0.374	0.069*		
	(0.311)	(0.038)		
	[0.014]	[0.025]		
Unexpected Cleared Non Connected	-0.484*	-0.040		
	(0.256)	(0.031)		
	[-0.026]	[-0.021]		
Expected Cleared Cantinas			0.867***	0.113***
			(0.258)	(0.028)
			[0.065]	[0.082]
Unexpected Cleared Cantinas			0.650***	0.066***
			(0.208)	(0.021)
			[0.059]	[0.059]
Expected Cleared No Cantinas			0.637**	0.067**
			(0.274)	(0.033)
			[0.036]	[0.037]
Unexpected Cleared No Cantinas			0.015	0.016
			(0.222)	(0.025)
			[0.001]	[0.012]
Number of Localities	1,187	1,187	1,187	1,187
Locality FE	Yes	Yes	Yes	Yes
Time x Province FE	Yes	Yes	Yes	Yes
R-squared	.247	.228	.244	.227
Observations	4,748	4,748	4,748	4,748

Notes: The Table reports fixed effects estimates associating luminosity with demining activities, allowing for heterogeneity based on i) localities non-connected vs connected to the colonial transportation network and ii) localities with no presence of colonial Cantinas vs localities with colonial Cantinas. In columns (1) and (3) the dependent variable is the log of luminosity plus the half of the minimum positive value of luminosity. In columns (2) and (4), the dependent variable is an indicator that takes the value of one if the locality emits some detectable from the satellite light (lit). All specifications focus on 4 years that correspond to the three main phases of landmine clearance, namely 1992, 1999, 2007 and 2015. Expected Cleared Connected is an indicator variable that takes on the value of 0 when the locality, connected to the colonial transportation network, is contaminated by surveyed/expected suspected hazardous areas (SHAs) and equals one following a locality's clearance of all surveyed/expected (SHAs); the indicator equals zero for all localities that were not contaminated. Unexpected Cleared Connected is an indicator variable that takes on the value of 0 when the locality, connected to the colonial transportation network, is contaminated by not surveyed/unexpected suspected hazardous areas (SHAs) and equals one following a locality's clearance of all not surveyed/unexpected (SHAs); the indicator equals zero for all localities that were not contaminated. Expected Cleared Non Connected is an indicator variable that takes on the value of 0 when the locality, not connected to the colonial transportation network, is contaminated by surveyed/expected suspected hazardous areas (SHAs) and equals one following a locality's clearance of all surveyed/expected (SHAs); the indicator equals zero for all localities that were not contaminated. Unexpected Cleared Non Connected is an indicator variable that takes on the value of 0 when the locality, not connected to the colonial transportation network, is contaminated by not surveyed/unexpected suspected hazardous areas (SHAs) and equals one following a locality's clearance of all not surveyed/unexpected (SHAs); the indicator equals zero for all localities that were not contaminated. Expected Cleared Cantinas is an indicator variable that takes on the value of 0 when the locality, where at least one cantina is present, is contaminated by surveyed/expected suspected hazardous areas (SHAs) and equals one following a locality's clearance of all surveyed/expected (SHAs); the indicator equals zero for all localities that were not contaminated. Unexpected Cleared Connected is an indicator variable that takes on the value of 0 when the locality, where at least one cantina is present, is contaminated by not surveyed/unexpected suspected hazardous areas (SHAs) and equals one following a locality's clearance of all not surveyed/unexpected (SHAs); the indicator equals zero for all localities that were not contaminated. Expected Cleared Non Connected is an indicator variable that takes on the value of 0 when the locality, where no cantina is present, is contaminated by surveyed/expected suspected hazardous areas (SHAs) and equals one following a locality's clearance of all surveyed/expected (SHAs); the indicator equals zero for all localities that were not contaminated. Unexpected Cleared Non Connected is an indicator variable that takes on the value of 0 when the locality, where no cantina is present, is contaminated by not surveyed/unexpected suspected hazardous areas (SHAs) and equals one following a locality's clearance of all not surveyed/unexpected (SHAs); the indicator equals zero for all localities that were not contaminated.

3.2 Local Agricultural Markets (Cantinas)

Table 4 columns (3)-(4) report panel estimates examining heterogeneity in terms of the presence of colonial cantinas (local agricultural markets) distinguishing between clearance of SHA as recorded in the preceding surveys and clearance of ex-ante unclassified SHA. The coefficients on the cleared indicator is significantly positive for localities hosting local agricultural markets, both when the look at the clearance of SHA as pinpointed by the preceding Mozambique-wide surveys and when we focus on clearance of "unexpected" SHA; this reassures that the estimates do not reflect some form of central prioritization. The estimates of clearance in localities without colonial cantinas are also positive, but smaller in magnitude and not always significant. We also estimated panel IV estimates instrumenting all clearance with operations in SHA that were not classified as such by the three surveys. The coefficient in localities with cantinas is significantly positive, suggesting economically sizable effects of clearance. In contrast, the IV coefficient on clearance in localities without cantinas is way smaller and does not pass standard significance thresholds.

4 Market Access Analysis

2SLS Estimates As shown in Table 7 in the main paper, there is a strong positive association between overall market access and market access based solely from clearing of unexpected at the time SHA; as such, the first-stage fit is strong. Another way to isolate variation in market access stemming from clearance operations of non-surveyed and thus unexpected SHA, is to instrument overall market access with variation that stems from the unexpected market access. Table 5 reports the estimates. The "reduced-form" models -reported in Panel B- that link luminosity with unexpected market access yield significantly positive estimates across all unconditional specifications (in (1)-(4)). The IV estimates in columns (1)-(4) are positive and highly significant implying that the component of overall market access that is solely driven by clearance of (unexpected) hazardous areas (not identified as suspected by the preceding at the time surveys), correlates strongly with luminosity. The "reduced-form" correlation retains economic and statistical significance when we condition on the expected MA, that reflects clearance of surveyed-expected and targeted by deminers SHA (in columns (5)-(8)). The IV estimates are comparable to the OLS ones (reported in Table of the paper). In columns (5)-(8) we control for the expected market access measure that reflects clearance of SHA identified by the preceding surveys and thus known to deminers at the time. Doing so, allows to further isolate changes in overall market access stemming from clearance of non-surveyed unexpected hazards. The IV estimates are unaffected, retaining statistical significance at standard confidence levels.

Table 5: **Market Access. 2SLS with Unexpected Component.**

Panel A. 2SLS
Demining-Phase Estimation
(1992, 1999, 2007, 2015)

	2SLS				2SLS controlling for Expected			
	Log Luminosity	Lit	Log Luminosity	Lit	Log Luminosity	Lit	Log Luminosity	Lit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log Total Market Access, Light (Initial)	0.431**	0.047**			0.417**	0.046**		
	(0.182)	(0.018)			(0.185)	(0.019)		
	[0.331]	[0.353]			[0.320]	[0.345]		
Log Total Market Access, Population(Initial)			1.090***	0.084***			1.134***	0.087***
			(0.234)	(0.023)			(0.256)	(0.025)
			[0.588]	[0.444]			[0.612]	[0.456]
Log Market Access Expected, Light (Initial)					-0.217	-0.037		
					(0.418)	(0.044)		
					[-0.165]	[-0.275]		
Log Market Access Expected, Population (Initial)							-0.427	-0.022
							(0.466)	(0.046)
							[-0.226]	[-0.113]
Number of Localities	1,187	1,187	1,077	1,077	1,187	1,187	1,077	1,077
Locality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time x Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-stat	788	788	816	816	887	887	762	762
Observations	4,748	4,748	4,308	4,308	4,748	4,748	4,308	4,308

Panel B. OLS
Demining-Phase Estimation
(1992, 1999, 2007, 2015)

	Reduced Form				Reduced Form controlling for Expected			
	Log Luminosity	Lit	Log Luminosity	Lit	Log Luminosity	Lit	Log Luminosity	Lit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log Market Access Unexpected, Light (Initial)	0.458**	0.050**			0.453**	0.050**		
	(0.194)	(0.020)			(0.194)	(0.020)		
	[0.351]	[0.375]			[0.347]	[0.373]		
Log Market Access Unexpected, Population (Initial)			1.103***	0.085***			1.042***	0.079***
			(0.237)	(0.024)			(0.245)	(0.024)
			[0.588]	[0.444]			[0.556]	[0.414]
Market Access Expected, Light (Initial)					0.262	0.016		
					(0.365)	(0.040)		
					[0.199]	[0.116]		
Market Access Expected, Population (Initial)							0.580*	0.055
							(0.350)	(0.036)
							[0.307]	[0.284]
Number of Localities	1,187	1,187	1,077	1,077	1,187	1,187	1,077	1,077
Locality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time x Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,748	4,748	4,308	4,308	4,748	4,748	4,308	4,308
R-squared	.236	.218	.254	.229	.236	.218	.256	.23

Notes: The table reports panel fixed effects 2SLS estimates associating luminosity with market access, fixing both the transportation network and the luminosity(population) for the construction of market access, instrumenting the latter for its corresponding not surveyed/unexpected component. The dependent variable in columns (1) and (3) is the log of luminosity plus the half of the minimum positive value of luminosity. The dependent variable is columns (2) and (4) is an indicator that takes the value of one if the locality is lit. All specifications focus on 4 years that correspond to the three main phases of landmine clearance, namely 1992, 1999, 2007 and 2015. Market Access, Light is the logarithm of luminosity-weighted market access fixing the transportation network to 1973 and holding all localities' luminosity fixed at their 1992 level. Market Access, Light is instrumented with Market Access Unexpected, Light (Initial), which is the logarithm of luminosity-weighted market access obtained by removing only not surveyed/unexpected SHAs and fixing the transportation network to 1973 and holding all localities' luminosity fixed at their 1992 level. Market Access Expected, Light (Initial) is the logarithm of luminosity-weighted market access obtained by removing only surveyed/expected SHAs and fixing the transportation network to 1973 and holding all localities' luminosity fixed at their 1992 level. Market Access, Population is the logarithm of population- weighted market access fixing the transportation network to 1973 and holding all localities' population fixed at their 1980 level. Market Access, Population is instrumented with Market Access Unexpected, Population (Initial) is the logarithm of population- weighted market access obtained by removing only not surveyed/unexpected SHAs and fixing the transportation network to 1973 and holding all localities' population fixed at their 1980 level. In columns (5) and (6) we control for Market Access Expected, Light (Initial), which is the logarithm of luminosity-weighted market access obtained by removing only surveyed/expected SHAs and fixing the transportation network to 1973 and holding all localities' luminosity fixed at their 1992 level. In columns (7) and (8) we control for Market Access Expected, Population (Initial), which is the logarithm of population-weighted market access obtained by removing only surveyed/expected SHAs and fixing the transportation network to 1973 and holding all localities' population fixed at their 1980 level. All specifications include locality-specific fixed-effects and province-year specific fixed effects (constants not reported). Standard errors in parentheses are clustered at the district (admin2) level and standardized "beta" coefficients [in brackets]. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

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