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Quasi-experimental evidence from Liberia

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Natural Resource Sector FDI, Government Policy, and Economic Growth: Quasi-Experimental Evidence from Liberia

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Abstract

Governments use a variety of policies to increase the impact of foreign investment on economic growth. An increasingly popular policy is to require that foreign companies provide public goods near the communities where their commercial investments are sited. This approach seeks to crowd in additional investments, create clusters of interconnected firms, and set in motion economic agglomeration processes. Post-2006 Liberia represents an ideal empirical setting to test the effectiveness of this approach. We construct a new dataset that measures the precise locations of 557 natural resource concessions granted to investors. We then merge these data with a remotely sensed measure of nighttime light growth at the 1 km $\times$ 1 km grid cell level and analyze it using a matched difference-in-differences strategy. We find heterogeneous treatment effects across sectors and investor types: mining (specifically iron-ore) investments projects have positive growth effects, while agriculture and forestry investment projects do not; furthermore, concessions granted to Chinese investors have positive growth effects while those given to U.S. investors do not. These patterns of heterogeneous treatment effects across sectors and investor types are consistent with the theory of change underpinning the government's development corridor strategy.

Keywords: FDI, economic growth, Liberia, public goods, geo-referenced data.

Highlights

- We examine the impact of FDI on local economic growth outcomes in Liberia.
- We introduce a new geo-referenced dataset of 557 natural resource concessions that the Liberian government granted to foreign investors.
- We use a matched difference-in-differences strategy to analyze changes in nighttime light.
- We find heterogeneous treatment effects across sectors and investor types.
- Chinese concessions increase growth but U.S. concessions do not; mining investment projects increase growth, but agriculture and forestry investment projects do not.

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Estimating the economic effects of foreign direct investment (FDI) is a challenge that has vexed scholars and policymakers for decades. The effects of FDI almost certainly vary across country and project characteristics, making generalizations difficult. In addition, even though FDI projects are sited in specific locations, available data are typically aggregated to the country level resulting in imprecise estimates.[1] Faced with these challenges, scholars have turned to sub-nationally geo-referenced investment, outcome, and covariate data and quasi-experimental methods of causal inference (Knutsen et al., 2017; Zhu, 2017; Fafchamps, Koelle & Shilpi, 2016; Aragón & Rud, 2016; Aragón & Rud, 2013). We make three contributions to this emerging body of work.

First, we evaluate the impact of FDI on local economic growth outcomes in post-2006 Liberia, which pursued a unique policy approach: in contrast to previous approaches—where host governments provided public goods to attract foreign investors—the Ellen Johnson-Sirleaf administration has required that foreign companies provide public goods. It has granted concessions that allow foreign investors to extract iron ore, gold, palm oil, timber, rubber, and other natural resources. However, these concession agreements also stipulate that investors must build and maintain public infrastructure—including roads, bridges, ports, railways, and power plants—near the communities where their commercial activities are sited. This strategy seeks to create new 'development corridors' by using privately provided public goods to set in motion economic agglomeration processes (Speakman & Koivisto, 2013).

Second, we identify the specific conditions under which this approach is most effective. We do this by assembling a dataset of all known natural resource concessions that the Liberian government granted to investors between 2004 and 2015, and then geo-referencing this dataset by constructing polygons that correspond to the specific tracts of land granted to concessionaires. We also categorize each concession by sector and investor type.

[1]See Section 2.1 of the Online Appendix for a review of this literature.

Third, in order to address the non-random assignment of the treatment (i.e. the possibility that locations with FDI may be different from locations without FDI in a way that threatens causal inference), we use a propensity score matching procedure to first prune our sample such that it only includes 'treated' and 'untreated' locations that are extremely similar across a large number of observed covariates and equally likely to receive treatment. This procedure minimizes the risk that 'treated' locations have features that predispose them to higher levels of economic growth independently of FDI. We then use a difference-in-difference strategy to compare changes in local economic growth in otherwise similar subnational localities with and without investment projects. We use a remotely sense measure of nighttime light growth as a proxy for local economic growth (Weidmann & Schutte, 2017; Henderson, Storeygard & Weil, 2012).

We recognize that investments in the natural resource sector may have negative, second-order effects, such as increased corruption and environmental degradation (Knutsen et al., 2017; Aragón & Rud, 2016). With respect to initial effect of FDI on economic outcomes, however, our results suggest that extractive sector FDI has improved local economic growth in Liberia. We also find a pattern of heterogeneous treatment effects that is consistent with the theory of change underpinning the government's development corridor strategy. Concessions that were subject to more demanding public good provision requirements (mining investment projects in general and iron ore investment projects in particular) produced higher levels of economic growth than those that faced less demanding public good provision requirements (agricultural and forestry investment projects). Likewise, those investors that were particularly well-positioned to meet the public good requirements of the host governments (Chinese concessionaires) achieved larger economic growth impacts than investors that were less well-positioned to meet such requirements (U.S. concessionaires).[2]

[2]We hypothesize that Chinese firms are better-positioned than U.S. companies to implement commercial investments and supply public goods in a timely manner. This might explain why Chinese-financed

Liberia's FDI Strategy

Governments have historically pursued three different strategies to increase the impact of foreign investment on domestic economic growth. Some governments have put their trust in the market mechanism and liberalized FDI inflows (Williamson, 2000, p. 252). These governments have refrained from regulating or directing foreign investment in the hopes that the market would instead identify the most optimal use of resources. A second strategy has involved the imposition of geographic restrictions by allowing foreign investors to operate only in specifically designated export processing zones. In these cases, governments hoped that the presence of foreign firms would enhance the productivity of domestic labor — for example, by training and educating a locally sourced labor force (Gorg & Strobl, 2005; Fosfuri, Motta & Rønde, 2001). A third strategy has involved the imposition of operational requirements that foreign firms enter into joint ventures with domestic companies and share their technologies with indigenous firms. In these cases, government policy has focused on facilitating technology transfer (Wang & Blomström, 1992).

However, these strategies are most relevant to countries with existing infrastructure and an entrepreneurial base ready to benefit from knowledge and technology transfers. Liberia lacks these preconditions and has pursued a different strategy. The novelty of its approach is that, rather than supplying public goods for use by private investors, the government has required that incoming investors provide public goods in or near the communities where their investments are physically sited. This strategy is premised on the idea that the concentration and co-location of private and public investments in specific geographic areas will crowd in additional investments, create clusters of interconnected firms, nurture the development of value chains, and set in motion economic agglomeration

projects produce near-term economic growth impacts. See p. 14 for additional details.

processes (Speakman & Koivisto, 2013).[3]

More specifically, the Johnson-Sirleaf administration has pursued a strategy of "develop[ing] spatial corridors off the back of concession-sponsored infrastructure" (AFDB, 2013, p. 34).[4] In 2010, it articulated this strategy:

> "[our] development corridor strategy will allow growth to accelerate by 'crowding in' investment, creating synergies among diverse activities along growth axes where users can share road-, rail-, port-, power-, telecommunications- and water infrastructure. ...In the past, wasteful practices included mines created as autonomous island investments with their own infrastructure. Potential other users were closed out. ...[Our] development corridor approach identifies potential other users of infrastructure from the start, and factors them into the design of the infrastructure. Planning shared infrastructure and communicating effectively with investors and communities can accelerate the process, reduce wasteful duplication of effort and improve both investor and community benefits." (Government of Liberia, 2010, p. vii).

The Government of Liberia's strategy assigns a higher level of priority to physical infrastructure investments than social sector investments such as schools and hospitals. There are good reasons to believe that the former will have larger, near-term impacts on economic growth than the latter. Existing empirical evidence indicates that investments in economic infrastructure (e.g. roads, railways, bridges, and electricity grids) produce

[3]Alternatively, the government could have taxed foreign investors and used the proceeds to fund infrastructure itself. However, this is not the case in Liberia, for two reasons: First, fiscal revenues from foreign investors are low because the government agreed to generous tax breaks in exchange for concessionaires building public infrastructure (Qaiyim & Siakor, 2014, p. 11). Liberia's Ministry of Planning and Economic Affairs estimated that the country's six major iron ore concessions would together generate only $129 million of government revenue (Government of Liberia, 2010, p. vii). Second, the government revenues that are generated via taxes on foreign investment are not used for specific infrastructure projects. Liberia's Revenue Authority emphasizes this point, noting that "revenues from the extractive sectors are not earmarked for specific spending or regions in Liberia." See `https://eiti.org/liberia#revenue-collection`, accessed October 6 2017.

[4]Also, see Section 2.2 in the Online Appendix.

more immediate and easily detectable growth effects (Clemens et al., 2011), whereas the economic growth effects of human capital investment can take years, if not decades, to materialize (Mayer, 2001)

There is also descriptive evidence that suggests the government's strategy of requiring concessionaires to invest in local public good provision may have increased the stock of physical infrastructure. While time-series data for road or rail density are not available, a recent IMF report indicates that about 1,000 additional kilometers of roads were paved between 2006 and 2016 (IMF, 2016, p. 35). Liberia's performance on UNCTAD's Liner shipping connectivity index, which measures how well countries are connected to global shipping networks, also increased by 60% over the same period. Additionally, data from the World Bank suggest that the percentage of Liberians with access to electricity increased from 0.01% in 2003 to 9.14% in 2014. Yet it remains unclear if these changes have actually resulted in higher local economic growth. Our study seeks to address this question.

Theory

We rely on Hirschman (1977) to identify two plausible channels through which natural resource sector investment and concessionaire-provided public goods might together result in economic growth: *backward linkages* and *consumption linkages*. Backward linkages to the local economy occur when the production of a given commodity requires the supply of goods and services as inputs. Walker & Minnitt (2006) and Bloch & Owusu (2012) note that the mining industry requires a large and diverse set of inputs, including raw materials (e.g. chemicals, steel), equipment (e.g. drills, generators, pumps), parts (e.g. cables, pipes), and engineering, construction, survey, legal, finance, insurance, laboratory, catering, vehicle maintenance, and transportation services. These linkages should be even stronger in geographical areas that enjoy higher levels of public good provision, as the availability of local infrastructure and public services should reduce the costs of doing business. Firms should also be able to more easily reach markets and integrate themselves into value chains in such areas (Speakman & Koivisto, 2013).

Consumption linkages refer to local spending that occurs as a result of increased incomes (from either wages or profits) related to commodity production. Employees spend their income, in part, on non-mining related goods and services (e.g. food, clothing, taxi services), and this in turn creates more opportunities for non-mining related enterprises. Tolonen (2014) provides evidence that the establishment of a new mine increases income-earning opportunities within the service sector by 41%. In Ghana, Fafchamps, Koelle & Shilpi (2016) find that locations close to gold mines had proportionally higher employment in industry and services, which suggests a shift from the informal to the formal sector. Chuhan-Pole et al. (2015) show that both men and women benefit monetarily from gold mines, but men are more likely to obtain direct employment as miners and women are more likely to gain from indirect employment opportunities in services. Relatedly, Kotsadam & Tolonen (2016) find that increases in mining activity result in sectoral shifts in employment out of agriculture: men move into skilled manual labor, while women find more employment in the service sector. These economic multiplier effects should be even larger in settings where public goods are provided.[5] We therefore test the following hypothesis:

Hypothesis 1 *Natural resource concessions will, on average, result in a higher level of economic growth in surrounding areas.*

When examining the effects of natural resource sector investments with concessionaire-provided public goods, one would ideally distinguish between the specific private invest-

[5]Note that Liberia has attracted very few greenfield investments. Virtually all FDI is located in the natural resource sector, which requires investors to obtain concessions (Werker & Beganovic, 2011). Therefore, it is not possible to compare FDI with and without concessions.

ment sites and the public goods provided in communities near concession areas (e.g. investments in general purpose roads vs. mine access roads). But for the vast majority of concessions in our dataset, such information is not available in publicly available contracts.

We do, however, have strong *a priori* reasons to believe that public good requirements included in concession contracts vary systematically by sector. The Liberian government's development corridor strategy rests on the assumption that only mining investors are able to plausibly finance large-scale transportation infrastructure themselves: "[m]ining is generally the only activity that can self-fund major transport infrastructure and thus anchor new development corridors" (Ministry of Planning and Economic Affairs, 2011). Therefore, we expect that mining concessions will result in stronger backward linkages than agriculture or forestry concessions.

We also expect to see a larger multiplier effect from the consumption linkages developed through mining concessions. The rationale for this expectation is again outlined in the Liberian government's development corridor strategy: "mining itself is capital intensive and can generate comparatively few jobs. ... The infrastructure it finances, however, can generate/sustain tens of thousands of jobs, both in mining-linked investments and in complementary value chains that are more labor intensive" (Government of Liberia, 2010, p. 54). For these reasons, we expect to observe a pattern of heterogeneous treatment effects across mining versus agriculture and forestry concessions:[6]

> **Hypothesis 2** *Mining concessions will, on average, have larger impacts on economic growth than agricultural or forestry concessions.*

We can also differentiate between different types of mining activities. Iron ore differs from mining gold, diamonds, bauxite, and base metals in that it offers the possibility of

[6]Note that we cannot compare mining and agriculture concessions to manufacturing FDI. While the literature has found that manufacturing can play an important role in generating production externalities, this type of FDI is largely nonexistent in Liberia (Werker & Beganovic, 2011).

large profits over long periods of time, which makes it easier for companies to justify major, up-front investments in infrastructure. Our dataset reveals that the average duration of contracts granted to iron ore concessionaires is 21 years, in contrast to just 9 years for other mining concessions. The average capital expenditures of iron ore investors are $1.6 billion, while those of other mining concessionaires equal only $43.2 million (Government of Liberia, 2010). Iron ore investors therefore have limited exit options and a weaker bargaining position vis-à-vis the host government.

Recognizing these constraints, the Liberian government has imposed particularly heavy public good requirements on incoming iron ore investors (AFDB, 2013). Specifically, the Johnson-Sirleaf administration has prioritized the development of three spatial development corridors near three major iron ore concessions: one near the Western Cluster iron ore deposit, a second near the Putu iron ore deposit, and a third near the Mount Gangra, Mount Tokadeh and Mount Yuelliton deposits (see Section 2.2 of the Online Appendix for more details). These "new iron ore concessions are [at] . . . the center of a new development strategy based on development corridors. . . . The idea is to have concession-sponsored infrastructure (roads, rail, ports, power and water) catalyze [economic] activity in other sectors within viable logistics proximity. Explicit provisions are being made in concession agreements to that end" (AFDB, 2013, p. 33). For these reasons, we expect to observe systematically different local economic agglomeration effects across different types of mining investments:

> **Hypothesis 3** *Iron ore concessions will, on average, have larger impacts on economic growth than other types of mining concessions.*

An investor's country of origin could also matter for local economic growth outcomes. First, managerial approaches related to employment might differ in ways that are economically consequential. Some analysts have argued that, in contrast to U.S. companies, Chinese firms have a preference for hiring Chinese workers instead of local labor to support their overseas investments (Dollar, 2016). Such hiring practices, if widespread, could limit the growth-enhancing effects of FDI by undermining the development of consumption linkages. However, it seems unlikely that this mechanism is operating in Liberia. The Ellen-Johnson Sirleaf administration has uniformly imposed local labor requirements on foreign investors, irrespective of their countries of origin.[7] There is also very little empirical evidence that Chinese companies primarily use Chinese labor. Sautman & Hairong (2015) examine a sample of 400 Chinese firms operating in Africa and find that 85% of their employees are local hires. Likewise, Warmerdam & Dijk (2013, p. 292) and World Bank (2012, p.22) find that roughly 90% of the workers employed by Chinese companies in Uganda and Ethiopia, respectively, are local hires. Given that U.S. companies in Africa also rely very heavily on local labor (Rounds & Huang, 2017, p.26), it seems unlikely that different labor sourcing practices would account for heterogeneous treatment effects across U.S. and Chinese concessionaires.

Second, while the Liberian government generally expects concessionaires to adhere to the same set of rules and norms independently of the country of origin, there could be differences in the enforcement of these standards that correlate with investors' countries of origin. With respect to corruption, for example, Chinese companies might be less constrained by international rules and thus more likely to use bribes to overcome operational impediments in Africa. However, in Liberia, it seems unlikely that U.S. and Chinese investors are differentially constrained by international rules. The European Accounting and Transparency Directive and Section 1504 of the Dodd Frank Act require natural resource companies listed on U.S. and European stock exchanges to disclose payments made

[7] The Government included almost identical local employment provisions in its contracts with Mittal Steel Liberia (a major Western concessionaire) and China Union (a major non-Western concessionaire). China Union's 2009 concession contract states that "[t]he Concessionaire may not hire individuals who are not citizens of Liberia for unskilled labor positions." It also specifies that "[t]he Concessionaire must employ and give preference to the employment of qualified citizens of Liberia for financial, accounting, technical, administrative, supervisory, managerial, and executive positions and other skilled positions."

to African governments in exchange for concessions, but only two out of 36 U.S. concessionaires operating in Liberia are listed on U.S. or European stock exchanges. Nor is there much evidence to support the claim that Chinese and U.S. firms comply at different rates with domestic rules and norms in host countries (Rounds & Huang, 2017; Sautman & Hairong, 2012; Irwin & Gallagher, 2013).

A third possibility is that Chinese firms are better positioned than U.S. companies to implement commercial investments and supply public goods in a timely manner. The U.S. embassy reported in 2009 that, during the vetting of proposals from prospective iron ore concessionaires, the Liberian authorities favored Chinese investors because of their willingness and ability to implement private and public investment activities on an expedited schedule.[8] Around the same time, the former President of Senegal, Abdoulaye Wade, published an op-ed in the *Financial Times*, noting that "China has helped African nations build infrastructure projects in record time" and "I have found that a contract that would take five years to discuss, negotiate and sign with the World Bank takes three months when we have dealt with Chinese authorities."[9] Dreher et al. (2017) provide causal evidence that the firms responsible for implementing Chinese-financed infrastructure projects produce large and near-term economic growth impacts, whereas U.S. infrastructure projects deliver economic growth benefits that accrue over longer periods of time. This reason for expecting differential growth impacts across investor nationalities would therefore seem to be more plausible than the alternative explanations summarized above.

Hypothesis 4 *Chinese concessions will, on average, register more easily detectable growth impacts than U.S. concessions.*

[8] "Liberia: Chinese Firm Wins Bid to Develop Bong Iron Ore Mine." *U.S. Embassy Cable,* January 21, 2009.

[9] "Time for the West to practice what it preaches," *Financial Times*, 23 January 2008.

A Quasi-experimental Approach

Matching Approach

Estimating the effect of FDI on economic growth is challenging because models only provide valid causal estimates if they are unaffected by endogeneity. A major threat to causal inference is the possibility that FDI does not cause growth, but investors are instead attracted to geographic locations with high growth potential. A positive correlation between local economic growth and FDI might only indicate that the very same locations that received FDI would have also experienced the same level of growth in the absence of FDI.

We address the possibility that locations with FDI may be different from locations without FDI in a way that threatens causal inference with a matching approach. We prune our sample to only include 'treated' and 'untreated' locations that are extremely similar across a large number of observed covariates. This procedure is designed to expunge any potential effects of self-selection bias — that is, the possibility that 'treated' locations have features that predispose them to higher levels of economic growth independently of FDI. Our goal, then, is to identify pairs of treated and untreated locations that are equally likely to receive treatment.

Given that matching only helps mitigate endogeneity problems if it is possible to measure relevant factors that influence treatment assignment, we carefully reviewed the existing literature on the subnational project siting decisions of foreign investors.[10] A wide range of factors influence where investors site their projects within countries, including climatic conditions, market size and access, human capital, transportation infrastructure, and local governance quality. We attempt to account for as many of these factors as possible by drawing upon diverse sources of data from satellite imagery, weather stations,

[10] See Section 4.1 in the Online Appendix.

household surveys, and administrative records.[11]

Our spatial units of observation are 1 km × 1 km grid cells that fall within buffers around each Demographic and Health Survey (DHS) Enumeration Area (EA). We rely on the 2007 wave of DHS, which contains 298 spatially referenced EAs. DHS EAs are subjected to displacement procedures to protect respondent anonymity. In most cases, urban EAs are displaced by up to 2km, while rural ones are displaced by up to 5km. We create buffers around EAs to account for geographical displacement. After creating buffers with a radius of either 2 or 5km, depending on the type of EA, we create 1km × 1km grid cells within the area encompassed by each buffer. We begin the matching process with approximately 13,000 observations at the grid-cell level.

In order to identify locations that are as similar as possible across our covariate data, we first employ a logit model that estimates the probability that a given grid cell is proximate to a FDI location (Ho et al., 2007; Imai, King & Stuart, 2008). This logit model is then used to derive the propensity that the units will 'receive the treatment' of exposure to the concession. The propensity score is, in turn, used in a nearest-neighbor matching routine (caliper = 0.25)[12] to create a matched sub-sample of treatment and control units, where the 'treated' grid cells are those near concession areas and 'control' grid cells are those far away from concession areas.

After estimating the propensity scores, we first drop units that lack common support, and then match grid cells without replacement using the nearest-neighbor approach.

[11]Importantly, we match on pretreatment nighttime light levels and trends (Cook, Shadish & Wong, 2008). In addition, we present average nighttime light values over the course of the pretreatment period (1992-2005) across our treated and control units. Our findings indicate that, after matching, pretreatment levels of nighttime light were roughly parallel, which suggests that in the absence of treatment the nighttime light differences across our treatment and control cases (matched locational pairs) would have been constant over time. See Sections 4.1 through 4.6 of the Online Appendix.

[12]The caliper determines the degree of similarity two locations must demonstrate to be considered as a matched pair. A 0.25 caliper is a common "best practice" in studies using propensity score matching for causal inference (Lunt, 2013; Rosenbaum & Rubin, 2012). As a robustness test, we re-estimate all models using a caliper of 0.1. This stricter criterion for identifying matched pairs results in a reduced sample size. However, our results do not change substantively; see Section 5.3 of the Online Appendix.

Matching without replacement forces the algorithm to sample from a wider geographic area, which minimizes the probability that our matched pairs will cluster in one area and thus accounts for possible biases resulting from spatial selection effects (e.g. geographic treatment spillovers from one location to a neighboring location).

If this matching procedure was successful, the treated and untreated samples should be nearly indistinguishable, apart from the fact that the former group was proximate to FDI and the latter group was not. Our matching procedure accomplishes this goal: the observable characteristics of our treated and untreated locations after matching are almost identical. After matching, covariate balance improves by approximately 90%.[13] This suggests that our subsequent statistical analysis compares only location pairs that are extremely similar, which significantly reduces the risk of endogeneity bias.[14]

Empirical Analysis

We estimate the growth impacts of natural resource sector FDI using a matched difference-in-differences (DID) strategy. Our estimation strategy first identifies matched pairs of cells, and then calculates the difference in the average change in nighttime light in the treatment locations before and after treatment minus the difference in the average change in nighttime light in the control locations before and after treatment. An attractive feature of this approach is the ability to control for time-invariant, unobservable characteristics that might also affect economic growth.

[13] The matching procedure leveraged here optimizes by selecting the best match for each individual treated cell, thus aiming to match along all elements of the distribution. We calculate this overall summary of the balance improvement by observing the change in mean differences after balancing (Ho et al., 2007). Each unit of observation is matched according to its propensity score on a unit-by-unit basis to the best-matched control; we seek to minimize the difference in propensity score between matched pairs. See Section 4.2 and 4.3 in the Online Appendix.

[14] Matching approaches are only as useful as the set of observed covariates used to achieve balance between treatment and control units. We cannot completely rule out the possibility that some unobserved confound biases our findings. Therefore, we make similar assumptions as instrumental variable approaches, which need to assume that there are no unobserved variables linking the instrument to the outcome except through the path of the instrumented variable.

With our preprocessed data, we estimate a linear model with the set of matched control and treatment units for each hypothesis following:

$$y = \beta_0 + \beta_1 \times T + \sum_{k=1} (B_k \times x_k) + \beta_k \times P_y + D_\tau + \epsilon \qquad (1)$$

where B_k and x_k are the regression coefficients and covariate information for each indexed covariate (k), β_1 is the regression coefficient for the treatment effect, T, and y represents the outcome variable over our study interval. P_y is the pre-treatment trend for the outcome variable. D_τ represents fixed effects for regions. We cluster errors by DHS enumeration areas to mitigate concerns of within-cluster spatial autocorrelation and the potential deflation of standard errors attributable to arbitrary grid cell sizes (Cameron, Gelbach & Miller, 2012).

We measure our outcome of interest—local economic growth—using satellite data on nighttime light emissions. We use this measure for three reasons. First, Figure 1 demonstrates that in Liberia there is a very strong relationship between GDP and nighttime light at the national level.[15] The bivariate correlation between these annual GDP and nightlight observations is 0.91. Second, previous research demonstrates that nighttime light is a useful measure of local economic activity (Jean et al., 2016; Henderson, Storeygard & Weil, 2012).Third, we lack an alternative measure of local economic growth. DHS surveys measure asset wealth at the household level, but do not provide time-series data as the various survey waves sample households in different enumeration areas. However, Weidmann & Schutte (2017) demonstrate that levels of nighttime light correlate strongly (0.73) with survey-based measures of asset wealth at the local level. Similarly, Khomba & Trew (2017) demonstrate that changes in nighttime light also correlate strongly (0.53) with changes in household consumption.

While nighttime light is the best available proxy measure for subnational economic

[15] We thank Bundervoet, Maiyo & Sanghi (2015) for providing us with their data to produce this Figure.

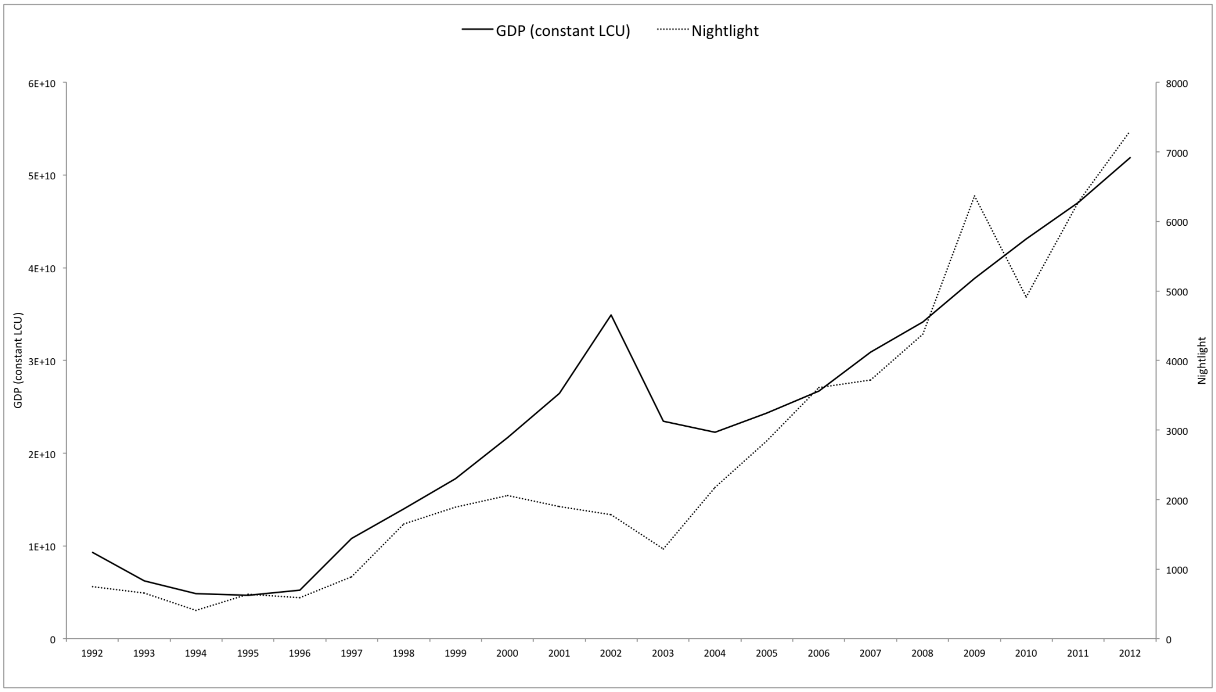


Figure 1: GDP and Nighttime Light in Liberia, 1992-2012

growth, it is not without limitations. For reasons of space, we discuss these limitations — and how we address them — in the Online Appendix.[16] To construct our outcome variable, we calculate the change in nighttime light levels over the full treatment period (2006-2012) for each 1 km $\times$ 1km grid cell.

Our causal variable of interest is foreign direct investment in the natural resource sector. We assembled a dataset of all known natural resource concessions granted to concessionaires in Liberia from 2004 to 2015.[17] Figure 2 demonstrates that these concessions are evenly distributed across Liberia and do not cluster in any part of the country. Each of the 557 concessions in this dataset is classified according to the sector of the concession and the nationality of the concessionaire or its parent company. A polygon-based geocoding methodology was also used to identify the specific tracts of land granted to concessionaires, which allows us to calculate at a high-level of spatial resolution whether

[16]See Section 3.2 of the Online Appendix.

[17]For more details on this dataset, see Section 3.1 of the Online Appendix.

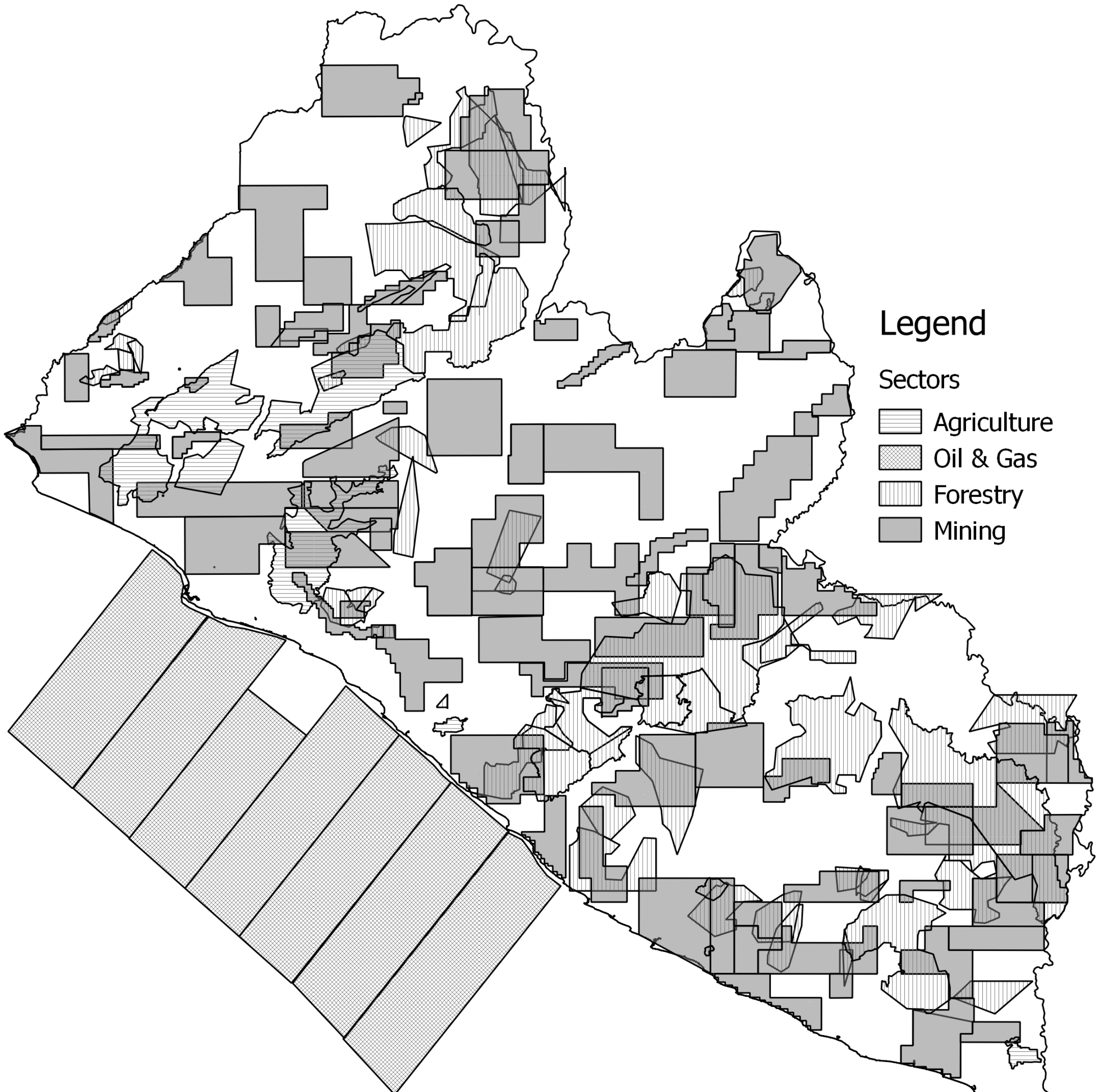


Figure 2: Map of all concession licenses in Liberia, 2006-2012. In addition to the precise location of concessions, the map differentiates concession by sector.

a particular location has been ‘treated’ with FDI activity.

We sub-divide our concessions dataset by sector and investor nationality to test each of our hypotheses. A 1km × 1km grid cell is considered ‘treated’ if it falls within 25km of a given concession type. For example, when we evaluate the nighttime light impacts of

Chinese concessions, we classify all cells that fall within 25km of a Chinese concession as 'treated.' [18]

The choice of 25km as the distance threshold requires justification, as other studies have used thresholds ranging from 20km (Kotsadam & Tolonen, 2016) to 100km (Aragón & Rud, 2013). At a theoretical level, we ought to pick a threshold appropriate for the country's size; more specifically, the expected range across which economic effects of FDI projects might diffuse should guide our choice of a distance cutoff for treatment status. We therefore use a plausible range of commuting distances for workers as a proxy. While no such information is available for Liberia, data from neighboring Ivory Coast suggest that 0km to 25km is a reasonable estimate (Kung et al., 2014, p. 6).

We also face empirical constraints that limit the use of certain thresholds. More specifically, the larger the radius used to define which locations are treated, the lower the number of locations that we can consider as (matched) counterfactual cases. Without a reasonable number of untreated locations available for matching, we cannot conduct the statistical analysis. In a country of Liberia's size, we cannot calculate estimates for most models if we use a radius of 30km or higher. Similarly, the smaller the radius used to define which locations are treated, the lower the number of treated observations. In this case, a large number of control locations are available for matching, but the small number of treated locations can leave us with an insufficient number of matched pairs for statistical analysis. We therefore face both an upper and lower limit with respect to possible thresholds. In sum, 25km represents a distance at which we can estimate effects across *all* our hypotheses.[19]

[18]When calculating our results, there is a risk that cells in the control group are contaminated by other types of concessions. When analyzing the effect of Chinese concessions, our control observations are defines as locations not exposed to Chinese concessions. However, this definition of control units may include locations exposed to U.S. concessions, as long as they are not close to Chinese concessions. This overlap, however, is not problematic as it introduces a conservative bias: if U.S. concessions increase local growth, control locations should light up more so than if they were not exposed to any concession at all. This makes finding statistically significant differences across treatment and control units more difficult.

[19]As a robustness test, we estimate all models for which we have sufficient data across a range of

We also include a range of control variables to account for residual variance in our outcome measure (after matching) that is not related to treatment. We control for temperature, precipitation, slope, elevation, the urban or rural nature of the location, population density, distance to roads, travel time to major population centers, proximity to development projects, proximity to natural resource deposits, the politically privileged or disadvantaged nature of a location, pretreatment nighttime light levels and trends, and region fixed effects. We also account for population characteristics (household education and literacy, household wealth, household size) and head of household characteristics (age, gender, marital status, religion, employment status).

Findings

We first estimate an overall treatment effect for all concessions over the 2006-2012 period, irrespective of sector or investor type.[20] Figure 3 shows that the overall treatment effect estimate is statistically insignificant.

However, to test the reliability of these results based on comparisons of treated and never-treated localities over the full treatment period, we compare early-treated and late-treated localities to never-treated localities to determine whether treatment impacts are larger in magnitude or more easily detectable in areas where concessions have been active for longer periods of time. The economic agglomeration processes described in the theory section of this paper take place over relatively long spans of time, so one would expect concessions with longer periods of implementation to register larger impacts on nighttime

different threshold distances. These results, reported in Section 5.4 of the Online Appendix, are largely consistent with the results reported here. There are some differences, though, which are to be expected considering the number of estimations performed. Following the frequentist interpretation of confidence intervals, we expect 95 of 100 analyses to contain the actual unknown value of the coefficient. Of the 115 models we estimate, only 6 models (equivalent to 5% of all models) are statistically significant and opposite sign from the estimates reported in the manuscript.

[20]Tables with the numerical results of the estimations for all Figures are available in Section 1.1 of the Online Appendix.

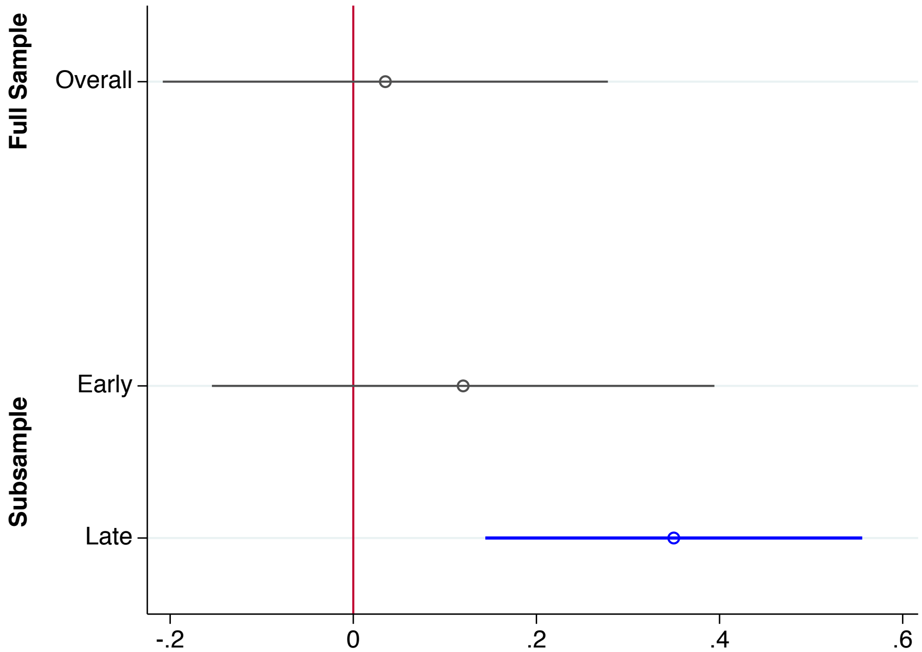
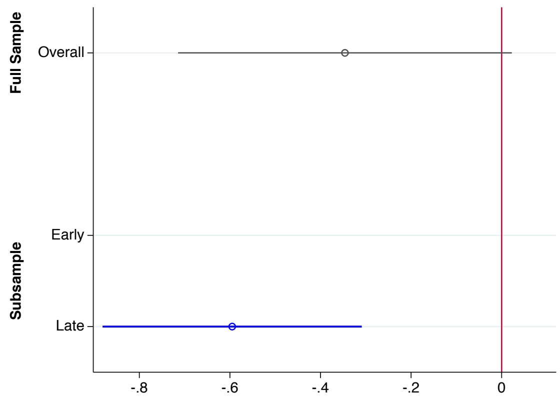


Figure 3: Effect of all concessions on local economic growth. All Figures show 95% confidence intervals.

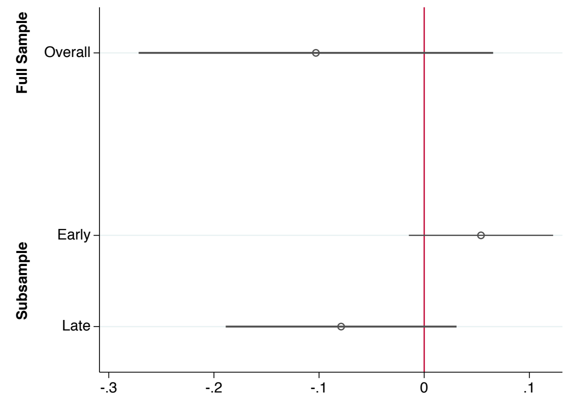
light growth.

Figure 3 summarizes the results from these early treatment and late treatment tests. For the early treatment test, we include only those concessions activated between 2006 and 2008 and measure nighttime light growth over 2005-2009 period.[21] The purpose of this test is to examine whether concessions have a measurable impact on nighttime light growth when early grid cells have been partly treated and no late grid cells have been treated. For the late treatment test, we include all concessions activated between 2006 and 2012 but restrict the period of outcome measurement to 2009-2013. Here we examine whether nighttime light growth impacts are larger or more easily detectable when all early grid cells have been treated *and* late grid cells have been partially treated. The early treatment test shows no statistically significant effect of concessions on nighttime

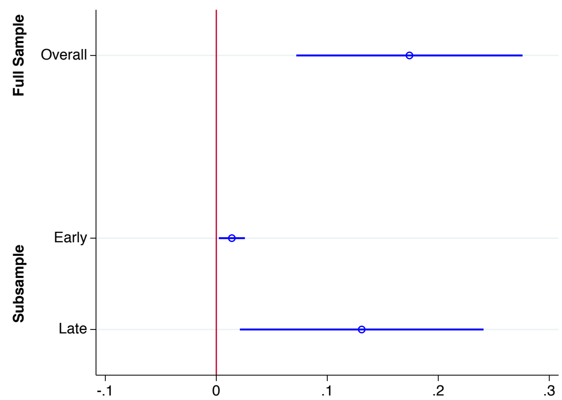
[21] We use 2005, rather than 2006, as the baseline year of measurement to ensure that it is not contaminated by treatment effects. We use 2009, rather than 2008, as the endline year of measurement to allow concessions granted near the end of the early treatment period to register detectable effects.



(a) Agriculture concession



(b) Forestry concession

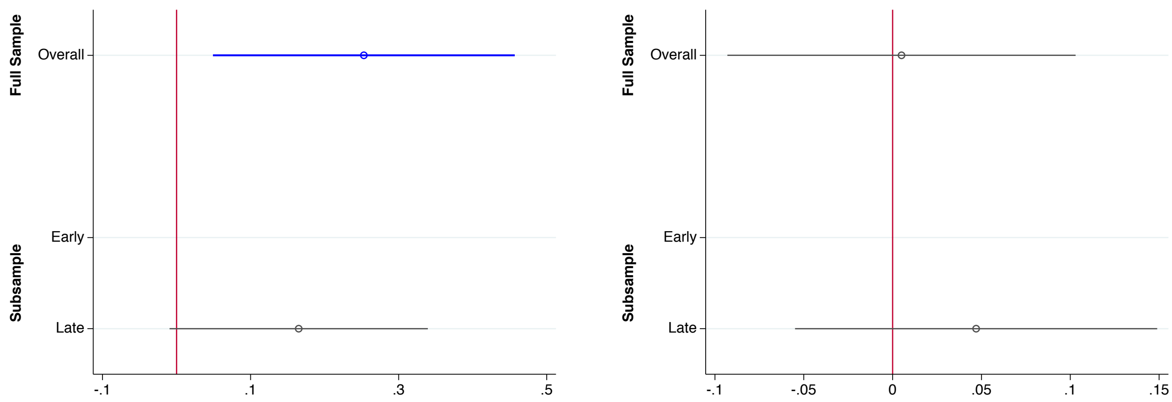


(a) Mining concession

Figure 4: Effect of mining, agricultural, and forestry concessions on local economic growth.

light growth, but the late treatment test does. This empirical pattern is consistent with our theoretical expectations: the economic development benefits of natural concessions are not immediate; they accrue over a period of time as backward linkages and consumption linkages form and grow.

However, it is possible that these results mask important sectoral heterogeneity in treatment effects. We first test Hypothesis 2 by separately estimating matched DID models for mining, agricultural, and forestry concessions. Our results are summarized in Figure 4. Consistent with our expectations, mining concessions have a positive and statistically significant impact on nighttime light growth, whereas agricultural and forestry



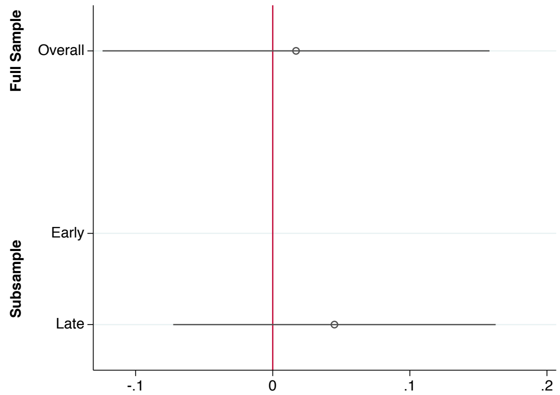
(a) Iron Ore concession (b) Other Mining concession

Figure 5: Effect of iron ore mining concessions and other mining concessions on local economic growth.

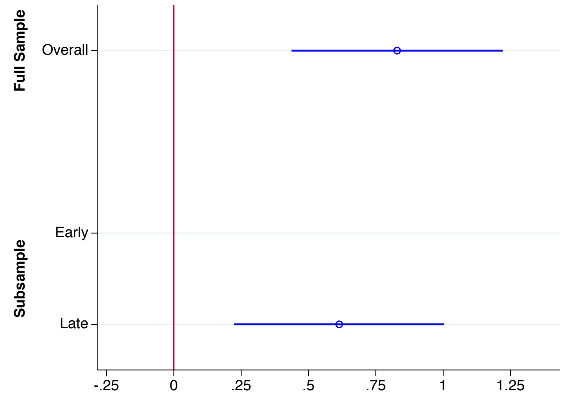
concessions do not. We can also see in Figure 4 that the late mining treatment registers a larger positive and statistically significant effect in a matched DID model specification than the early mining treatment.[22] This empirical pattern suggests that investments subjected to more demanding public good requirements deliver significant economic growth benefits, but with a time lag. It also suggests that *direct* employment effects are probably not the primary mechanism through which concessions spur economic agglomeration process, as the agriculture and forestry sectors are considerably more labor-intensive than the mining sector (World Bank, 2010, p. 14).

We further disaggregate mining concessions by distinguishing iron ore concessions from other mining operations, such as gold, diamonds, bauxite, and base metals. Figure 5 provides evidence that supports Hypothesis 3: concessions that subject to particularly demanding public good provision requirements (iron ore investments) produced higher levels of economic growth than those that faced less demanding public good provision requirements.

[22]We are unable to estimate early and late treatment effect for agricultural concessions due to insufficient counterfactual observations after matching.



(a) U.S. concession



(b) Chinese concession

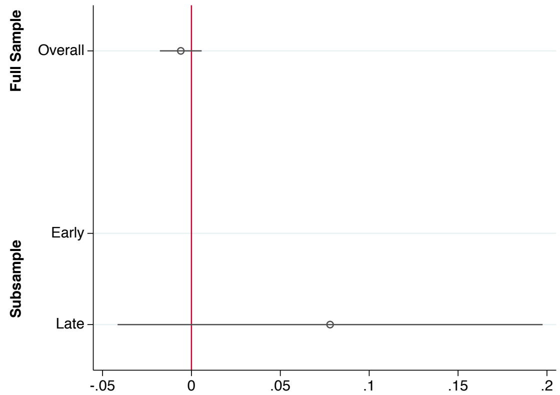
Figure 6: Effect of U.S. and Chinese concessions on local economic growth.

We also disaggregate treatment effects by investor type. Hypothesis 4 proposed that Chinese companies should have larger—or more easily detectable—effects on local economic growth than U.S. investors. Figure 6 shows that U.S. concessions do not have any discernible effect on local economic growth, while Chinese concessions register a positive treatment effect.

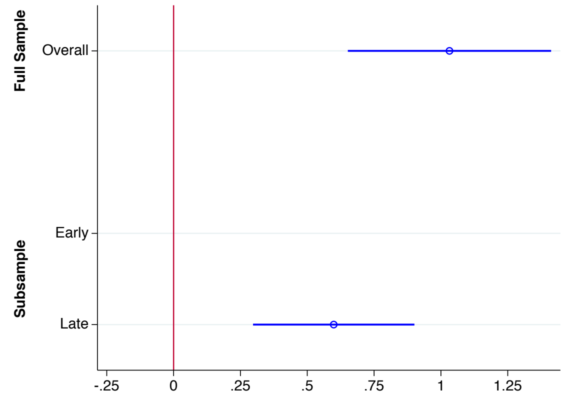
However, since Chinese firms are more active in mining sectors than agriculture, it is possible that we have erroneously assigned causal power to investor type differences when in fact we are detecting a sectoral "pass through" effect. Therefore, to account for the possibility that we have conflated investor nationality and sectoral effects, we compare the treatment effects of Chinese and U.S. concessions in the mining sector only. Figure 7 shows that the differences across investor types still persist, even after controlling for sector. This provides strong support for Hypothesis 4.

Summary of Robustness Tests

We also conducted a battery of robustness tests, which are presented in their entirety in the Online Appendix. One potential threat to causal inference is that even after



(a) U.S. mining concession



(b) Chinese mining concession

Figure 7: Effect of U.S. and Chinese concessions on local economic growth.

a concession has been granted, a firm might choose not to undertake any investment activities in which case we would not expect any changes in nighttime lights. Systematic information on the implementation status of concessions does not exist; however, we do have information about the exploratory or extractive nature of mining concessions. We expect nighttime light growth to mostly be affected by actual mining extraction activities and not exploratory activities, and Figure 8 confirms that this is indeed the case. It should also be noted that, in the event investment activities had not begun in a subset of our 'treated' locations, the treatment effect sizes that we report would be smaller than they would otherwise be the case if all 'treated' locations were in fact treated. Our estimates of investment impacts on nighttime light growth can therefore be interpreted as lower-bound, conservative estimates.

Second, we have assumed thus far that any 1km $\times$ 1km grid cell will respond in the same manner if exposed to a concession. But this might not be the case: the propensity to 'light up' in response to treatment might differ across grid cells. For reasons that we describe in the Online Appendix, a treated location might be more likely to light up if it is physically proximate to road networks. Therefore, we interact a grid cell's treatment

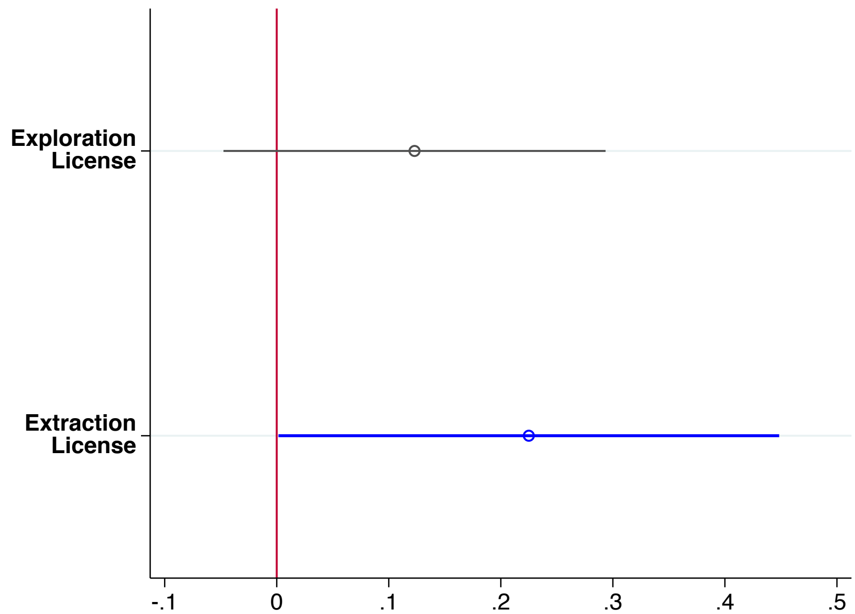


Figure 8: Effect of exploration versus extraction licenses in the mining sector.

status with that grid cell's distance from the pre-treatment road network to test the robustness of our findings. The direct, unconditional effects of treatment remain intact after controlling for the propensity to light up.

Third, our main model specification exclude cells exposed to concessions granted prior to 2006 due to endogeneity concerns. Most of these pre-2006 concessions were granted to urban areas, presumably because they were more easily administered by the transitional administration after a long civil war. By excluding these concessions, it is possible that our main model specifications produce results that disproportionately measure treatment effects in rural areas. However, our results remain unchanged if we re-estimate our models by including cells that were exposed to the full set of concessions from 2004-2013.

Finally, in negotiations with potential concessionaires, we assume that the central government has the power to require that their partners provide public goods. However, weakening commodity prices might undermine the bargaining power of the government, as companies should have weaker incentives to invest when prices are low. Yet, Figure 9

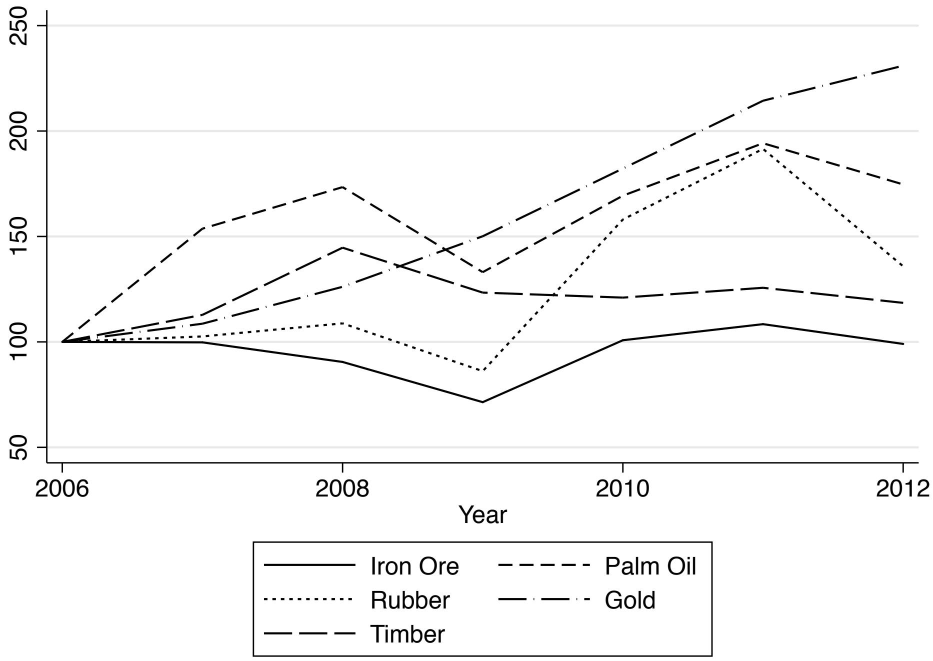


Figure 9: Price developments of Liberia's main export goods for the period of study. All prices have been converted to an index (Year 2006 = 100) to facilitate comparison.

shows that commodity prices have were relatively stable, or even increasing, during our period of study.

Case study of Mittal Steel Liberia

The findings from our statistical analysis are consistent with the expected effects of the government's spatial development corridor strategy. However, they do not provide direct evidence of whether FDI generate economic growth in the way that our theory suggests—through the development of backward linkages and consumption linkages. To gain greater leverage on this question, we conducted a case study of an iron ore concession granted to Mittal Steel Liberia (MSL).

We selected this case because it was the first, large-scale iron ore concession that the Johnson-Sirleaf administration granted to a foreign investor and as such it had the longest possible 'gestation period' to set in motion the causal processes that our theory suggests should be at work. Our theoretical argument and econometric evidence suggests that iron ore concessions are a uniquely effective at spurring local economic agglomeration because of the consumption and backward linkages that they help to create. Therefore, if our theoretical argument is valid, we would at minimum expect to see some descriptive evidence that these processes were set in fact motion by the first, large-scale iron ore concession with a reasonably long period of implementation. This type of descriptive evidence does not provide evidence of causation, but it does allow us to evaluate whether our hypothesized causal processes are at least plausible.

The concession agreement between MSL and the Government of Liberia was signed in December 2006, and approved by the Liberian Parliament in May 2007. Under the terms of its 25-year, $1.5 billion agreement, MSL was granted rights to explore for, extract, and export iron ore from deposits in Mount Gangra, Mount Tokadeh and Mount Yuelliton in Nimba County (Kaul, Heuty & Norman, 2009), and area of approximately 600 square kilometers.

In exchange for the concession, MSL agreed to spend roughly $800 million on a 267 km railway from Yekepa (Nimba County) and a port in Buchanan (Grand Bassa County). It also agreed to place special priority on hiring Liberians as opposed to expatriates, and estimated at the time that the 2006 agreement was signed that it expected to directly employ 3,500 people and generate an additional 15,000 to 20,000 jobs via contractors and suppliers (ArcelorMittal Liberia, 2006, p. 40).

To better understand the effects of this concession, we sought to answer three questions: What was the status of the local economy prior to the granting of the concession (pre-treatment conditions)? What specific activities did the investor implement once the concession was granted (the treatment)? Is there any descriptive evidence that suggests these activities may have affected the local economy (post-treatment conditions)?

Information concerning the *pre-treatment conditions* is available from baseline surveys conducted in Nimba, Grand Bassa, and Bong counties. Households in potentially affected areas had average annual incomes of $79 (URS, 2010). Most residents in these areas were subsistence farmers, or farmers growing rubber, plantains, or cocoa for small amounts of monetary income. Few had access to wage employment in the formal economy. Almost no surveyed households had access to grid electricity or a generator. Enumerators found that "[g]enerally 60% of households use candles for lighting, and 40% use kerosene lamps" (URS, 2010, p. 39).

MSL's activities (the *treatment*), which began in 2007, brought far-reaching changes to the region. The company honored its commitment to provide infrastructure. It rebuilt the 267 km railway from Yekepa to Buchanan; built nearly 100 bridges and various hospitals, schools, hand pump wells, markets, and roads along the railway corridor; and renovated the port in Buchanan, creating facilities to unload and store iron ore from train wagons and transport ore and other materials onto ships (Fry, 2014; Booth, 2008; Kramer, 2011). By 2011, MSL was running 3 trains a day to the port in Buchanan, with 20,000 tons of iron ore transported by each train (Thomashausen & Shah, 2014). The company also built its headquarters in Yekepa, a town located 25 kilometers north of the primary mining site (Mount Tokadeh), and there it invested in housing facilities for its employees, a hospital, a theater, an airstrip, and water, sewerage, and emergency response services (Fry, 2014). Additionally, MSL built a power plant and a power distribution network for the towns of Tokadeh and Yekepa (Booth, 2008), as well as a power plant in Buchanan (ArcelorMittal Liberia, 2012, p. 5). It also rehabilitated a 35 km road from Saniquellie to Yekepa (Booth, 2008), and agreed to pave a 70 km road from Yekepa to Ganta — at a cost of roughly $40 million (Thomashausen & Shah, 2014).

Estimates vary, but MSL hired somewhere between 2,000 and 5,000 employees and contractors (Government of Liberia, 2010; Kramer, 2011; URS, 2013a; Lanier, Mukpo

& Wilhelmsen, 2012). It also provided on-the-job training to local hires (Kramer, 2011; ArcelorMittal Liberia, 2016). As of 2015, MSL claimed that it had achieved "a 96% Liberian employment rate for full-time employees and 99% Liberian rate for contractors" (ArcelorMittal Liberia, 2016, p. 11). These unskilled and semi-skilled jobs pay $3 or $3.50 a day, a significant income in a country where "only a small share (less than 10%) of the population earns more than the minimum wage of $2 per day" (World Bank, 2010, p. 51).

We can also compare pre- and post-treatment outcomes using household surveys undertaken in Yekepa. With respect to *employment*, the percentage of surveyed households with a member employed by MSL increased from 3.3% in 2008 to 10.7% in 2011. Thus, "significant employment opportunities [were] created by the Phase 1 mine operations with residents working either directly for [ArcelorMittal], indirectly with contractors, or with other independent businesses established around the mine community" (URS, 2013a, p. 45). Correspondingly, unemployment declined by 33%.

Households in the nearby towns and villages (including Bonlah, Lugbeyee, Kanlah, Gbapa, Zolowee, and Makinto) saw their *incomes* double, on average (URS, 2013b, p. 41). In the port city of Buchanan, household surveys revealed that individuals in the project-affected areas earned, on average, $82 more each year than individuals in comparison areas geographically removed from MSL investments. (URS, 2013a, p. 49).[23]

Non-concession related business activities also increased. Between 2008 and 2011, the number of households engaged in small business activity increased by 172%. There was also a major increase in "petty trading and service provision," such as "selling food, artistry, carpentry, hair braiding, [and] motorbike taxi driving." For example, a camp near the mining site was "built by business entities and private individuals who decided that they could take advantage of the business opportunities provided by the presence of [MSL]" (URS, 2010, p. 31). The mine appears to have prompted a shift away from

[23]The method by which these comparison areas were identified is not made clear in the URS study. Therefore, this evidence should be interpreted as descriptive rather than rigorous counterfactual evidence.

subsistence farming activities and toward wage labor activities: agricultural work on one's own farmland declined over the same period of time that private sector employment and small businesses activity spiked (URS, 2013a, pp. 46, 88). At the time when post-treatment surveys were conducted, "[t]he number of local businesses is likely to continue to expand as off-shift workers will spend their wages on food, clothing and other products and services" (URS, 2013a, p. 45).

These large-scale changes took relatively little time to materialize. In 2008, the U.S. Embassy reported that "Mittal's investment is already having a positive impact on the rural population" and it "is already serving as an anchor for other investments in Grand Bassa and Nimba."[24] Several years later, a group of field researchers reported that "Arcelor-Mittal's presence in the region is ubiquitous, and its impact on the lives of residents in communities near the mine and along the railroad have been immense" (Lanier, Mukpo & Wilhelmsen, 2012, p. 20).

Conclusion

Governments are typically expected to provide public goods to attract foreign investors, which subsequently results in increased economic activity. But herein lies a catch-22: without economic activity, limited tax revenues are available to finance public goods; and without public goods, limited economic activity generates tax revenues. To escape this trap, African governments are increasingly requiring that foreign investors provide public goods. We examine if this strategy works.

We present evidence from Liberia suggesting that this type of 'industrial policy' can result in economic growth. Concessions that were subject to particularly demanding public good provision requirements (mining investments and iron ore investments) produced

[24] "Liberia: ArcelorMittal Initiates Infrastructure Word on Iron Ore Mining Concession." *U.S. Embassy Cable,* February 8, 2008.

higher levels of economic growth than those that faced less demanding public good provision requirements (agricultural and forestry investments). Also, those investors more readily able to satisfy public good requirements (Chinese concessionaires) achieved larger economic growth impacts than investors that were not as well-positioned to meet such requirements (U.S. concessionaires).

While natural resource sector FDI has increased local economic growth in Liberia, it should be noted that foreign investments have not been without challenges. Observers point to political tensions between winners and losers (Paczynska, 2016), the marginalization of indigenous communities in concession negotiations (Qaiyim & Siakor, 2014), and conflicts over land rights (Lanier, Mukpo & Wilhelmsen, 2012). There are also reasons to believe that natural resource sector FDI can have negative, second-order effects, such as corruption and environmental degradation (Knutsen et al., 2017; Aragón & Rud, 2016).

Notwithstanding these caveats, we believe this new form of 'industrial policy' merits greater attention. Our study suggests by requiring investors to build and maintain infrastructure near the communities where their commercial activities are sited, governments in resource-rich countries can kick-start local economic agglomeration processes through the development of backward and consumption linkages. In other words, rather than taxing foreign investors and providing public goods themselves, governments can achieve significant economic development gains by using their bargaining power to require the provision of public goods by private actors. This strategy may be particularly attractive to and appropriate for states with limited bureaucratic capacity.

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Online Appendix

This online appendix provides supplementary information on the empirical results presented in the article "Natural Resource Sector FDI, Government Policy, and Economic Growth: Quasi-Experimental Evidence from Liberia."

1 Tables of Main Analysis

1.1 Regression Outputs for Main Models

Summary *Tables containing the regression outputs for the models presented in the manuscript are displayed in this section.*

This section presents the tables with the main results reported in the manuscript. These numerical results are the basis for the various Figures illustrating our findings.

1.1.1 Main Results: All Concessions

Table 1: All Concessions (2006-2012), 25 km.

	Whole	Early	Late
Treatment	0.035	0.12	0.350***
	(0.124)	(0.14)	(0.105)
Urban/Rural	2.390***	0.001	−1.115
	(0.634)	(0.001)	(1.626)
Elevation	0.001	0.002***	0.01
	(0.001)	(0.001)	(0.01)
Pop. Density	0.004***	−0.00000	0.003
	(0.001)	(0)	(0.003)
Aid Projects	0.00001*	0	0.00003***
	(0.000)	(0.00001)	(0.00001)
Nat. Resource Location	−0.00001	0.046	0.0001
	(0.00001)	(0.151)	(0.0001)
Home Regions	−0.167*	−0.00001	−7.490
	(0.09)	(0.0001)	(5.023)
Dist. to Roads	0.00002	−0.010	0.0001
	(0.00003)	(0.062)	(0.0001)
Slope	−0.038	−0.001	−0.906
	(0.065)	(0.001)	(1.06)
Urban Travel Time	−0.0001	−0.002	−0.003
	(0.0004)	(0.006)	(0.002)
Pre-Period Precipitation	0.003	0.143	0.037
	(0.007)	(0.113)	(0.035)
Pre-Period Temperature	−0.052	−0.261	−0.491
	(0.098)	(0.162)	(1.213)
Pre-Period NTL (Avg)	−0.462	3.197*	−0.988
	(0.318)	(1.696)	(0.812)
Pre-Period NTL (Trend)	3.247	0.009	5.826
	(7.659)	(0.032)	(19.95)
Household Numbers	0.099*	0.732	0.758**
	(0.059)	(0.56)	(0.337)
Gender	−0.728	−0.012**	−7.959*
	(0.839)	(0.005)	(4.228)
Age	−0.015*	0.378*	0.206**
	(0.009)	(0.221)	(0.099)
Edu. (Primary)	−0.041	−1.068*	0.981*
	(0.132)	(0.645)	(0.53)
Edu. (Secondary)	0.16	0.00001***	−10.300*
	(0.499)	(0.000)	(5.874)
Wealth	0.000	−0.336*	−0.00002
	(0.000)	(0.18)	(0.00001)
Employment (Yes)	−1.142**	−0.364	0.72
	(0.475)	(0.455)	(0.449)
Religion	0.323	0.432	19.474
	(0.412)	(0.674)	(12.016)
Occupation (44)	0.964**	0.481	−4.971
	(0.447)	(0.378)	(4.541)

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Table 1 – Continued

	Whole	Early	Late
Occupation (62)	0.604*	−3.394**	−4.702
	(0.354)	(1.372)	(4.47)
Occupation (65)	−0.012	−3.051**	
	(0.511)	(1.433)	
DHS - North Central	6.764*	−2.900**	
	(3.472)	(1.274)	
DHS - North Western	6.091*	−2.839**	−5.306*
	(3.494)	(1.418)	(3.071)
DHS - South Central	7.162**	−2.990*	0.996
	(3.4)	(1.702)	(1.155)
DHS - S. East A	7.156**	−0.332	−0.570
	(3.465)	(2.904)	(2.813)
DHS - S. East B	6.941**		−2.733
	(3.478)		(2.435)
Constant	−5.233		7.786
	(4.065)		(28.362)

1.1.2 Main Results: Agriculture, Forestry, and Mining Concessions

Table 2: Agriculture, Forestry, and Mining Concessions (2006-2012), 25 km

	Agriculture		Forestry			Mining		
	All	Late	All	Early	Late	All	Early	Late
Treatment	−0.346	−0.595***	-0.102	0.064**	-0.130*	0.174***	0.014**	0.131**
	(0.188)	(0.146)	(0.084)	(0.026)	(0.075)	(0.052)	(0.006)	(0.056)
Urban/Rural	−0.836	2.681***			-0.0002	2.262***	-0.028	0.678
	(1.878)	(0.687)			(0.0003)	(0.45)	(0.03)	(0.45)
Elevation	−0.007*	−0.003**	-0.0004	0.0004	0.001*	0.0001	0.0001	−0.0004
	(0.004)	(0.001)	(0.0004)	(0.0003)	(0.001)	(0.001)	(0.0001)	(0.001)
Pop. Density	0.003	−0.0001	0.002**	-0.003**	0.0000	0.002***	-0.0002	0.001
	(0.002)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.0003)	(0.001)
Aid Projects	0.00001	−0.00000	0.00000**	0.0000	0.0000	−0.00000*	0.0000	−0.00000
	(0.00001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Nat. Resource Location	0.0001**	0.00001	0.0000	0.0000	-0.007	0.0000	0.0000	−0.00000
	(0.00002)	(0.00001)	(0.000)	(0.000)	(0.045)	(0.000)	(0.000)	(0.000)
Home Regions	0.119	0.140***	-0.035	0.074	0.0000	0.216***	0.005	0.034
	(0.084)	(0.05)	(0.057)	(0.08)	(0.00001)	(0.07)	(0.005)	(0.058)
Dist. to Roads	0.0001	−0.00000	-0.00002	-0.00001	-0.008	−0.00001	0.0000	−0.00000
	(0.0001)	(0.0001)	(0.00002)	(0.00002)	(0.015)	(0.00003)	(0.00001)	(0.00002)
Slope	0.259**	0.249***	-0.002	-0.003	-0.0002	−0.034	-0.001	−0.029
	(0.121)	(0.076)	(0.017)	(0.007)	(0.0002)	(0.042)	(0.002)	(0.036)
Urban Travel Time	−0.004	−0.002	0.0001	-0.0002	-0.067	−0.0002	-0.0002	−0.0001
	(0.003)	(0.003)	(0.0002)	(0.0002)	(0.071)	(0.0001)	(0.0002)	(0.0002)
Pre-Period Precipitation	−0.055	−0.034	-0.044	-0.023	0.002	0.008	0.659	0.012
	(0.038)	(0.021)	(0.075)	(0.025)	(0.003)	(0.005)	(0.522)	(0.008)
Pre-Period Temperature	2.226**	0.333	0.006	0.002	4.613***	0.067	-12.531	−0.097
	(1.117)	(0.28)	(0.004)	(0.002)	(1.402)	(0.117)	(23.374)	(0.098)
Pre-Period NTL (Avg)	−0.060	−1.060***	3.376**	16.054***	-0.304***	−0.421***	6.694	−0.815***
	(0.242)	(0.153)	(1.527)	(2.714)	(0.086)	(0.067)	(6.596)	(0.136)
Pre-Period NTL (Trend)	1.105	16.741***	-0.01	-0.805**	-0.024	8.247***	-0.062	13.084***
	(2.444)	(1.84)	(0.102)	(0.392)	(0.017)	(2.059)	(0.194)	(2.901)
Household Numbers	−0.011	0.177***	-0.029	0.01	0.073	0.059	-0.003	0.003
	(0.095)	(0.061)	(0.021)	(0.007)	(0.12)	(0.06)	(0.003)	(0.038)
Gender	0.275	1.301***	-0.066	-0.214	0.002	0.651	0.019	0.934*
	(0.862)	(0.429)	(0.097)	(0.184)	(0.005)	(0.57)	(0.035)	(0.535)
Age	−0.062**	−0.024**	0.0003	0.0003	0.200	−0.003	0.0004*	0.006
	(0.024)	(0.011)	(0.005)	(0.002)	(0.124)	(0.004)	(0.0003)	(0.005)
Edu. (Primary)	0.742**	0.624***	0.320**	0.757	1.914***	0.014	0.023*	−0.003
	(0.31)	(0.172)	(0.144)	(0.673)	(0.653)	(0.076)	(0.012)	(0.095)
Edu. Level (Secondary)	−0.242	0.249	0.293		0.0000	0.088	-0.042*	−0.274
	(0.887)	(0.475)	(0.357)		(0.000)	(0.44)	(0.022)	(0.279)
Wealth	−0.00001**	−0.00001***	0.00000*	0.00000***	-0.142	0.0000	0.0000	0.0000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.093)	(0.000)	(0.000)	(0.000)
Employment (Yes)	0.812	−0.299	-0.134	-0.052	0.048	−0.142	-0.043**	−0.308*
	(0.517)	(0.216)	(0.099)	(0.047)	(0.13)	(0.157)	(0.021)	(0.184)
Religion	1.756**	0.672	0.003	-0.157	-0.105	0.491	-0.0001	0.896
	(0.872)	(0.441)	(0.145)	(0.164)	(0.167)	(0.314)	(0.033)	(0.695)
Occupation (44)	−2.708***	−0.682*	-0.139	0.109	-0.041	0.138	0.019	0.156
	(0.938)	(0.405)	(0.203)	(0.119)	(0.129)	(0.154)	(0.029)	(0.16)
Occupation (62)	−3.250***	−1.130***	-0.114	0.065	-0.317	0.096	-0.038	−0.086
	(0.967)	(0.412)	(0.154)	(0.081)	(0.391)	(0.182)	(0.029)	(0.159)
Occupation (65)	−1.284			0.118	5.290**	0.184	0.027	0.272
	(1.074)			(0.164)	(2.325)	(0.221)	(0.066)	(0.221)
DHS - North Central	0.322		3.512	0.141	5.179**	6.850***	0.023	−0.186
	(1.013)		(3.145)	(0.126)	(2.366)	(2.236)	(0.049)	(2.031)
DHS - North Western		−0.616	3.432	0.118	5.947***	6.332***	0.032	−1.125
		(0.465)	(3.175)	(0.164)	(2.284)	(2.296)	(0.037)	(2.359)
DHS - South Central	−3.886*	−0.119	4.271	0.141	5.587**	6.673***	-0.002	−0.442
	(2.067)	(0.395)	(3.088)	(0.126)	(2.331)	(2.219)	(0.037)	(1.999)

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Table 2 – Continued

	Agriculture		Forestry			Mining		
	All	Late	All	Early	Late	All	Early	Late
DHS - S. East A	−42.645*	−1.495*	3.859	0.026	5.337**	6.633***	0.143	−0.191
	(22.742)	(0.843)	(3.183)	(0.077)	(2.325)	(2.274)	(0.135)	(2.066)
DHS - S. East B		−1.686*	3.491		-3.81	6.703***		−0.220.000
		(0.867)	(3.19)		(2.911)	(2.21)		(1.956)
Constant		−2.802	-2.983	0.167	0.167	−9.751***		0.619
		(5.104)	(3.718)	(0.422)	(0.422)	(3.77)		(3.401)

1.1.3 Main Results: Iron Ore and Non-Iron Ore Mining Concessions

Table 3: Iron Ore and Non-Iron Ore Concessions (2006-2012), 25 km

	Iron Ore		Non-Iron Ore Mining	
	All	Late	All	Late
Treatment	0.253**	0.165*	0.005	0.047
	(0.104)	(0.089)	(0.05)	(0.052)
Urban/Rural	2.247***	0.848	2.371***	1.124***
	(0.513)	(0.52)	(0.375)	(0.42)
Elevation	0.001	0.001*	0.001	0.0005
	(0.001)	(0.001)	(0.001)	(0.001)
Pop. Density	0.003***	0.001	0.001***	0.001***
	(0.001)	(0.001)	(0.0005)	(0.001)
Aid Projects	0.0000	0.00000*	−0.00000	−0.00000
	(0.000)	(0.000)	(0.000)	(0.000)
Nat. Resource Location	0.00000	−0.00000	0.00000*	0.00000
	(0.000)	(0.000)	(0.000)	(0.000)
Home Regions	−0.050	0.013	0.173**	0.013
	(0.038)	(0.034)	(0.08)	(0.074)
Dist. to Roads	0.00004*	0.00003	0.00002	0.00004*
	(0.00002)	(0.00002)	(0.00002)	(0.00002)
Slope	−0.021	−0.057	−0.008	−0.019
	(0.045)	(0.04)	(0.019)	(0.02)
Urban Travel Time	−0.0005*	−0.0005*	−0.00005	−0.00003
	(0.0003)	(0.0002)	(0.0001)	(0.0001)
Pre-Period Precipitation	0.006	0.0004	−0.001	0.004
	(0.004)	(0.004)	(0.004)	(0.005)
Pre-Period Temperature	−0.064	−0.054	−0.020	−0.201*
	(0.097)	(0.084)	(0.092)	(0.107)
Pre-Period NTL (Avg)	−0.339***	−0.741***	−0.395***	−0.889***
	(0.108)	(0.107)	(0.085)	(0.097)
Pre-Period NTL (Trend)	9.676***	12.268***	8.407***	13.079***
	(2.248)	(1.953)	(0.956)	(2.267)
Household Numbers	0.004	−0.004	0.037	0.039
	(0.022)	(0.02)	(0.041)	(0.032)
Gender	0.183	0.299	0.473*	0.366
	(0.354)	(0.329)	(0.255)	(0.258)
Age	0.002	0.003	0.0004	−0.001
	(0.004)	(0.004)	(0.003)	(0.003)
Edu. (Primary)	0.523**	0.427**	0.225	0.336
	(0.213)	(0.181)	(0.34)	(0.358)
Edu. (Secondary)	0.857***	0.938***	0.099*	0.078
	(0.244)	(0.317)	(0.057)	(0.06)
Wealth	0.00000	−0.00000	0.987**	0.807***
	0.000	(0.000)	(0.426)	(0.28)
Employment (Yes)	−0.313**	−0.326**	0.00000	−0.00000
	(0.144)	(0.163)	(0.000)	(0.000)
Religion	0.068	0.115	−0.050	−0.016
	(0.145)	(0.136)	(0.153)	(0.128)
Occupation (44)	0.467*	0.153	0.115	0.23
	(0.26)	(0.163)	(0.339)	(0.303)
Occupation (62)	−0.012	0.0001	0.1	0.241
	(0.132)	(0.118)	(0.335)	(0.327)
Occupation (65)	−0.436	−0.028	−1.574***	0.241
	(0.64)	(0.365)	(0.35)	(0.499)
DHS - North Central	9.158***	2.306	0.400**	0.231*
	(2.625)	(2.697)	(0.179)	(0.137)
DHS - North Western	9.307***	2.634	0.149	0.166
	(2.611)	(2.699)	(0.122)	(0.126)
DHS - South Central	9.842***	3.155	−3.347***	−0.467
	(2.601)	(2.656)	(0.744)	(0.689)
DHS - S. East A	9.415***	2.836	3.682**	2.071

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Table 3 – Continued

	Iron Ore		Non-Iron Ore Mining	
	All	Late	All	Late
	(2.653)	(2.72)	(1.511)	(1.591)
DHS - S. East B	9.223***	2.643	3.650**	1.766
	(2.613)	(2.679)	(1.636)	(1.806)
Region - S. East B			3.979***	2.291
			(1.432)	(1.549)
Constant	−9.071**	−1.975	−4.313	1.316
	(3.689)	(3.322)	(2.639)	(2.828)

1.1.4 Main Results: US and Chinese Concessions

Table 4: US and Chinese Concessions (2006-2012), 25 km

	China		USA	
	All	Late	All	Late
Treatment	0.829***	0.614***	0.017	0.045
	(0.2)	(0.199)	(0.072)	(0.06)
Urban/Rural	−2.389	−6.416**	−0.0003	−0.0005
	(3.194)	(2.579)	(0.001)	(0.0004)
Elevation	−0.002	−0.001	0.001***	0.001**
	(0.002)	(0.002)	(0.0003)	(0.0004)
Pop. Density	0.002**	0.002***	0.00001***	0.00000**
	(0.001)	(0.0004)	(0.000)	(0.000)
Aid Projects	0.00000	0.00001*	−0.00000	−0.00000
	(0.00001)	(0.00001)	(0.000)	(0.000)
Nat. Resource Location	0.00001	−0.00002	−0.155***	−0.075**
	(0.00001)	(0.00001)	(0.039)	(0.031)
Home Regions	−0.006	0.02	−0.00001	−0.00000
	(0.081)	(0.058)	(0.00002)	(0.00001)
Dist. to Roads	−0.0002**	−0.00003	−0.013	0.004
	(0.0001)	(0.0001)	(0.019)	(0.015)
Slope	−0.043	−0.011	−0.0002	−0.0002
	(0.078)	(0.064)	(0.0002)	(0.0001)
Urban Travel Time	−0.005**	−0.004*	0.002	0.003
	(0.002)	(0.002)	(0.003)	(0.003)
Pre-Period Precipitation	−0.031*	0.039**	−0.071	−0.065
	(0.016)	(0.019)	(0.075)	(0.061)
Pre-Period Temperature	−0.138	−0.660**	−0.097	−0.668***
	(0.198)	(0.269)	(0.08)	(0.208)
Pre-Period NTL (Avg)	−0.552***	−0.865***	4.222***	11.767***
	(0.086)	(0.1)	(0.913)	(3.137)
Pre-Period NTL (Trend)	9.956***	13.150***	−0.025	−0.028
	(2.02)	(1.818)	(0.02)	(0.017)
Household Numbers	−0.129**	−0.040	−0.235	−0.092
	(0.066)	(0.061)	(0.27)	(0.177)
Gender	−0.399	−0.407	0.004	0.004
	(0.702)	(0.663)	(0.004)	(0.003)
Age	0.019**	0.019*	0.271**	0.246**
	(0.01)	(0.01)	(0.125)	(0.108)
Religion	−0.199	0.115	0.729***	0.582**
	(0.326)	(0.413)	(0.269)	(0.259)
Edu. (Primary)	1.138***	1.162***	0.00000***	0.0000
	(0.33)	(0.404)	(0.000)	(0.000)
Edu. (Secondary)	0.436	0.219	−0.338**	−0.228**
	(1.013)	(1.156)	(0.143)	(0.102)
Wealth	0.0000	−0.00000	−0.321	−0.535**
	(0.000)	(0.000)	(0.317)	(0.254)
Employment (Yes)	0.265	0.897*	−0.014	−0.317
	(0.293)	(0.505)	(0.328)	(0.288)
Marital Status	0.579	0.705	−0.468	−0.767***
	(0.371)	(0.435)	(0.475)	(0.284)
Occupation (44)	1.150***	1.570***	0.18	0.005
	(0.433)	(0.583)	(0.201)	(0.111)
Occupation (62)			0.099	0.005
			(0.129)	(0.091)
Occupation (65)	−1.207**	−1.366**		
	(0.489)	(0.585)		
DHS - North Central	−0.425	−0.926*	0.511	2.618***
	(0.34)	(0.507)	(0.649)	(0.772)
DHS - North Western	−0.370	−2.113	0.144	2.312***
	(1.415)	(1.36)	(0.608)	(0.783)

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Table 4 – Continued

	China		USA	
	All	Late	All	Late
DHS - South Central	−0.236	−5.081**	0.991*	2.926***
	(1.425)	(2.477)	(0.583)	(0.726)
DHS - S. East A	0.775	−5.065**	0.862	2.868***
	(1.437)	(2.502)	(0.673)	(0.77)
DHS - S. East B	1.668	−4.036	0.262	2.475***
	(1.226)	(2.522)	(0.669)	(0.765)
Constant	7.057	13.583**	1.636	−0.610
	(4.599)	(5.89)	(1.94)	(1.653)

1.1.5 Main Results: US and Chinese Mining Concessions

Table 5: US and Chinese Mining Concessions (2006-2012), 25 km

	China		USA	
	All	Late	All	Late
Treatment	1.032***	0.599***	−0.006	−0.006
	(0.194)	(0.154)	(0.078)	(0.061)
Urban/Rural	−4.577*	−0.027	2.054***	0.776*
	(2.362)	(2.576)	(0.497)	(0.408)
Elevation	0.003	−0.001	−0.0003	−0.0003
	(0.003)	(0.002)	(0.001)	(0.0005)
Pop. Density	0.002***	0.001**	0.002***	0.003***
	(0.0004)	(0.001)	(0.001)	(0.001)
Aid Projects	−0.00001	0.00001	0.00001***	0.00000**
	(0.00001)	(0.00001)	(0.000)	(0.000)
Nat. Resource Location	0.00002*	0.0000	−0.00000	−0.00000
	(0.00001)	(0.00001)	(0.0000)	(0.00000)
Home Regions	0.085	0.103	−0.119***	−0.051
	(0.101)	(0.069)	(0.041)	(0.036)
Dist. to Roads	−0.0001	0.00005	−0.00001	−0.00001
	(0.0001)	(0.0001)	(0.00002)	(0.00001)
Slope	−0.095	−0.062	−0.024	−0.012
	(0.096)	(0.078)	(0.024)	(0.019)
Urban Travel Time	−0.003	−0.001	−0.0004**	−0.0002*
	(0.003)	(0.001)	(0.0002)	(0.0001)
Pre-Period Precipitation	−0.020	0.023	0.003	0.002
	(0.014)	(0.018)	(0.004)	(0.003)
Pre-Period Temperature	−0.101	−0.462*	0.009	−0.025
	(0.229)	(0.262)	(0.07)	(0.056)
Pre-Period NTL (Avg)	−0.573***	−0.844***	−0.164*	−0.922***
	(0.097)	(0.113)	(0.098)	(0.124)
Pre-Period NTL (Trend)	10.027***	12.825***	4.670***	15.415***
	(1.838)	(1.839)	(1.169)	(1.781)
Household Numbers	−0.155*	0.02	−0.028	−0.026
	(0.081)	(0.071)	(0.021)	(0.018)
Gender	−0.621	−0.371	0.015	0.012
	(0.719)	(0.758)	(0.29)	(0.222)
Age	0.042***	0.044***	0.004	0.002
	(0.009)	(0.01)	(0.004)	(0.003)
Religion	−0.280	−0.800*	0.011	0.144
	(0.514)	(0.44)	(0.143)	(0.139)
Edu. (Primary)	1.193***	1.095***	0.342**	0.204*
	(0.352)	(0.277)	(0.147)	(0.105)
Edu. (Secondary)	0.149	0.769	0.646**	0.343*
	(1.205)	(1.086)	(0.284)	(0.206)
Wealth	0.00000*	−0.00000	0.00000**	0.0000
	(0.000)	(0.000)	(0.000)	(0.000)
Employment (Yes)	−0.306	0.474	−0.316*	−0.207
	(0.312)	(0.543)	(0.176)	(0.141)
Marital Status	−0.089	0.835	−0.303	−0.713***
	(0.368)	(0.728)	(0.255)	(0.209)
Occupation (44)	0.527	1.836***	0.1	−0.456**
	(0.398)	(0.696)	(0.268)	(0.221)
Occupation (62)	−1.327***		−0.663**	−0.933***
	(0.489)		(0.288)	(0.257)
Occupation (65)	−0.073	−0.916	0.239	0.042
	(0.34)	(0.589)	(0.224)	(0.143)
DHS - North Central		−0.347	0.13	0.109
		(0.438)	(0.173)	(0.141)
DHS - North Western	−0.489	0.026		
	(1.241)	(0.894)		

Continued on Next Page...

Table 5 – Continued

	China		USA	
	All	Late	All	Late
DHS - South Central	0.368	0.583		
	(1.318)	(0.91)		
DHS - S. East A	1.227	1.215	-0.316^{*}	-0.240^{*}
	(1.226)	(0.937)	(0.175)	(0.134)
DHS - S. East B	0.871	1.937^{***}	0.594^{**}	0.377^{**}
	(0.909)	(0.63)	(0.251)	(0.183)
Constant	3.962	3.798	-0.228	1.056
	(4.595)	(5.076)	(1.73)	(1.297)

2 Background Information

2.1 A Brief Review of Existing Studies

Summary *In this section, we provide a brief review of existing studies on the causal relationship between FDI and growth. We describe how the conclusions derived depend on the types of data and methods used.*

In order to address the challenge of endogeneity (i.e. the possibility that two-way causation undermines the interpretation of the cross-country regressions reported earlier), previous research has generally taken one of three approaches. The first approach involves analysis of cross-country, macro-economic, panel data. In contrast to cross-country regressions, these studies use panel cointegration techniques to analyze the time-series properties of the aggregated FDI flows for multiple countries to properly identify the direction of (granger) causality. Mello (1999) analyzes 32 countries between 1970-1990 and provides evidence that FDI causes growth in OECD countries, but fails to find the same relationship in developing countries. However, Hansen & Rand (2006) find that FDI increases GDP in 32 developing countries between 1970-2000, and Nair-Reichert & Weinhold (2001) also find that FDI promotes growth in a sample of 24 developing countries between 1971 and 1995, although the relationship is heterogeneous across countries. Others do not identify a one-directional, causal relationship from FDI to growth, but rather bi-directional causality between FDI and growth (Choe, 2003; Basu, Chakraborty & Reagle, 2003).

This literature have been criticized by Banerjee, Marcellino & Osbat (2004) and Gutierrez (2003) on the grounds that it is possible for the null hypotheses of 'no panel cointegration' to be rejected, even though this conclusion is driven only by a few cointegrated relationships. Therefore, researchers can mistakenly assume a whole panel to be cointegrated.

As a consequence, a separate group scholars have conducted country-by-country panel analysis of macro-economic data. However, the results from this literature are also inconsistent. FDI has purportedly increased growth in South Africa (Fedderke & Romm, 2006), Mexico (Ramirez, 2000), and Argentina (Cuadros, Orts & Alguacil, 2004), as well as in Singapore, Hong Kong, and Taiwan (Zhang, 2001). Yet others have found that strong economic performance attracts FDI in India (Chakraborty & Basu, 2002), Chile (Chowdhury & Mavrotas, 2006), Brazil (Cuadros, Orts & Alguacil, 2004; Zhang, 2001), and Colombia (Zhang, 2001). Still another groups finds evidence of a bi-directional relationship in Malaysia and Thailand (Chowdhury & Mavrotas, 2006), China (Liu, Burridge & Sinclair, 2002), and Indonesia (Zhang, 2001).

Data limitations have also prevented this literature from reaching its full potential. FDI inflows are usually reported as net flows, making it impossible to differentiate between a host country that had FDI activities and a country that received FDI in-flows and out-flows that cancelled each other out (Kerner, 2014). Also, in spite of the fact that most theories relate to the effect of specific investment projects or the activities of specific firms, the FDI data used to test the observable implications of these theories are aggregate measures that remove any information about the investor or investment-specific characteristics from the equation. “All that we observe is the cross-national distribution of MNCs’ collective investments (net profit repatriations and other reverse flows) during a given year” (Barry, 2015, p. 247). This disconnect implies that “[aggregate] FDI [flows] are merely a second-best or proxy measure”(Stephan & Pfaffmann, 2001, p. 197).

A third literature uses firm-level panel data instead of cross-country, macroeconomic data. These studies typically analyze panels of firms operating in a single country. They seek to identify the positive spillovers from foreign to domestic firms suggested by the endogenous growth theory. For this reason, the productivity of domestic firms is correlated with the extent of foreign presence in their sector. However, the results from this literature are contradictory. Studies of firms in Morocco (Haddad & Harrison, 1993), Venezuela (Aitken & Harrison, 1999), the Czech Republic (Djankov & Hoekman, 2000), and Bulgaria, Romania, and Poland (Konings, 2001) find no evidence of positive technology spillovers and conclude that FDI does not accelerate growth. By contrast, firm-level studies in Lithuania (Javorcik, 2004), the U.K. (Haskel, Pereira & Slaughter, 2007), and the U.S. (Keller & Yeaple, 2009) suggest that FDI does increase economic growth.[1]

These studies also face significant data limitations. Sorens & Ruger (2012) point out that most firm-level datasets are plagued by systematically missing data, resulting in selection bias. For example, many studies utilize data on outward U.S. investment from the Bureau of Economic Analysis, but this dataset only includes “data for countries that are major investment partners of the United States, as detailed information on smaller FDI hosts is not provided due to corporate confidentiality concerns” (Blanton & Blanton, 2012, p. 437). Thus, the data from the Bureau of Economic Analysis are effectively censored both with respect to the set of home countries and host countries.

In summary, these three different empirical approaches — cross-country, panel data analysis, country-by-country panel data analysis, and country-by-country, firm-level, panel data analysis — have failed to produce a consensus about the nature of the relationship between FDI and growth.

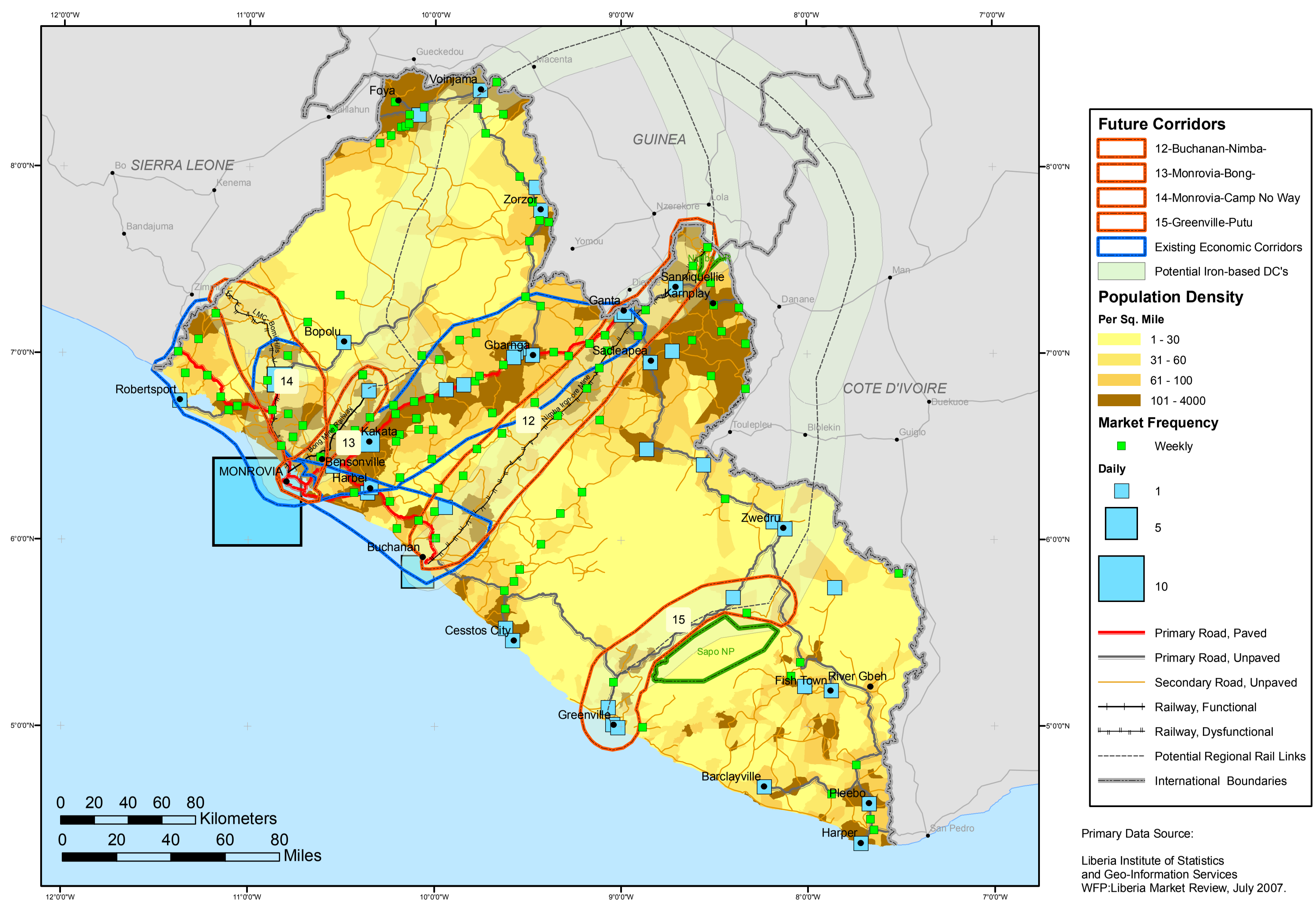
[1] A review of firm-level studies by Gorg & Greenaway (2004) confirms the heterogeneity in findings by reporting that six studies find evidence of positive spillover effects, while 19 do not.

2.2 Liberia's Growth Corridors

Summary *This section provides additional information regarding Liberia's strategy of promoting economic growth through allocating concessions, particularly in the iron ore sector.*

The Johnson-Sirleaf administration initially prioritized the development of three spatial development corridors (see Figure 1) near large population centers and existing markets: one corridor that runs from the iron ore mines in Nimba County to the port city of Buchanan; a second corridor that runs from Monrovia to Tubmanburg and then to Bomi Hills, Bea Mountain, and Mano River (where the Western Cluster iron ore deposits are located); and a third corridor than runs from the Putu Range (where the Putu iron ore deposit is located) in Grand Gedeh county to Greenville.[2]

[2]The Government of Liberia also identified a fourth potential development corridor that would run north from Monrovia to the Bong range iron ore deposit in Bong County and the Wologizi iron ore deposit in Lofa county (see Figure 1). However, given that the Wologizi iron ore deposit had "not yet been proven economically viable" at the time the authorities drafted their strategy, this fourth potential development corridor was not assigned a high level of priority (Government of Liberia, 2010: 55).



Source: Government of Liberia, 2010. This map was provided by Dr. Lucie Phillips of IBI International upon request, and we are republishing it with permission from Mr. Sebastian Muah, who oversaw the preparation of the Government of Liberia's development corridor strategy during his period of service as Deputy Minister for Economic Affairs and Policy in Liberia's Ministry of Planning and Economic Affairs.

Figure 1: The Johnson-Sirleaf Administration's Development Corridor Priorities.

3 Data Used for Analyses

3.1 The Independent Variable: Geocoding of Natural Resource Concessions

Summary *Our main independent variable are FDI concessions in Liberia. In this section, we describe our process for geo-referencing data on concession boundaries in Liberia. We employ an innovative methodology to translate location information from LEITI contracts into latitude and longitude coordinates, which we are then spatially rendered for our analysis.*

We first compiled all natural resource concession contracts published by the Liberian Extractive Industries Transparency Initiative (Government of Liberia, 2016). Since approximately 95% of Liberia's FDI is concentrated in the natural resource sector (Werker & Beganovic, 2011; Mlachila & Takebe, 2011), we are confident that this dataset of FDI activities provides a close approximation of the full universe of FDI projects in Liberia between 2004 and 2015. We then use the information contained in these detailed contracts to code various attributes (described at greater length below) of concessions that the Government of Liberia granted to investors in the mining, agriculture, forestry, and oil/gas sectors between 2004 and 2015. We then sourced additional data from two other publicly available databases owned and operated by the Liberian government: (a) the Ministry of Lands, Mines, and Energy's Mining Cadastre Administration System (MCAS), which contains detailed, historic, and up-to-date information on mining licenses and agreements, but does not capture licenses in other sectors; and (b) the Liberia National Concessions Portal, which displays attribute data for all active concessions, but does not contain historical data. Standardizing and synthesizing the data from these two official sources allowed us to eliminate many missing data problems (specific to each source).

Following this process of merging and de-duplicating data from diffferent sources, we searched for missing attributes — particularly the financial amounts associated with each investment — through open-source data collection and triangulation methods. In addition, each data source contained geographic information regarding the approximate shape of each concession area,[3] which we used to geo-reference the concession areas as

[3]The data sources provide different types of spatial information. Concession contracts published by the Liberia Extractive Industries Transparency Initiative (LEITI) generally consist of one of four types: (1) decimal degrees representing the vertices of a concession area, which we then map and compare to digitized maps of concession areas provided by the Ministry of Lands, Mines, and Energy; (2) UTM coordinates corresponding to the vertices of a concession area; (3) survey coordinates that provide the approximate locations of the vertices of a concession area; or (4) survey coordinates that do not provide the approximate locations of the vertices of a concession area. The third and fourth types presented the greatest geo-referencing challenge because survey coordinates had to be converted into sequential points, and then mapped as best as possible. By contrast, the Liberia National Concessions Portal and the MCAS provide readily available geometries for each concession area within their respective databases. Therefore, in cases where we uncovered overlapping concessions (reported in either of these portals and

polygons in our investment-level database. Geo-referencing the specific tracts of land upon which investors (concessionaires) were granted rights to explore, extract, or sell natural resources was a crucial first step to operationalize our different measures of what geographic areas were impacted by FDI.

In order to test whether and when different types of concessions have different treatment effects, we further coded each natural resource concession in our dataset on several key dimensions, including the sector of the concession (agriculture, mining, or forestry) and the nationality of the concessionaire or its parent company. These concession attribute variables are described in greater detail below:

- Sectors: Our dataset categorizes each concession according to its sector. These sectors including mining, agriculture, and forestry. Mining accounts for approximately two-thirds of investments in Liberia. The lion's share of concessions (about 95%) granted to investors during the treatment period (2006-2012) were in the mining and forestry sector, with mining licenses comprising of 77% of total licenses and forestry accounting for another 18%. The Liberian government has recently begun to grant more agricultural concessions to foreign investors (e.g. to establish palm oil plantations).[4]. We therefore focus our empirical tests on the independent effects of mining, agriculture, and forestry concessions.[5]

- Nationalities: To test for differential impacts of Chinese and U.S.-based investors, we first obtained data on the nationality of the companies that applied for concession licenses. Since most of these firms are subsidiaries of foreign companies, we obtained information on the country in which the parent company is incorporated. In cases where the parent company itself is a subsidiary, we sought information on its owner. In instances where ownership is shared among multiple partners, we used the information of the majority investor (more specifically, greater than 50%) to code nationality. Data sources include self-reported data by concessionaires; proprietary databases such as Dun and Bradstreet, CompuStat, and ORBIS; and annual reports obtained from the websites of companies. All of our empirical analyses rely on the nationality of the ultimate owner – that is, the final company in the path of ownership.

The full dataset has been made available to the public. It can be downloaded at `http://aiddata.org/data/liberia-concessions-geocoded-research-release-level-1-v-1-0`

the LEITI contracts) and there was some degree of uncertainty about the survey information contained in LEITI contracts, we relied upon the spatial information contained in the Liberia National Concessions Portal and the MCAS.

[4]The remaining foreign concessions exist in the oil and natural gas sector.

[5]Mining concessions involve the exploration or extraction of more than 15 mineral resources, including gold, diamond, bauxite, iron ore, and base metals. Agriculture concessions involve extraction of palm oil and rubber products, whereas forestry concessions consist of harvesting timber products.

3.2 The Dependent Variable: Advantages and Disadvantages of Nighttime lights

Summary *This section discusses the advantages and limitations associated with using remotely-sensed nighttime light growth as an outcome measure.*

We measure our outcome of interest—local economic growth—using satellite data on nighttime light emissions. There are four important caveats and points of clarification about this outcome measure that merit discussion. First, nighttime light growth is not a direct measure of subnational economic growth, but it is widely used by economists, political scientists, and geographers as a strong proxy measure of subnational economic growth (Henderson, Storeygard & Weil, 2011; Henderson, Storeygard & Weil, 2012; Weidmann & Schutte, 2017; Gennaioli et al., 2014; Hodler & Raschky, 2014; Khomba & Trew, 2017).[6] Henderson, Storeygard & Weil (2011) and Henderson, Storeygard & Weil (2012) demonstrate that there is a strong, positive correlation between GDP growth and nighttime light growth.[7] Hodler & Raschky (2014, pp. 1028-1031) use subnational GDP estimates from Gennaioli et al. (2014), covering 1,503 subnational regions within 82 countries, to estimate the relationship between nighttime lights and subnational GDP. They estimate elasticities between nighttime lights and GDP at the national and subnational levels, respectively, of around 0.3.

Second, comparisons of nighttime light over time can be problematic due to sensor degradation and the fact that satellites capture both persistent lighting (e.g. street lights) and ephemeral lights (e.g. fires) (Wu et al., 2013). To address this problem, we remove all ephemeral events, such as fires, from the data. Our measurements are also calibrated across sensors and years using the coefficients reported in Elvidge et al. (2014, p. 102).

Third, nighttime light measurements suffer from a so-called 'overglow' problem, whereby light from one spatial unit can spill over from one spatial unit to an adjacent unit, making it difficult to reliably detect changes at fine spatial scales Weidmann & Schutte (2017). However, this problem is most acute in well-lit, urban areas and virtually all of our units of observation are in poorly-lit rural and urban areas.

A fourth potential problem is that nighttime light is measured on a 0-63 scale that is subject to top-coding and bottom-coding (Jean et al., 2016); that is to say, exceptionally

[6]Chen & Nordhaus (2011) present an A-E grading system for the quality of a country's statistical systems (A indicating a high quality system and E indicating extremely weak or non-existent system) and provide evidence that "luminosity is likely to add value as a proxy for [economic] output for countries with the poorest statistical systems, those that receive a D or an E grade.... and [t]his is true at the national level and at subnational levels where data are available" (Chen & Nordhaus, 2011, p. 8594). Liberia receives a "D" in their grading system. They conclude that "luminosity data may be a useful supplement to current economic indicators in countries and regions with very poor quality or missing data" (Chen & Nordhaus, 2011, p. 8594).

[7]Weidmann & Schutte (2017) demonstrate that nighttime light correlates strongly (.73) with survey-based measures of asset wealth at the local level. Khomba & Trew (2017) also find a strong, positive correlation between nighttime light growth and household consumption gains.

high levels of light cannot be detected beyond the threshold of 63, and exceptionally low but non-zero levels of light may result in a score of 0. Top coding is not a significant challenge in our study because baseline and endline levels of nighttime light are low across the entire country. However, bottom coding is a potential problem since Liberia contains a large number of very poor, totally unlit areas (where growth may occur outside the sensor's detection capabilities). We address this issue by testing (in Section 5.1 of this Online Appendix) whether our empirical results hold after we control for a grid cell's underlying 'propensity to light up.'

Finally, several additional notes of clarification are in order regarding the way in which we have operationalized our outcome measures. Since nighttime light is measured many times over the course of a calendar year, we use average annual estimates of nighttime light. Also, to ensure that we fully capture any treatment effects that may have accrued during the 2006-2012 period, we measure nighttime light growth by subtracting its mean value in 2005 from its mean value in 2013. We use 2005, rather than 2006, as our baseline year of measurement to ensure that our baseline outcome measurement is not contaminated by treatment effects. We use 2013 as our endline year of measurement to allow concessions granted near the end of the treatment period (e.g. 2012) to register detectable effects.

4 Matching Algorithm

4.1 Description of matching process

Summary *This section provides details regarding the matching process we use in our paper. Specifically, we discuss the variables we use to identify locations that are as similar as possible. In addition, we present the logit models using these variables to predict whether a location was treated or not.*

Matching only helps address endogeneity if it is possible to measure the variables that influence treatment assignment (i.e. investment siting decisions).[8] For this reason, we carefully reviewed the existing literature on the determinants of investment project siting decisions at subnational scales (e.g., Ledyaeva, 2009; Ledyaeva, Karhunen & Kosonen, 2013; Mukim & Nunnenkamp, 2012; Meyer & Nguyen, 2005; Cheng & Kwan, 2000; Wattanadumrong, Collins & Snell, 2010). We identified a set of factors that influence where investor site their projects within countries, including market size, market access, human capital, transportation infrastructure, institutional quality, proximity to natural resources, and domestic political considerations.

In our analysis, we attempt to account for as many of these factors as possible by drawing on data from satellite imagery, weather stations, household surveys, and administrative records. For instance, we control for slope, elevation, temperature and precipitation as these physical characteristics are known to influence the siting decisions of investors in the natural resource sector. The slope and elevation data are sourced from the NASA Shuttle Radar Topography Mission and the temperature and precipitation data are drawn from the Center for Climactic Research at the University of Delaware. We also include a variable that measures a grid cell's proximity to known natural resources—including iron ore, gold, and diamonds—as this too may influence siting decisions.[9]

We account for access to markets by including a measure of distance to roads from CIESIN's Global Roads Open Access Database and a DHS-based measure of the urban or rural nature of a given location. We control for population density because investors are generally more productive and profitable in places where they can source labor.[10]

[8] Note that matching approaches are only as useful as the set of observed covariates used to achieve balance between treatment and control units. We cannot completely rule out the possibility that some unobserved confound biases our findings. Therefore, we make similar assumptions as instrumental variable approaches, which need to assume that there are no unobserved variables linking the instrument to the outcome except through the path of the instrumented variable.

[9] We calculate the distance between a DHS grid cell and its nearest natural resource, irrespective of type. We source data pre-treatment locations of iron ore and gold from the Natural Resource Location Dataset (see: http://civilwardynamics.org/data/) and the US Geological Survey's Mineral Resources Data System (MRDS). We draw upon PRIO-GRID 2.0 (http://grid.prio.org/#/) for data on diamond deposits.

[10] In a 2011 report entitled texitDeveloping Liberia's Economic Corridors, Liberia's Ministry of Planning and Economic Affairs noted that "[o]ne measure of the attraction of areas as targets for investment is the level of population density – the lower the density, the lower the level of its current economic

The population density data are drawn from CIESIN's Gridded Population of the World (GPW) v4 dataset, which is measured at a resolution of 30-arc seconds and in five-year intervals.[11] We also control for urban travel time to capture the ease with which labor can commute to potential project sites. These data come from the European Commission Joint Research Centre.

Additionally, to account for the fact that development and investment projects may be co-located (Li et al. 2013), we include a measure of proximity to Chinese development projects from 2000-2005.[12] The colocation of development and investment projects is a potentially important source of confounding, as previous research suggests development projects themselves have local economic growth effects. (**Dreher et al. 2016**) and Isaksson and Kotsadam (2016) find that Chinese and World Bank development projects have positive effects on local development outcomes, as measured by nighttime light emissions.[13]

In order to capture potential political bias in the spatial allocation of natural resource concessions, we identify the birth regions of the members of Ellen Johnson-Sirleaf's first cabinet (who were appointed in early 2006) and construct a ADM1-level measure of the number of cabinet members who were born in a given county (ICHINO & NATHAN, 2013; Soumahoro, 2015; Wahman & Boone, 2017; Hodler & Raschky, 2014). We manually assembled this dataset by first using the CIA's *Chief of State and Cabinet Members of Foreign Governments* to identify all members of Ellen Johnson-Sirleaf's first cabinet, and then using a diverse set of publicly available resources to identify the towns, villages, districts, and counties where these public officials were born.[14] Given that this locational information varied in its precision and a common geographical unit of observation was needed to consistently measure the birth regions of cabinet members, we used the raw data to identify the number of cabinet members who were born in a given county (ADM1). We then mapped these county-level data to the 1 km x 1 km grid cell level to facilitate integration with our treatment, outcome, and covariate data.

Another set of matching covariates, which relate to local population characteristics, are drawn from the 2007 Demographic and Health Survey (DHS).[15] Access to skilled and semi-skilled labor is often important to foreign investors and may therefore influence their project siting decisions. We capture the expected productivity of the local workforce by

attractiveness?" (MOPEA 2011: 5).

[11]We use CIESIN's 2005 data to avoid endogeneity problems, as nighttime light is one of the input variables that CIESIN uses to model population estimates.

[12]More specifically, we calculate the distance between a DHS grid cell and its nearest Chinese development project. These data are drawn from AidData's Chinese Official Finance to Africa, Version 1.1.1 dataset (available at http://aiddata.org/subnational-geospatial-research-datasets). We only include those projects geocoded with the precision code levels 1 and 2 — that is, projects with latitude and longitude coordinates within 25 km of the exact intervention sites — in our analysis.

[13]We attempted to included both World Bank and Chinese development projects in this measure, However, we were ultimately unable to include World Bank projects in this measure because none were active in our pre-treatment period (prior to 2006).

[14]These data and the underlying source materials used to generate the data are available upon request.

[15]We use 2007 DHS data, as opposed to subsequent years of DHS data, to minimize endogeneity concerns.

measuring the education and literacy levels of households living at a particular location. Given that baseline skills and work experiences of local residents might also matter to investors, we match on a set of indicators that measure the occupations held by members of local households. We also include a measure of the employment status of local residents in our matching algorithm to capture prevailing levels of wage competition due to available surplus labor. A battery of other indicators that measure potentially consequential characteristics of the local population—gender, age, religion, marital status, household size, household wealth, and residence type—are also included. Regional fixed effects are included to account for other idiosyncratic factors that may affect investor preferences.

Finally, we include pretreatment measures of nighttime light levels (2005) and trends (1992-2005) in our matching routine to maximize covariate balance across our treatment and control locations.[16] These variables capture otherwise unobservable factors (e.g. local conflict, local governance quality, locations of previously active concessions) that may influence treatment assignment (Cook, Shadish & Wong, 2008). By effectively rendering many otherwise unobservable confounding factors observed, we can have greater confidence that we are not omitting key variables that make our treated units more likely to grow economically even in the absence of FDI.

In the following, we report results for the first stage of the matching process for each model reported in our study. We sub-divide this section by results for localities that were treated during our whole treatment period (2006-2012), only early-treated localities (2006-2008), and only late-treated localities (2009-2012).

Our results indicate that localities which are rich in natural resources are more likely to receive treatment. We also find that that concessions tend to be sited in more remote and mountainous areas - specifically, rural areas, areas located at higher elevations, and areas on steeply sloped lands. Additionally, we find that localities which are closer to roads, population centers, and development projects are more likely to receive treatment. Consistent with the notion that concessions might be allocated according to domestic political considerations, we also find the localities in the home regions of cabinet ministers are more likely to receive treatment. Finally and importantly, we find that pretreatment nighttime light levels and trends are correlated with treatment assignment. Areas that registered lower baseline levels of nighttime light (subnational economic development) in the pretreatment period are more likely to be treated, and areas that experienced more nighttime light growth (subnational economic growth) in the pretreatment period are more likely to be treated.[17] The fact that these pretreatment outcome variables correlate with treatment assignment gives us greater confidence that we are expunging otherwise

[16]These data, collected nightly using satellite images from the National Oceanic and Atmospheric Administration (NOAA), measure nighttime light activity for pixels that correspond to individual square kilometers. The nightly data are then aggregated into annual measures using the mean for each 1 km x 1 km grid cell. The variable that we use is measured on a 0-63 scale, with higher values indicating more intense economic activity. It excludes exceptional instances (such as fires) and other cases of background noise.

[17]These results suggest that relatively underdeveloped localities and localities experiencing some degree of economic growth are more desirable places for investors to site their projects.

unobservable selection effects that would have biased our treatment effect estimates in the second stage of our matching routine (Cook, Shadish & Wong, 2008).

4.1.1 1st Stage Results: All Concessions

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	10320514775294500.0000	41579761.1547	248210054.33	0.0000
Urban/Rural (Urban)	-739130758232651.8750	5500352.9374	-134378787.44	0.0000
Elevation	-1242425046629.2336	9893.7809	-125576365.69	0.0000
Pop. Density	-12112951979.0969	3098.3713	-3909457.79	0.0000
Dist. to Projects	-892769481.5309	29.9611	-29797602.77	0.0000
Dist. to Resources	3614839349.3683	52.1940	69257815.04	0.0000
Home Counties	114303718347777.1562	616971.6332	185265759.70	0.0000
Dist. to Roads	64465650741.7316	430.6035	149709999.92	0.0000
Slope	169068652520421.1875	647372.1230	261161465.75	0.0000
Urban Travel Time	-676670775617.4266	4862.9675	-139147706.59	0.0000
Pre-Period Precipitation (Avg.)	-6652208153835.6699	83368.7539	-79792582.22	0.0000
Pre-Period Temp. (Avg.)	-222775587035852.0000	1700818.2091	-130981421.67	0.0000
Pre-Period NTL (Avg.)	76494045250315.7500	950606.6039	80468665.94	0.0000
Pre-Period NTL (Trend)	-1646018703308301.0000	13769856.7270	-119537823.52	0.0000
Edu. Level (Primary)	82644095263706.6406	1671516.9529	49442570.79	0.0000
Edu. Level (Secondary)	-2196163446888947.5000	9409808.5512	-233390874.53	0.0000
Edu. Level (Tertiary)	-6398196243074239.0000	41645846.2098	-153633479.10	0.0000
Religion	-1649756160622001.7500	3321085.4646	-496752094.53	0.0000
Household Numbers	8444442142095.8193	363050.2931	23259703.42	0.0000
Gender	-294196321228701.9375	4393877.4674	-66955968.48	0.0000
Age	14459876361570.2832	62140.7589	232695522.50	0.0000
Literacy (Partial)	3898883543392628.5000	6124266.8256	636628620.93	0.0000
Literacy (Whole)	1345299858178486.0000	8562515.8041	157115021.91	0.0000
Wealth	3173030017.2188	12.3360	257217194.76	0.0000
Status - Married	-2598228252940122.5000	2990287.1413	-868889217.04	0.0000
Status - Living Together	-407009863145380.7500	3138294.4642	-129691419.27	0.0000
Status - Not Living Together	-2010598092701179.2500	13689723.8980	-146869148.54	0.0000
Residence	-369823291270163.5000	14994089.0619	-24664605.48	0.0000
Working	-437332492038100.3750	2278010.8192	-191979989.01	0.0000
Occupation (44)	-1295735760474135.7500	3106323.4643	-417128407.71	0.0000
Occupation (62)	756878513425077.1250	2443055.9758	309808093.19	0.0000
Occupation (65)	-329183814878708.6250	8089395.5172	-40693252.56	0.0000
Region - North Central	-1409550413878234.0000	14484413.1720	-97314982.47	0.0000
Region - North Western	1894412931016899.2500	14819052.6507	127836304.77	0.0000
Region - South Central	-243246673850339.9688	13994376.5610	-17381744.22	0.0000
Region - South Eastern A	129647196706600.7812	14421876.7197	8989620.37	0.0000
Region - South Eastern B	-1504776869285809.7500	14480771.5358	-103915517.59	0.0000

Table 6: PSM Results (First Stage) for All Concessions (2006-2012), 25 km

Note: Estimates and standard errors of this model are extraordinarily large. The reason for the size of the coefficients are the fixed effects for DHS regions. This results in a small number of observations for a limited number of regions. The default Newton-Raphson algorithm solving the maximum likelihood equation can be sensitive to low N.

Concerned with the accuracy of our results, we conducted two robustness tests. First, we re-estimated the model by replacing the Newton-Raphson OLS approach with a GAM-based Iteratively reweighted least squares approach, restricting the GAM to only linear form (to approximate a GLS), which is more resilient to outliers/small Ns than traditional GLS. It, too, was able to solve and gave us 'normal' looking coefficients and standard errors without changing the substantive interpretation of subsequent treatment effects. Second, we re-estimate the original model but removed the fixed effects for DHS regions from the dataset. Removing the DHS regions out allowed the traditional GLS estimator to solve the maximum likelihood estimation again. The size and direction of the second stage did not change significantly.

In light of these additional tests, we Table 1 shows original estimation which uses the same model specification as all subsequent models reported in this section. For sake of completeness, Table 2 displays the result of the first stage matching process without DHS fixed effects.

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	169.4391	18.4162	9.20	0.0000
Urban/Rural	-12.8353	1.6517	-7.77	0.0000
Elevation	-0.0145	0.0013	-11.23	0.0000
Pop. Density	-0.0048	0.0009	-5.09	0.0000
Dist. to Projects	-0.0000	0.0000	-4.78	0.0000
Dist. to Resources	0.0000	0.0000	2.07	0.0385
Home Counties	-0.4729	0.2072	-2.28	0.0225
Dist. to Roads	0.0002	0.0001	2.32	0.0203
Slope	0.9114	0.1180	7.72	0.0000
Urban Travel Time	-0.0027	0.0006	-4.53	0.0000
Pre-Period Precipitation (Avg.)	0.1592	0.0188	8.48	0.0000
Pre-Period Temp. (Avg.)	-7.0019	0.7847	-8.92	0.0000
Pre-Period NTL (Avg.)	0.6991	0.2243	3.12	0.0018
Pre-Period NTL (Trend)	2.3752	8.3026	0.29	0.7748
Edu. Level (Primary)	0.9820	0.2446	4.01	0.0001
Edu. Level (Secondary)	-3.4288	2.7565	-1.24	0.2135
Edu. Level (Tertiary)	-2.8262	128690.9506	-0.00	1.0000
Religion	-4.9349	0.5200	-9.49	0.0000
Household Numbers	0.4523	0.0840	5.39	0.0000
Gender	-1.4459	0.2795	-5.17	0.0000
Age	0.0378	0.0122	3.09	0.0020
Literacy (Partial)	22.6578	27583.2755	0.00	0.9993
Literacy (Whole)	10.5532	2.3649	4.46	0.0000
Wealth	0.0000	0.0000	6.41	0.0000
Status - Married	-7.6713	2.0023	-3.83	0.0001
Status - Living Together	13.6877	4459.6121	0.00	0.9976
Status - Not Living Together	19.1343	49709.3158	0.00	0.9997
Residence	23.6698	47822.4869	0.00	0.9996
Working	-2.1728	1.0450	-2.08	0.0376
Occupation (44)	-6.4612	1.1905	-5.43	0.0000
Occupation (62)	-2.2039	1.1617	-1.90	0.0578
Occupation (65)	20.7478	41979.0994	0.00	0.9996

Table 7: PSM Results (First Stage) for All Concessions (2006-2012), 25 km, without fixed effects for DHS regions.

4.1.2 1st Stage Results: Agriculture Concessions

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-200.7877	2119.3776	-0.09	0.9245
Urban/Rural (Urban)	-14.3435	1.4508	-9.89	0.0000
Elevation	0.0103	0.0025	4.11	0.0000
Pop. Density	0.0037	0.0005	7.68	0.0000
Dist. to Projects	-0.0001	0.0000	-11.90	0.0000
Dist. to Resources	0.0003	0.0000	15.23	0.0000
Home Counties	-0.0369	0.0414	-0.89	0.3733
Dist. to Roads	-0.0001	0.0001	-1.66	0.0966
Slope	1.0026	0.1158	8.66	0.0000
Urban Travel Time	-0.0063	0.0012	-5.21	0.0000
Pre-Period Precipitation (Avg.)	1.1954	0.0675	17.72	0.0000
Pre-Period Temp. (Avg.)	1.4238	0.5516	2.58	0.0098
Pre-Period NTL (Avg.)	-0.2153	0.1292	-1.67	0.0956
Pre-Period NTL (Trend)	4.9428	1.5592	3.17	0.0015
Edu. Level (Primary)	-1.0687	0.1830	-5.84	0.0000
Edu. Level (Secondary)	-3.5098	1.7908	-1.96	0.0500
Edu. Level (Tertiary)	3.9745	16931.6507	0.00	0.9998
Religion	-18.5159	1.2256	-15.11	0.0000
Household Numbers	-0.7888	0.0721	-10.94	0.0000
Gender	-2.4541	0.5413	-4.53	0.0000
Age	-0.1582	0.0124	-12.75	0.0000
Literacy (Partial)	8.4878	2178.8716	0.00	0.9969
Literacy (Whole)	-4.7214	1.1036	-4.28	0.0000
Wealth	0.0000	0.0000	5.57	0.0000
Status - Married	2.5517	1.0471	2.44	0.0148
Status - Living Together	1.8443	1.0848	1.70	0.0891
Status - Not Living Together	2.7599	7192.7437	0.00	0.9997
Residence	4.6952	3849.4257	0.00	0.9990
Working	3.9341	0.3383	11.63	0.0000
Occupation (44)	-10.0381	0.7792	-12.88	0.0000
Occupation (62)	-13.5069	0.9196	-14.69	0.0000
Occupation (65)	-15.6516	1797.5893	-0.01	0.9931
Region - North Central	36.3251	2119.3132	0.02	0.9863
Region - North Western	50.7159	2119.3139	0.02	0.9809
Region - South Central	23.4180	2119.3128	0.01	0.9912
Region - South Eastern A	-17.0841	2150.0398	-0.01	0.9937
Region - South Eastern B	25.5004	2119.3130	0.01	0.9904

Table 8: PSM Results (First Stage) for Agriculture Concessions (2006-2012), 25 km

4.1.3 1st Stage Results: Forestry Concessions

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	3.50	367.00	0.010	0.992
Urban/Rural (Urban)	-0.36	0.258	-1.38	0.17
Elevation	0.0017	0.0004	4.76	0.0000
Pop. Density	-0.0082	0.0009	-8.40	0.3360
Dist. to Projects	-0.0000	0.0000	-6.32	0.0000
Dist. to Resources	0.0000	0.0000	1.43	0.15
Home Counties	0.0234	0.026	-9.026	0.0000
Dist. to Roads	-0.0002	0.0000	-12.29	0.0000
Slope	0.149	0.0246	6.052	0.0000
Urban Travel Time	-0.0033	0.0002	14.32	0.0000
Pre-Period Precipitation (Avg.)	1028.00	116.20	8.850	0.0000
Pre-Period Temp. (Avg.)	4.14	0.953	4.35	0.0000
Pre-Period NTL (Avg.)	-0.2172	0.0754	-2.88	0.0039
Pre-Period NTL (Trend)	6.709	1.379	4.87	0.0000
Edu. Level (Primary)	0.3812	0.06602	5.774	0.0000
Edu. Level (Secondary)	-18.80	201.00	-0.094	0.9255
Edu. Level (Tertiary)	5.438	1638.0000	0.00	0.9973
Religion	0.9452	0.1235	7.65	0.0000
Household Numbers	-0.07194	0.013	-5.183	0.0000
Gender	-0.3235	0.0876	-3.693	0.0000
Age	0.0225	0.0027	8.45	0.0000
Literacy (Partial)	-16.34	307.6	-0.053	0.9576
Literacy (Whole)	3.757	0.5445	6.899	0.0000
Wealth	-0.0000	0.0000	-0.069	0.945
Status - Married	1.150	0.138	8.331	0.0000
Status - Living Together	-0.2747	0.145	-1.90	0.0573
Status - Not Living Together	2.043	683.60	0.030	0.976
Residence	6.987	667.40	0. 0	0.9916
Working	0.3000	0.0912	3.289	0.0000
Occupation (44)	-0.591	0.1328	-4.437	0.0000
Occupation (62)	0.733	0.1077	6.81	0.0000
Occupation (65)	1.113	0.434	2.565	0.0103
Region - North Central	-9.929	367.00	-0.027	0.979074
Region - North Western	-9.963	367.00	-0.026	0.978418
Region - South Central	-6.42	367.00	-0.018	0.97907
Region - South Eastern A	-7.64	367.00	-0.021	0.983402
Region - South Eastern B	-8.062	367.00	-0.022	0.982475

Table 9: PSM Results (First Stage) for Forestry Concessions (2006-2012), 25 km

4.1.4 1st Stage Results: Mining Concessions

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	34.4591	338.2308	0.10	0.9189
Urban/Rural (Urban)	-1.9263	0.2891	-6.66	0.0000
Elevation	-0.0051	0.0007	-7.79	0.0000
Pop. Density	0.0022	0.0004	4.92	0.0000
Dist. to Projects	0.0000	0.0000	4.44	0.0000
Dist. to Resources	-0.0000	0.0000	-7.30	0.0000
Home Counties	-0.0207	0.0512	-0.41	0.6855
Dist. to Roads	0.0003	0.0000	8.45	0.0000
Slope	0.4957	0.0808	6.13	0.0000
Urban Travel Time	-0.0020	0.0002	-9.10	0.0000
Pre-Period Precipitation (Avg.)	-0.0002	0.0054	-0.03	0.9723
Pre-Period Temp. (Avg.)	-0.6773	0.1219	-5.56	0.0000
Pre-Period NTL (Avg.)	-0.3289	0.0727	-4.52	0.0000
Pre-Period NTL (Trend)	2.8039	1.2353	2.27	0.0232
Edu. Level (Primary)	-0.1956	0.0961	-2.04	0.0417
Edu. Level (Secondary)	0.0403	0.5775	0.07	0.9443
Edu. Level (Tertiary)	-1.1450	2288.5229	-0.00	0.9996
Religion	-2.3429	0.3261	-7.18	0.0000
Household Numbers	0.1026	0.0225	4.55	0.0000
Gender	-3.0152	0.3266	-9.23	0.0000
Age	0.0055	0.0039	1.41	0.1577
Literacy (Partial)	15.8222	328.2578	0.05	0.9616
Literacy (Whole)	0.2694	0.4617	0.58	0.5596
Wealth	-0.0000	0.0000	-3.72	0.0002
Status - Married	-2.0518	0.2624	-7.82	0.0000
Status - Living Together	0.8667	0.3550	2.44	0.0146
Status - Not Living Together	-3.3155	2.0281	-1.63	0.1021
Residence	-4.5771	787.8229	-0.01	0.9954
Working	-0.6704	0.1473	-4.55	0.0000
Occupation (44)	0.7241	0.1580	4.58	0.0000
Occupation (62)	2.0358	0.1270	16.03	0.0000
Occupation (65)	16.9083	436.1394	0.04	0.9691
Region - North Central	-13.1074	338.2188	-0.04	0.9691
Region - North Western	-9.6907	338.2193	-0.03	0.9771
Region - South Central	-11.9686	338.2186	-0.04	0.9718
Region - South Eastern A	-12.1798	338.2188	-0.04	0.9713
Region - South Eastern B	-11.5918	338.2188	-0.03	0.9727

Table 10: PSM Results (First Stage) for Mining Concessions (2006-2012), 25 km

4.1.5 1st Stage Results: Iron Ore Mining Concessions

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	39.8950	2.3365	17.07	0.0000
Urban/Rural (Urban)	-3.5070	0.3291	-10.66	0.0000
Elevation	-0.0068	0.0005	-14.73	0.0000
Pop. Density	-0.0020	0.0003	-6.68	0.0000
Dist. to Projects	-0.0000	0.0000	-1.58	0.1149
Dist. to Resources	-0.0001	0.0000	-26.12	0.0000
Home Counties	-0.1046	0.0231	-4.52	0.0000
Dist. to Roads	-0.0002	0.0000	-6.09	0.0000
Slope	0.1503	0.0271	5.55	0.0000
Urban Travel Time	0.0005	0.0002	1.94	0.0530
Pre-Period Precipitation (Avg.)	0.0170	0.0040	4.28	0.0000
Pre-Period Temp. (Avg.)	-1.1971	0.0904	-13.25	0.0000
Pre-Period NTL (Avg.)	-0.4642	0.0625	-7.43	0.0000
Pre-Period NTL (Trend)	11.8629	1.4629	8.11	0.0000
Edu. Level (Primary)	-0.7141	0.0735	-9.72	0.0000
Edu. Level (Secondary)	-4.1132	0.5018	-8.20	0.0000
Edu. Level (Tertiary)	-18.2681	496.1828	-0.04	0.9706
Religion	0.5121	0.1305	3.92	0.0001
Household Numbers	-0.0493	0.0150	-3.28	0.0010
Gender	-1.3395	0.2015	-6.65	0.0000
Age	0.0022	0.0026	0.82	0.4098
Literacy (Partial)	-0.5575	0.2006	-2.78	0.0054
Literacy (Whole)	3.1642	0.4721	6.70	0.0000
Wealth	0.0000	0.0000	4.30	0.0000
Status - Married	-0.4656	0.1654	-2.82	0.0049
Status - Living Together	0.0506	0.1658	0.31	0.7600
Status - Not Living Together	2.2705	0.9358	2.43	0.0153
Residence	12.8406	128.4718	0.10	0.9204
Working	1.0251	0.1023	10.02	0.0000
Occupation (44)	-1.1843	0.1269	-9.33	0.0000
Occupation (62)	-1.1284	0.1067	-10.58	0.0000
Occupation (65)	1.6285	0.3918	4.16	0.0000
Region - North Central	-5.8537	1.1681	-5.01	0.0000
Region - North Western	-10.0269	1.1806	-8.49	0.0000
Region - South Central	-9.9850	1.1583	-8.62	0.0000
Region - South Eastern A	-7.5963	1.1750	-6.46	0.0000
Region - South Eastern B	-8.4014	1.1802	-7.12	0.0000

Table 11: PSM Results (First Stage) for Forestry Concessions (2006-2012), 25 km

4.1.6 1st Stage Results: Non-Iron Ore Mining Concessions

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	38.4260	2.4795	15.50	0.0000
Elevation	-0.0121	0.0006	-21.12	0.0000
Pop. Density	-0.0021	0.0004	-5.88	0.0000
Dist. to Projects	0.0000	0.0000	13.55	0.0000
Dist. to Resources	-0.0001	0.0000	-30.98	0.0000
Home Counties	-0.1705	0.0243	-7.02	0.0000
Urban/Rural (Urban)	-3.7672	0.3623	-10.40	0.0000
Dist. to Roads	-0.0002	0.0000	-7.54	0.0000
Slope	0.1703	0.0285	5.97	0.0000
Urban Travel Time	0.0006	0.0002	2.68	0.0075
Pre-Period Precipitation (Avg.)	0.0029	0.0040	0.72	0.4728
Pre-Period Temp. (Avg.)	-0.9648	0.0940	-10.27	0.0000
Pre-Period NTL (Avg.)	-0.4779	0.0635	-7.53	0.0000
Pre-Period NTL (Trend)	11.4086	1.4962	7.62	0.0000
Edu. Level (Primary)	-0.6043	0.0753	-8.03	0.0000
Edu. Level (Secondary)	-4.3818	0.5435	-8.06	0.0000
Edu. Level (Tertiary)	-19.6117	815.9927	-0.02	0.9808
Religion	0.3951	0.1345	2.94	0.0033
Household Numbers	-0.0698	0.0155	-4.51	0.0000
Gender	-2.0565	0.2078	-9.90	0.0000
Age	0.0085	0.0027	3.12	0.0018
Literacy (Partial)	-0.4879	0.2020	-2.41	0.0157
Literacy (Whole)	3.2072	0.5136	6.24	0.0000
Wealth	0.0000	0.0000	3.32	0.0009
Status - Married	-0.5614	0.1685	-3.33	0.0009
Status - Living Together	0.1900	0.1686	1.13	0.2599
Status - Not Living Together	1.9786	1.2442	1.59	0.1118
Residence	13.6631	208.6714	0.07	0.9478
Working	0.4597	0.1054	4.36	0.0000
Occupation (44)	-0.6879	0.1311	-5.25	0.0000
Occupation (62)	-0.9069	0.1089	-8.33	0.0000
Occupation (65)	1.1857	0.3957	3.00	0.0027
Region - North Central	-7.7650	1.3455	-5.77	0.0000
Region - North Western	-12.6208	1.3729	-9.19	0.0000
Region - South Central	-11.2415	1.3437	-8.37	0.0000
Region - South Eastern A	-8.6857	1.3602	-6.39	0.0000
Region - South Eastern B	-10.4620	1.3704	-7.63	0.0000

Table 12: PSM Results (First Stage) for Non-Iron Ore Mining Concessions (2006-2012), 25 km

4.1.7 1st Stage Results: US Concessions

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	9.4399	243.7056	0.04	0.9691
Elevation	0.0081	0.0004	19.89	0.0000
Pop. Density	-0.0001	0.0003	-0.28	0.7794
Dist. to Projects	-0.0000	0.0000	-12.70	0.0000
Dist. to Resources	0.0000	0.0000	4.95	0.0000
Home Counties	0.3633	0.0250	14.55	0.0000
Urban/Rural (Urban)	-1.6170	0.2708	-5.97	0.0000
Dist. to Roads	0.0001	0.0000	3.34	0.0008
Slope	-0.0336	0.0226	-1.48	0.1381
Urban Travel Time	-0.0016	0.0002	-9.27	0.0000
Pre-Period Precipitation (Avg.)	0.0290	0.0029	10.14	0.0000
Pre-Period Temp. (Avg.)	0.0307	0.0582	0.53	0.5986
Pre-Period NTL (Avg.)	-0.0312	0.0516	-0.61	0.5450
Pre-Period NTL (Trend)	1.9931	0.6734	2.96	0.0031
Edu. Level (Primary)	-0.0212	0.0570	-0.37	0.7106
Edu. Level (Secondary)	16.0232	227.8833	0.07	0.9439
Edu. Level (Tertiary)	16.4446	1424.3774	0.01	0.9908
Religion	2.0507	0.1313	15.62	0.0000
Household Numbers	0.0099	0.0127	0.78	0.4357
Gender	0.3568	0.1516	2.35	0.0186
Age	-0.0235	0.0022	-10.67	0.0000
Literacy (Partial)	-15.2364	202.4194	-0.08	0.9400
Literacy (Whole)	-15.1740	227.8833	-0.07	0.9469
Wealth	0.0000	0.0000	3.82	0.0001
Status - Married	2.9514	0.1701	17.36	0.0000
Status - Living Together	2.2638	0.1727	13.11	0.0000
Status - Not Living Together	5.4938	0.6485	8.47	0.0000
Residence	0.6049	465.7935	0.00	0.9990
Working	0.2101	0.0830	2.53	0.0114
Occupation (44)	-0.2757	0.1105	-2.50	0.0126
Occupation (62)	-0.3205	0.0842	-3.80	0.0001
Occupation (65)	16.8406	247.0433	0.07	0.9457
Region - North Central	-17.6579	243.7020	-0.07	0.9422
Region - North Western	-16.1663	243.7021	-0.07	0.9471
Region - South Central	-16.6320	243.7020	-0.07	0.9456
Region - South Eastern A	-16.2652	243.7021	-0.07	0.9468
Region - South Eastern B	-15.2495	243.7021	-0.06	0.9501

Table 13: PSM Results (First Stage) for US Concessions (2006-2012), 25 km

4.1.8 1st Stage Results: Chinese Concessions

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	13.2294	500.2725	0.03	0.9789
Elevation	-0.0148	0.0017	-8.77	0.0000
Pop. Density	-0.0013	0.0004	-3.42	0.0006
Dist. to Projects	0.0000	0.0000	8.10	0.0000
Dist. to Resources	-0.0001	0.0000	-8.64	0.0000
Home Counties	-0.0448	0.0374	-1.20	0.2309
Urban/Rural (Urban)	-20.0641	500.2626	-0.04	0.9680
Dist. to Roads	-0.0005	0.0001	-7.34	0.0000
Slope	0.7640	0.0655	11.67	0.0000
Urban Travel Time	-0.0048	0.0009	-5.60	0.0000
Pre-Period Precipitation (Avg.)	0.1429	0.0107	13.34	0.0000
Pre-Period Temp. (Avg.)	-0.3070	0.1409	-2.18	0.0293
Pre-Period NTL (Avg.)	-0.7848	0.0916	-8.57	0.0000
Pre-Period NTL (Trend)	19.1500	1.8553	10.32	0.0000
Edu. Level (Primary)	0.5607	0.1433	3.91	0.0001
Edu. Level (Secondary)	-6.0495	1.2415	-4.87	0.0000
Edu. Level (Tertiary)	-23.8173	26378.2569	-0.00	0.9993
Religion	-1.8077	0.2372	-7.62	0.0000
Household Numbers	0.4714	0.0374	12.61	0.0000
Gender	1.1892	0.3873	3.07	0.0021
Age	-0.0137	0.0052	-2.65	0.0082
Literacy (Partial)	-17.4752	3783.7431	-0.00	0.9963
Literacy (Whole)	1.1019	0.7155	1.54	0.1236
Wealth	0.0000	0.0000	7.37	0.0000
Status - Married	-0.7547	0.2825	-2.67	0.0076
Status - Living Together	0.8814	0.2649	3.33	0.0009
Status - Not Living Together	20.7363	16361.5152	0.00	0.9990
Residence	19.6128	6411.2766	0.00	0.9976
Working	2.8494	0.2665	10.69	0.0000
Occupation (44)	-0.0652	0.3166	-0.21	0.8368
Occupation (62)	-1.8299	0.2673	-6.84	0.0000
Occupation (65)	37.4672	730.1878	0.05	0.9591
Region - North Central	-26.4362	500.2658	-0.05	0.9579
Region - North Western	-25.5753	500.2658	-0.05	0.9592
Region - South Central	-27.8603	500.2656	-0.06	0.9556
Region - South Eastern A	-80.7852	1233.3051	-0.07	0.9478
Region - South Eastern B	-46.4923	1022.1726	-0.05	0.9637

Table 14: PSM Results (First Stage) for Chinese Concessions (2006-2012), 25 km

4.1.9 1st Stage Results: US Mining Concessions

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	10.1986	239.6383	0.04	0.9661
Elevation	0.0090	0.0004	22.20	0.0000
Pop. Density	0.0007	0.0004	1.78	0.0745
Dist. to Projects	-0.0000	0.0000	-14.78	0.0000
Dist. to Resources	0.0000	0.0000	10.48	0.0000
Home Counties	0.3183	0.0253	12.60	0.0000
Urban/Rural (Urban)	-1.1224	0.2605	-4.31	0.0000
Dist. to Roads	0.0002	0.0000	9.69	0.0000
Slope	-0.1161	0.0228	-5.08	0.0000
Urban Travel Time	-0.0034	0.0002	-16.15	0.0000
Pre-Period Precipitation (Avg.)	0.0194	0.0028	6.86	0.0000
Pre-Period Temp. (Avg.)	-0.0827	0.0581	-1.42	0.1548
Pre-Period NTL (Avg.)	-0.0308	0.0507	-0.61	0.5439
Pre-Period NTL (Trend)	2.0743	0.6633	3.13	0.0018
Edu. Level (Primary)	0.2524	0.0591	4.27	0.0000
Edu. Level (Secondary)	16.4841	239.7775	0.07	0.9452
Edu. Level (Tertiary)	16.5875	1426.1690	0.01	0.9907
Religion	1.4152	0.1169	12.10	0.0000
Household Numbers	0.0741	0.0129	5.75	0.0000
Gender	-0.3071	0.1538	-2.00	0.0458
Age	-0.0198	0.0022	-8.84	0.0000
Literacy (Partial)	-14.8493	202.0525	-0.07	0.9414
Literacy (Whole)	-15.6430	239.7774	-0.07	0.9480
Wealth	0.0000	0.0000	6.45	0.0000
Status - Married	2.6850	0.1718	15.62	0.0000
Status - Living Together	2.4724	0.1747	14.15	0.0000
Status - Not Living Together	-12.7900	454.9012	-0.03	0.9776
Residence	-0.0128	462.5993	-0.00	1.0000
Working	0.0734	0.0829	0.89	0.3760
Occupation (44)	0.2510	0.1121	2.24	0.0251
Occupation (62)	0.3864	0.0868	4.45	0.0000
Occupation (65)	17.9298	250.2889	0.07	0.9429
Region - North Central	-15.2360	239.6347	-0.06	0.9493
Region - North Western	-13.6603	239.6348	-0.06	0.9545
Region - South Central	-13.6275	239.6347	-0.06	0.9547
Region - South Eastern A	-13.4086	239.6348	-0.06	0.9554
Region - South Eastern B	-12.5660	239.6348	-0.05	0.9582

Table 15: PSM Results (First Stage) for US Mining Concessions (2006-2012), 25 km

4.1.10 1st Stage Results: Chinese Mining Concessions

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	99.0866	736.3798	0.13	0.8930
Elevation	-0.0059	0.0021	-2.80	0.0051
Pop. Density	-0.0011	0.0006	-1.80	0.0712
Dist. to Projects	0.0000	0.0000	2.59	0.0096
Dist. to Resources	0.0000	0.0000	0.19	0.8479
Home Counties	0.0304	0.0475	0.64	0.5219
Urban/Rural (Urban)	-19.6096	736.3536	-0.03	0.9788
Dist. to Roads	-0.0002	0.0001	-2.80	0.0051
Slope	0.9331	0.0874	10.67	0.0000
Urban Travel Time	-0.0040	0.0011	-3.76	0.0002
Pre-Period Precipitation (Avg.)	0.3068	0.0191	16.03	0.0000
Pre-Period Temp. (Avg.)	-5.0916	0.3351	-15.19	0.0000
Pre-Period NTL (Avg.)	-0.9510	0.1041	-9.14	0.0000
Pre-Period NTL (Trend)	24.7774	2.2840	10.85	0.0000
Edu. Level (Primary)	1.7177	0.1992	8.62	0.0000
Edu. Level (Secondary)	-7.0785	1.3078	-5.41	0.0000
Edu. Level (Tertiary)	-24.7689	43252.1273	-0.00	0.9995
Religion	-6.9705	0.4475	-15.58	0.0000
Household Numbers	0.7996	0.0495	16.14	0.0000
Gender	-0.2405	0.4330	-0.56	0.5786
Age	0.0396	0.0073	5.43	0.0000
Literacy (Partial)	-11.8756	6264.8215	-0.00	0.9985
Literacy (Whole)	-0.0553	0.7278	-0.08	0.9394
Wealth	0.0000	0.0000	9.19	0.0000
Status - Married	-2.1139	0.3457	-6.11	0.0000
Status - Living Together	0.4333	0.3198	1.36	0.1754
Status - Not Living Together	20.4627	34399.0545	0.00	0.9995
Residence	19.8624	10148.2876	0.00	0.9984
Working	5.0299	0.3935	12.78	0.0000
Occupation (44)	-2.3159	0.4118	-5.62	0.0000
Occupation (62)	-2.2335	0.3462	-6.45	0.0000
Occupation (65)	37.0214	1063.0432	0.03	0.9722
Region - North Central	-25.5388	736.3578	-0.03	0.9723
Region - North Western	-21.7601	736.3578	-0.03	0.9764
Region - South Central	-25.9700	736.3577	-0.04	0.9719
Region - South Eastern A	-85.5939	1813.6328	-0.05	0.9624
Region - South Eastern B	-54.8710	1430.8667	-0.04	0.9694

Table 16: PSM Results (First Stage) for Chinese Mining Concessions (2006-2012), 25 km

4.2 Improvement in means across treatment and control groups

Based on the logit models presented in Section 4.1, we create a propensity score to actually identify similar locations. This section provides information on the performance of the matching process. Specifically, we report results for improvements in covariate *means* after matching.

The tables show that the covariate balance improves by approximately 90% after matching (notwithstanding variation across our treatment definitions), which suggests that our analysis compares locations that are only extremely similar and thus minimizes the risk of endogeneity bias. The matching procedure leveraged here optimizes by selecting the best match for each individual treated cell, thus aiming to match along all elements of the distribution. We calculate this overall summary of the balance improvement by observing the change in mean differences after balancing (Ho et al., 2007). Each unit of observation is matched according to its propensity score on a unit-by-unit basis to the best-matched control; we seek to minimize the difference in propensity score between matched pairs.

In sum, the tables report improvements in the covariate balance post-matching, illustrating that our matching approach succeeds at comparing similar locations where one received treatment while the other did not.

4.2.1 Covariance Balance after Matching: All Concessions

Covariate	Means Treated	Means Control	Mean Diff	% Balance Improvement
Propensity Score	0.44	0.44	0.00	100.00
Urban/Rural (Rural)	0.96	0.95	0.01	57.27
Urban/Rural (Urban)	0.04	0.05	-0.01	57.27
Elevation	297.39	296.44	0.95	99.30
Population Density	59.97	50.67	9.30	80.72
Dist. to Projects	143229.44	110298.57	32930.87	-315.88
Dist. to Resources	47792.31	35608.16	12184.14	-179.35
Home Counties	1.86	1.51	0.35	-688.92
Dist. to Roads	809.09	768.80	40.30	90.64
Slope	1.16	0.79	0.37	-18.53
Urban Travel Time	299.21	421.18	-121.97	-10.76
Pre-Period Precipitation (Avg.)	117.17	109.73	7.43	-6.24
Pre-Period Temp. (Avg.)	23.95	24.29	-0.34	0.41
Pre-Period NTL (Avg.)	0.13	0.10	0.02	91.02
Pre-Period NTL (Trend)	0.01	0.01	0.00	83.73
Education (Primary)	0.18	0.21	-0.03	65.80
Education (Secondary)	0.04	0.04	0.00	49.42
Education (Tertiary)	0.00	0.00	0.00	100.00
Religion	0.04	0.12	-0.08	2.43
Household Numbers	5.52	5.62	-0.09	14.46
Gender	0.65	0.68	-0.03	38.12
Age	38.95	39.36	-0.41	88.28
Literacy (Partial)	0.01	0.00	0.01	30.53
Literacy (Full)	0.04	0.04	0.00	68.74
Wealth	-71446.61	-54092.52	-17354.09	-17.95
Status - Married	0.83	0.96	-0.13	52.53
Status - Living Together	0.08	0.04	0.04	78.48
Status - Not Living Together	0.00	0.00	0.00	100.00
Residence	0.00	0.00	0.00	100.00
Working	0.88	0.97	-0.08	50.78
Occupation (44)	0.19	0.36	-0.17	47.07
Occupation (62)	0.38	0.49	-0.11	64.25
Occupation (65)	0.01	0.00	0.01	-22.23
Region - North Central	0.48	0.60	-0.12	58.41
Region - North Western	0.08	0.00	0.08	53.30
Region - South Central	0.08	0.00	0.08	50.50
Region - South Eastern A	0.19	0.36	-0.18	26.99
Region - South Eastern B	0.16	0.04	0.12	29.10

Table 17: Covariance Balance after Matching for All Concessions (2006-2012), 25 km

4.2.2 Covariance Balance after Matching: Agriculture Concessions

Covariate	Means Treated	Means Control	Mean Diff	% Balance Improvement
Propensity Score	0.60	0.51	0.09	89.89
Urban/Rural (Rural)	1.00	0.99	0.01	81.06
Urban/Rural (Urban)	0.00	0.01	-0.01	81.06
Elevation	72.64	68.54	4.10	96.95
Population Density	60.68	47.40	13.28	69.90
Dist. to Projects	71598.34	79338.70	-7740.36	10.03
Dist. to Resources	41757.69	44847.88	-3090.19	80.17
Home Counties	2.06	1.79	0.27	-78.46
Dist. to Roads	777.28	806.19	-28.91	95.29
Slope	0.96	0.90	0.06	-6.39
Urban Travel Time	193.19	212.41	-19.22	87.87
Pre-Period Precipitation (Avg.)	128.90	128.67	0.23	98.36
Pre-Period Temp. (Avg.)	23.63	23.64	-0.00	99.17
Pre-Period NTL (Avg.)	0.34	0.31	0.03	-393.67
Pre-Period NTL (Trend)	0.02	0.02	0.00	47.93
Education (Primary)	0.35	0.33	0.02	59.68
Education (Secondary)	0.00	0.00	0.00	100.00
Education (Tertiary)	0.00	0.00	0.00	100.00
Religion	0.13	0.16	-0.03	15.54
Household Numbers	5.59	5.70	-0.10	79.04
Gender	0.70	0.70	0.00	94.09
Age	37.96	38.45	-0.49	87.83
Literacy (Partial)	0.00	0.00	-0.00	87.01
Literacy (Full)	0.00	0.00	0.00	95.83
Wealth	-46814.87	-47734.06	919.19	94.41
Status - Married	0.52	0.53	-0.01	93.10
Status - Living Together	0.48	0.46	0.02	91.78
Status - Not Living Together	0.00	0.00	0.00	100.00
Residence	0.00	0.00	0.00	100.00
Working	0.63	0.67	-0.04	83.56
Occupation (44)	0.25	0.21	0.05	-54.42
Occupation (62)	0.55	0.64	-0.09	60.57
Occupation (65)	0.00	0.00	0.00	100.00
Region - North Central	0.00	0.01	-0.01	95.55
Region - North Western	0.21	0.22	-0.01	91.66
Region - South Central	0.54	0.48	0.06	68.06
Region - South Eastern A	0.00	0.00	0.00	100.00
Region - South Eastern B	0.25	0.28	-0.03	83.98

Table 18: Covariance Balance after Matching for Agriculture Concessions (2006-2012), 25 km

4.2.3 Covariance Balance after Matching: Forestry Concessions

Covariate	Means Treated	Means Control	Mean Diff	% Balance Improvement
Propensity Score	0.49	0.44	0.05	88.03
Urban/Rural (Rural)	0.98	0.97	0.01	73.48
Urban/Rural (Urban)	0.02	0.03	-0.01	73.48
Elevation	192.45	190.34	2.11	98.86
Pop. Density	39.16	79.96	-40.80	88.31
Dist. to Projects	105431.18	102463.77	2967.40	93.48
Dist. to Resources	47005.95	44427.02	2578.92	89.49
Home Counties	1.48	1.57	-0.10	90.51
Dist. to Roads	1187.83	1121.15	66.69	59.33
Slope	1.25	1.19	0.06	-985.11
Urban Travel Time	347.80	324.49	23.31	78.18
Pre-Period Precipitation (Avg.)	0.0031	.0031	0.00	71.49
Pre-Period Temp. (Avg.)	-0.0757	-0.08	0.05	98.85
Pre-Period NTL (Avg.)	0.12	0.26	-0.13	53.29
Pre-Period NTL (Trend)	0.01	0.01	-0.01	76.92
Education (Primary)	0.29	0.28	0.01	81.79
Education (Secondary)	0.00	0.01	0.01	86.26
Education (Tertiary)	0.00	0.00	0.00	54.68
Religion	0.11	0.11	0.00	71.48
Household Numbers	5.71	5.76	-0.05	47.55
Gender	0.13	0.11	0.02	48.57
Age	42.45	42.82	-0.37	80.32
Literacy (Partial)	0.00	0.01	-0.01	77.34
Literacy (Full)	0.00	0.02	-0.1	79.09
Wealth	-53247.98	-48375.24	-4872.74	81.23
Status - Married	0.78	0.72	0.05	90.08
Status - Living Together	0.18	0.20	-0.03	90.16
Status - Not Living Together	0.00	0.00	0.00	100.00
Residence	0.00	0.00	0.00	90.94
Working	0.77	0.77	0.00	97.63
Occupation (44)	0.17	0.19	-0.02	85.35
Occupation (62)	0.66	0.63	0.03	74.92
Occupation (65)	0.00	0.00	0.00	87.15
Region - North Central	0.22	0.25	-0.03	90.07
Region - North Western	0.21	0.19	0.01	87.95
Region - South Central	0.12	0.13	-0.01	97.17
Region - South Eastern A	0.25	0.22	0.02	85.95
Region - South Eastern B	0.21	0.20	0.00	87.05

Table 19: Covariance Balance after Matching for Forestry Concessions (2006-2012), 25 km

4.2.4 Covariance Balance after Matching: Mining Concessions

Covariate	Means Treated	Means Control	Mean Diff	% Balance Improvement
Propensity Score	0.75	0.71	0.03	88.16
Urban/Rural (Rural)	0.90	0.96	-0.06	-64.49
Urban/Rural (Urban)	0.10	0.04	0.06	-64.49
Elevation	194.46	201.33	-6.86	81.44
Population Density	329.24	40.50	288.74	-362.35
Dist. to Projects	91967.93	96065.24	-4097.31	-216.10
Dist. to Resources	49091.92	53234.91	-4142.99	70.27
Home Counties	1.99	1.58	0.41	-1876.93
Dist. to Roads	893.04	891.68	1.36	99.49
Slope	0.86	0.85	0.01	97.34
Urban Travel Time	468.64	483.90	-15.25	90.97
Pre-Period Precipitation (Avg.)	117.19	116.20	0.99	53.71
Pre-Period Temp. (Avg.)	24.26	24.26	-0.00	99.96
Pre-Period NTL (Avg.)	1.14	0.31	0.84	-1532.04
Pre-Period NTL (Trend)	0.06	0.01	0.05	-365.56
Education (Primary)	0.38	0.43	-0.04	55.63
Education (Secondary)	0.08	0.01	0.07	-147.12
Education (Tertiary)	0.00	0.00	0.00	-263.62
Religion	0.01	0.01	0.00	95.46
Household Numbers	6.25	6.13	0.12	59.05
Gender	0.73	0.73	-0.00	91.15
Age	42.41	42.42	-0.02	96.66
Literacy (Partial)	0.01	0.00	0.01	5.83
Literacy (Full)	0.08	0.03	0.06	-198.18
Wealth	-40246.76	-50784.89	10538.13	-966.68
Status - Married	0.91	0.95	-0.05	83.27
Status - Living Together	0.02	0.02	0.00	98.60
Status - Not Living Together	0.00	0.00	-0.00	-99.41
Residence	0.00	0.00	0.00	-9.09
Working	0.79	0.81	-0.02	33.04
Occupation (44)	0.17	0.18	-0.01	68.65
Occupation (62)	0.47	0.52	-0.05	76.19
Occupation (65)	0.02	0.00	0.02	-148.55
Region - North Central	0.21	0.22	-0.01	45.48
Region - North Western	0.00	0.01	-0.00	98.17
Region - South Central	0.06	0.08	-0.02	84.10
Region - South Eastern A	0.53	0.54	-0.00	98.87
Region - South Eastern B	0.12	0.15	-0.04	34.42

Table 20: Covariance Balance after Matching for Mining Concessions (2006-2012), 25 km

4.2.5 Covariance Balance after Matching: Iron Ore Mining Concessions

Covariate	Means Treated	Means Control	Mean Diff	% Balance Improvement
Propensity Score	0.53	0.46	0.07	86.36
Urban/Rural (Rural)	0.98	0.98	0.00	-73.10
Urban/Rural (Urban)	0.02	0.02	-0.00	-73.10
Elevation	201.73	198.25	3.48	86.09
Population Density	67.67	64.58	3.09	93.55
Dist. to Projects	85742.35	84367.47	1374.88	92.58
Dist. to Resources	21507.78	25482.49	-3974.71	89.38
Home Counties	1.75	1.77	-0.02	92.66
Dist. to Roads	919.65	1077.89	-158.25	71.75
Slope	1.16	1.17	-0.01	47.42
Urban Travel Time	261.28	285.51	-24.23	82.60
Pre-Period Precipitation (Avg.)	116.34	118.31	-1.97	61.81
Pre-Period Temp. (Avg.)	24.00	24.06	-0.06	28.00
Pre-Period NTL (Avg.)	0.23	0.23	0.00	99.07
Pre-Period NTL (Trend)	0.01	0.01	0.00	97.34
Education (Primary)	0.28	0.29	-0.01	92.71
Education (Secondary)	0.05	0.05	0.01	79.45
Education (Tertiary)	0.00	0.00	0.00	100.00
Religion	0.12	0.09	0.02	32.90
Household Numbers	5.53	5.55	-0.02	89.93
Gender	0.68	0.68	0.00	97.58
Age	43.05	43.11	-0.06	96.83
Literacy (Partial)	0.02	0.02	-0.01	19.13
Literacy (Full)	0.06	0.05	0.01	70.59
Wealth	-36557.40	-44466.14	7908.75	74.56
Status - Married	0.67	0.70	-0.03	84.51
Status - Living Together	0.27	0.26	0.02	89.77
Status - Not Living Together	0.00	0.00	0.00	91.74
Residence	0.00	0.00	0.00	94.16
Working	0.80	0.79	0.01	64.29
Occupation (44)	0.17	0.17	0.00	92.71
Occupation (62)	0.64	0.62	0.02	74.16
Occupation (65)	0.01	0.01	0.00	100.00
Region - North Central	0.37	0.31	0.06	81.19
Region - North Western	0.23	0.20	0.02	62.98
Region - South Central	0.23	0.23	0.00	95.57
Region - South Eastern A	0.14	0.22	-0.08	56.32
Region - South Eastern B	0.02	0.03	-0.01	95.72

Table 21: Covariance Balance after Matching for Iron Ore Mining Concessions (2006-2012), 25 km

4.2.6 Covariance Balance after Matching: Non-Iron Ore Mining Concessions

Covariate	Means Treated	Means Control	Mean Diff	% Balance Improvement
Propensity Score	0.51	0.45	0.05	89.12
Elevation	195.70	190.70	5.00	80.01
Population Density	82.16	69.34	12.82	73.26
Dist. to Projects	63284.53	63293.79	-9.27	99.97
Dist. to Resources	22681.59	26600.66	-3919.07	89.53
Home Counties	1.78	1.82	-0.04	82.48
Urban/Rural (Rural)	0.98	0.98	-0.00	24.08
Urban/Rural (Urban)	0.02	0.02	0.00	24.08
Dist. to Roads	929.35	1072.16	-142.81	74.51
Slope	1.14	1.14	-0.00	97.17
Urban Travel Time	261.68	289.93	-28.25	79.72
Pre-Period Precipitation (Avg.)	117.46	118.70	-1.24	75.97
Pre-Period Temp. (Avg.)	24.01	24.06	-0.06	29.26
Pre-Period NTL (Avg.)	0.32	0.24	0.08	77.93
Pre-Period NTL (Trend)	0.02	0.01	0.01	79.67
Education (Primary)	0.28	0.27	0.01	90.01
Education (Secondary)	0.05	0.05	0.01	77.46
Education (Tertiary)	0.00	0.00	0.00	100.00
Religion	0.10	0.10	0.00	97.27
Household Numbers	5.62	5.54	0.08	59.88
Gender	0.68	0.68	0.00	97.68
Age	42.58	42.74	-0.17	91.57
Literacy (Partial)	0.02	0.02	0.00	86.70
Literacy (Full)	0.06	0.05	0.01	67.75
Wealth	-36171.93	-44961.51	8789.58	71.73
Status - Married	0.67	0.69	-0.02	92.50
Status - Living Together	0.27	0.27	0.00	97.56
Status - Not Living Together	0.00	0.00	0.00	63.77
Residence	0.00	0.00	0.00	61.56
Working	0.78	0.80	-0.01	62.19
Occupation (44)	0.18	0.17	0.01	90.55
Occupation (62)	0.62	0.64	-0.01	83.73
Occupation (65)	0.01	0.01	-0.00	64.81
Region - North Central	0.35	0.30	0.04	87.87
Region - North Western	0.21	0.20	0.01	85.50
Region - South Central	0.25	0.23	0.02	35.66
Region - South Eastern A	0.15	0.22	-0.06	63.82
Region - South Eastern B	0.02	0.04	-0.01	94.98

Table 22: Covariance Balance after Matching for Non-Iron Ore Mining Concessions (2006-2012), 25 km

4.2.7 Covariance Balance after Matching: US Concessions

Covariate	Means Treated	Means Control	Mean Diff	% Balance Improvement
Propensity Score	0.50	0.45	0.04	82.24
Elevation	183.09	173.44	9.64	43.97
Population Density	75.46	38.06	37.40	68.99
Dist. to Projects	81241.32	85007.80	-3766.48	66.62
Dist. to Resources	42952.64	47064.11	-4111.47	-11.73
Home Counties	1.60	1.38	0.22	61.96
Urban/Rural (Rural)	0.99	0.99	0.00	82.19
Urban/Rural (Urban)	0.01	0.01	-0.00	82.19
Dist. to Roads	1197.46	1274.85	-77.39	28.19
Slope	1.18	1.17	0.01	84.99
Urban Travel Time	337.63	362.27	-24.64	46.07
Pre-Period Precipitation (Avg.)	119.72	120.10	-0.38	89.49
Pre-Period Temp. (Avg.)	24.02	24.00	0.01	-1531.98
Pre-Period NTL (Avg.)	0.32	0.18	0.14	68.56
Pre-Period NTL (Trend)	0.02	0.01	0.01	74.57
Education (Primary)	0.29	0.28	0.01	89.76
Education (Secondary)	0.03	0.02	0.01	59.74
Education (Tertiary)	0.00	0.00	0.00	100.00
Religion	0.07	0.05	0.03	74.34
Household Numbers	5.61	5.62	-0.01	61.46
Gender	0.71	0.71	0.00	91.51
Age	42.77	42.89	-0.12	93.79
Literacy (Partial)	0.00	0.00	-0.00	97.44
Literacy (Full)	0.03	0.02	0.01	-32.68
Wealth	-51905.29	-55826.96	3921.67	3.71
Status - Married	0.79	0.80	-0.00	97.38
Status - Living Together	0.18	0.19	-0.01	93.72
Status - Not Living Together	0.00	0.00	0.00	100.00
Residence	0.00	0.00	0.00	100.00
Working	0.79	0.83	-0.03	-20.83
Occupation (44)	0.12	0.12	0.01	93.57
Occupation (62)	0.68	0.71	-0.03	75.88
Occupation (65)	0.00	0.00	0.00	100.00
Region - North Central	0.20	0.20	0.00	98.96
Region - North Western	0.15	0.15	-0.00	97.56
Region - South Central	0.20	0.17	0.03	58.71
Region - South Eastern A	0.24	0.25	-0.01	76.26
Region - South Eastern B	0.21	0.23	-0.02	-8.36

Table 23: Covariance Balance after Matching for US Concessions (2006-2012), 25 km

4.2.8 Covariance Balance after Matching: Chinese Concessions

Covariate	Means Treated	Means Control	Mean Diff	% Balance Improvement
Propensity Score	0.44	0.40	0.03	94.49
Elevation	96.93	96.94	-0.01	99.99
Population Density	139.23	120.61	18.62	91.79
Dist. to Projects	46898.89	49029.32	-2130.43	94.82
Dist. to Resources	15136.04	16060.72	-924.68	97.07
Home Counties	2.10	1.98	0.11	80.95
Urban/Rural (Rural)	0.98	0.98	-0.00	90.60
Urban/Rural (Urban)	0.02	0.02	0.00	90.60
Dist. to Roads	705.64	720.26	-14.61	97.73
Slope	1.06	1.06	0.01	-148.98
Urban Travel Time	120.07	123.13	-3.06	98.86
Pre-Period Precipitation (Avg.)	126.08	126.13	-0.05	99.53
Pre-Period Temp. (Avg.)	23.74	23.74	0.00	98.98
Pre-Period NTL (Avg.)	0.57	0.61	-0.04	96.56
Pre-Period NTL (Trend)	0.03	0.03	0.00	98.83
Education (Primary)	0.19	0.18	0.01	88.86
Education (Secondary)	0.02	0.02	-0.00	75.79
Education (Tertiary)	0.00	0.00	0.00	100.00
Religion	0.20	0.20	-0.01	84.93
Household Numbers	5.14	4.98	0.15	59.80
Gender	0.67	0.66	0.02	73.69
Age	41.67	42.81	-1.13	31.54
Literacy (Partial)	0.00	0.00	0.00	100.00
Literacy (Full)	0.02	0.02	-0.00	79.83
Wealth	-24530.44	-28021.94	3491.50	93.44
Status - Married	0.62	0.62	0.00	99.26
Status - Living Together	0.32	0.33	-0.00	97.51
Status - Not Living Together	0.00	0.00	0.00	100.00
Residence	0.01	0.00	0.01	71.61
Working	0.74	0.74	-0.00	97.86
Occupation (44)	0.32	0.25	0.07	64.07
Occupation (62)	0.43	0.51	-0.08	71.22
Occupation (65)	0.00	0.00	0.00	100.00
Region - North Central	0.12	0.10	0.01	93.34
Region - North Western	0.38	0.41	-0.03	90.02
Region - South Central	0.48	0.45	0.02	91.49
Region - South Eastern A	0.00	0.00	-0.00	98.67
Region - South Eastern B	0.00	0.01	-0.01	95.80

Table 24: Covariance Balance after Matching for Chinese Concessions (2006-2012), 25 km

4.2.9 Covariance Balance after Matching: US Mining Concessions

Covariate	Means Treated	Means Control	Mean Diff	% Balance Improvement
Propensity Score	0.46	0.42	0.04	84.82
Elevation	181.99	169.86	12.13	59.88
Population Density	53.20	39.65	13.55	90.59
Dist. to Projects	82170.74	87632.07	-5461.33	55.43
Dist. to Resources	43947.90	48987.15	-5039.26	40.32
Home Counties	1.64	1.43	0.21	65.98
Urban/Rural (Rural)	0.99	0.99	0.00	78.45
Urban/Rural (Urban)	0.01	0.01	-0.00	78.45
Dist. to Roads	1135.41	1189.70	-54.28	59.09
Slope	1.18	1.18	-0.01	73.82
Urban Travel Time	314.80	340.32	-25.52	62.27
Pre-Period Precipitation (Avg.)	119.92	120.75	-0.83	79.69
Pre-Period Temp. (Avg.)	23.99	23.96	0.03	53.10
Pre-Period NTL (Avg.)	0.30	0.20	0.11	80.87
Pre-Period NTL (Trend)	0.02	0.01	0.00	85.80
Education (Primary)	0.28	0.29	-0.01	61.47
Education (Secondary)	0.03	0.03	0.01	74.59
Education (Tertiary)	0.00	0.00	0.00	100.00
Religion	0.07	0.07	-0.00	98.11
Household Numbers	5.67	5.61	0.06	62.93
Gender	0.70	0.71	-0.01	50.79
Age	42.40	42.19	0.21	89.07
Literacy (Partial)	0.00	0.00	-0.00	94.09
Literacy (Full)	0.03	0.03	0.01	60.05
Wealth	-50126.90	-54714.13	4587.23	46.96
Status - Married	0.77	0.77	0.00	100.00
Status - Living Together	0.20	0.21	-0.00	87.61
Status - Not Living Together	0.00	0.00	0.00	100.00
Residence	0.00	0.00	0.00	100.00
Working	0.78	0.80	-0.02	50.96
Occupation (44)	0.13	0.12	0.01	89.10
Occupation (62)	0.68	0.71	-0.03	71.36
Occupation (65)	0.00	0.00	0.00	100.00
Region - North Central	0.19	0.17	0.02	90.03
Region - North Western	0.14	0.16	-0.02	-59.79
Region - South Central	0.23	0.18	0.05	59.68
Region - South Eastern A	0.22	0.24	-0.01	23.71
Region - South Eastern B	0.22	0.26	-0.04	-86.77

Table 25: Covariance Balance after Matching for US Mining Concessions (2006-2012), 25 km

4.2.10 Covariance Balance after Matching: Chinese Mining Concessions

Covariate	Means Treated	Means Control	Mean Diff	% Balance Improvement
Propensity Score	0.39	0.37	0.03	96.38
Elevation	93.05	98.26	-5.22	95.31
Population Density	177.02	155.49	21.53	91.55
Dist. to Projects	37737.21	39005.21	-1268.01	97.37
Dist. to Resources	15245.12	16790.10	-1544.98	94.96
Home Counties	1.85	1.81	0.04	93.15
Urban/Rural (Rural)	0.97	0.98	-0.01	86.16
Urban/Rural (Urban)	0.03	0.02	0.01	86.16
Dist. to Roads	790.83	826.70	-35.87	94.18
Slope	1.06	1.11	-0.05	-36.80
Urban Travel Time	114.13	128.90	-14.76	94.51
Pre-Period Precipitation (Avg.)	127.93	127.94	-0.01	99.88
Pre-Period Temp. (Avg.)	23.71	23.78	-0.07	78.54
Pre-Period NTL (Avg.)	0.81	0.74	0.07	95.24
Pre-Period NTL (Trend)	0.04	0.04	0.01	94.26
Education (Primary)	0.26	0.25	0.01	84.57
Education (Secondary)	0.02	0.02	-0.00	89.49
Education (Tertiary)	0.00	0.00	0.00	100.00
Religion	0.08	0.07	0.00	95.34
Household Numbers	5.05	5.18	-0.12	26.60
Gender	0.69	0.69	-0.00	93.04
Age	40.90	41.29	-0.40	62.51
Literacy (Partial)	0.00	0.00	-0.00	81.51
Literacy (Full)	0.02	0.02	-0.01	82.37
Wealth	-30004.76	-28548.52	-1456.25	97.47
Status - Married	0.63	0.65	-0.02	92.98
Status - Living Together	0.32	0.30	0.02	88.64
Status - Not Living Together	0.00	0.00	0.00	100.00
Residence	0.01	0.00	0.01	45.35
Working	0.68	0.67	0.01	94.95
Occupation (44)	0.24	0.21	0.03	81.86
Occupation (62)	0.45	0.48	-0.03	90.00
Occupation (65)	0.00	0.00	-0.00	-209.43
Region - North Central	0.06	0.07	-0.01	93.26
Region - North Western	0.32	0.30	0.03	88.88
Region - South Central	0.58	0.57	0.02	95.31
Region - South Eastern A	0.00	0.02	-0.02	89.69
Region - South Eastern B	0.00	0.01	-0.01	93.96

Table 26: Covariance Balance after Matching for Chinese Mining Concessions (2006-2012), 25 km

4.3 Improvement of variance across treatment and control groups

While Section 4.2 shows that matching minimizes the differences in *means*, it does not provide information on how matching minimizes the differences in *variances* across treatment and control groups. This section provides information in this regard.

While some studies report average improvements in variance ratios before and after matching, others caution against using any single distributional measurement to assess balance quality (Austin, 2009). Therefore, rather than providing a single measurement, we report the full distribution of propensity scores for our treated and control units before and after matching. Figure 2 presents propensity score histograms for our treatment and control units before and after matching. The Figure suggests that the distribution of propensity scores improves significantly after matching.

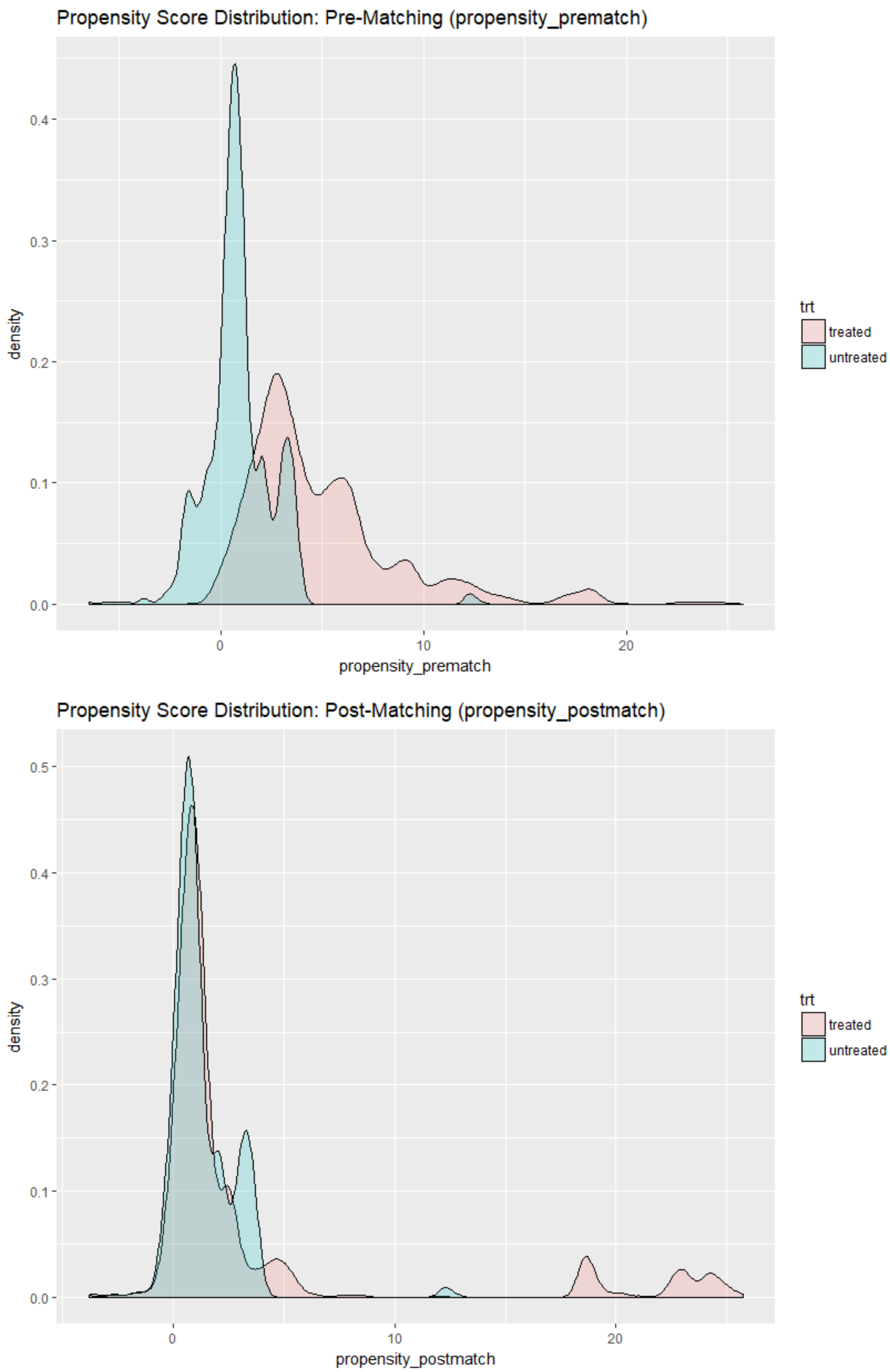


Figure 2: Propensity Score Distribution before and after matching. The Figure shows histograms (for both treatment and control units) of propensity scores pre-matching, and one that shows the same two histograms post-matching.

4.4 Parallel Trends Assumption 1: Group means over time

The key identifying assumption of our difference-in-differences estimation strategy is that, in the absence of treatment, nighttime light trends would have been parallel in treated and control locations (Angrist & Pischke, 2008). In our analysis, we attempt to address this issue by matching on pretreatment nighttime light trends (see Sections 4.1, 4.2, and 4.3 of the Online Appendix).

However, even after matching on pretreatment nighttime light trends, it is challenging to verify whether the parallel trends assumption has been violated. We cannot directly test this 'parallel trends' assumption since we are conducting observational rather than experimental research and it is not possible to observe nighttime light in our treated locations in the absence of treatment. However, we employ three indirect tests of the assumption, which we present in the following Sections 4.4, 4.5, and 4.6 of this Online Appendix.

The first approach examines average nighttime light in our treatment and control units prior to the treatment period. In the top panel of Figure 3, we report pretreatment levels of nighttime light in our treated and control units (including observations where nighttime light equals zero). In the bottom panel of Figure 3, we report the same summary statistics only after excluding all observations when nighttime light equals zero (since the prevalence of zeros in our dataset may arbitrarily introduce parallel developments). In both cases, it appears that nighttime light trends are roughly parallel. This pattern suggests that in the absence of treatment the nighttime light differences across our treated and control cases (matched locational pairs) would have been constant over time. Therefore, the evidence that is presented in Figure 3 does not suggest that the parallel time trend assumption has been violated.

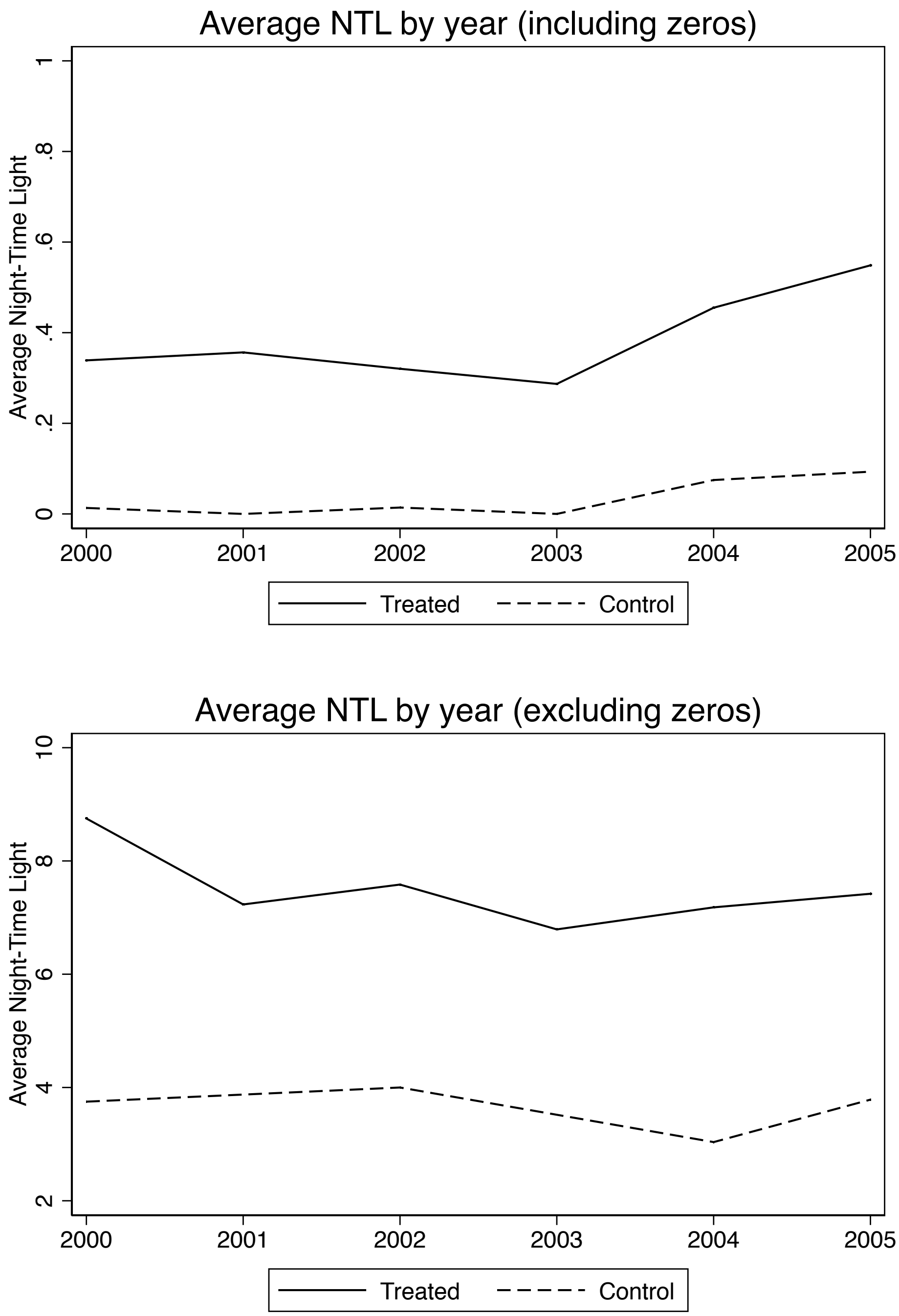
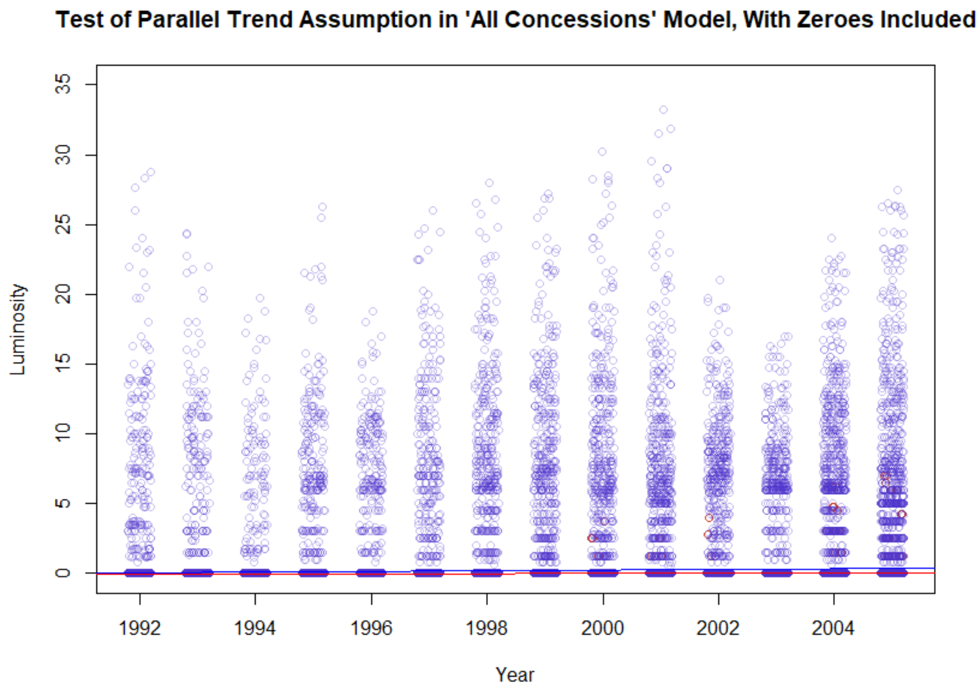


Figure 3: Mean of nighttime lights by year in our pre-treatment period. Top panel shows the trend in average NTL calculated including observations where NTL equals zero. Due to the prevalence of zeros in the data, this may arbitrarily introduce parallel developments. For this reason, the bottom panel plots the mean NTL for both treatment and control group while calculating the average without observations equal to zero. In both cases, the trends appear to be parallel.

4.5 Parallel Trends Assumption 2: Trend lines

Section 4.4 reports mean nighttime light value in our treated and control units prior to the treatment period. A more systematic way to examine whether pretreatment nighttime lights trends are parallel across the treatment and control units is to fit a time trend over the pre-treatment period separately for treatment and control groups. We follow BenYishay & Kranker (2015) and BenYishay et al. (2017) by regressing outcomes over treatment status X time in the pre-treatment sample.

Figure 4 presents the results from our 'all concessions' model, as well as the dispersion of observations in each year. The red line represents the control group and the blue line represents the treatment group. The top panel in Figure 4 includes all observations, including those with nighttime light values equal to zero. It shows that the trend lines between the treatment and control groups are roughly parallel over the entire pre-treatment period (1992-2005). This pattern suggests that the parallel trends assumption in this case has not been violated. The bottom panel in Figure 4 presents the results of the same model but excluding all nighttime light observations equal to zero (since the prevalence of zeros in our dataset may again arbitrarily introduce parallel developments). This results in a truncated sample since no non-zero observations are available for the control group prior to 2000. The trend lines are not entirely parallel: the control group (in red) is trending slightly upwards in the pre-treatment period, whereas the treatment group (in blue) is relatively flat. The fact that there is an upward trend in nighttime light in the control group prior to treatment suggests that, if anything, we would likely underestimate the size of our treatment effects by only considering areas that were lit in the first place.



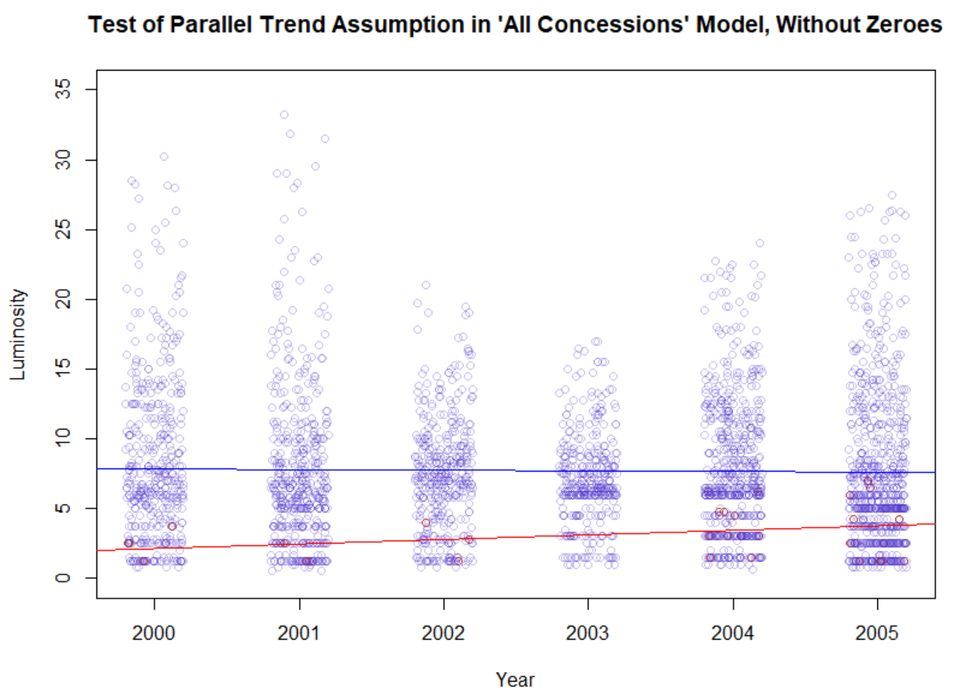


Figure 4: Time trend over the pre-period resulting from regressing outcomes over treatment status X time in the pre-treatment sample. The top panel includes observations equal to zero. Due to the prevalence of zeros in the data, this may arbitrarily introduce parallel developments. The bottom panel thus excludes observations equal to zero.

4.6 Parallel Trends Assumption 3: Statistical Analysis of Pre-Trends

In order to more systematically test whether the parallel trend assumption has been violated, we follow the same approach implemented in Beatty & Shimshack (2011) and Lima & Silveira Neto (2017): we replicate our difference-in-difference analysis during the pretreatment period (1992-2005) using the same treatment and control units from the treatment period. More specifically, in order replicate the matched difference-in-difference analysis during the pretreatment period (1992-2005), we use the treatment and control units from the model that seeks to identify the effect of being within 25 km any type of natural resources concession (see Table 22 in Section 4.1 of the Online Appendix). If nighttime light trends were parallel in treated and control locations during the pretreatment period, we would expect to observe no statistically significant effect of being located within 25km of a natural resource concession before the concession was actually granted to an investor.

Table 27 displays the empirical results. Re-estimating the treatment effect for the same treatment and control units, but for the pre-treatment period (i.e., prior to 2006), results in a statistically insignificant treatment effect. These results suggest that in the absence of treatment the nighttime light differences across our treated and control cases (matched locational pairs) would have been constant over time. As such, they do not provide any empirical grounds to believe that the parallel time trend assumption has been violated.

Table 27: All Concessions Pre-Treatment Period (1992-2005), 25 km.

Treatment	0.068
	(0.059)
Urban/Rural	0.0003
	(0.0003)
Elevation	0.0002
	(0.0002)
Pop. Density	0.00000
	(0.00000)
Aid Projects	-0.00000
	(0.00000)
Nat. Resource Location	-0.018
	(0.020)
Home Regions	0.00001
	(0.00001)
Dist. to Roads	-0.014
	(0.013)
Slope	-0.00001
	(0.0001)
Urban Travel Time	0.028
	(0.042)
Pre-Period Temperature	0.002**
	(0.001)
Pre-Period Precipitation	15.271***
	(2.605)
Pre-Period NTL (Trend)	-0.753**
	(0.335)
Pre-Period NTL (Avg)	0.019
	(0.014)
Household Numbers	-0.012
	(0.066)
Gender	-0.007**
	(0.003)
Age	0.039
	(0.042)
Edu. (Primary)	0.064
	(0.231)
Edu. (Secondary)	0.00000
	(0.00000)
Wealth	-0.253**
	(0.125)
Employment	0.172
	(0.128)
Religion	0.137
	(0.119)
Occupation (44)	0.055
	(0.073)
Occupation (62)	0.038
	(0.101)
DHS Region NC	-10.089***
	(3.216)

Continued on Next Page...

Table 27 – Continued

DHS Region NW	-10.277***
	(3.232)
DHS Region SC	-10.206***
	(3.222)
DHS Region SE - A	-10.129***
	(3.238)
DHS Region SE - B	-10.112***
	(3.238)
Constant	9.362***
	(3.432)
Note:	*p<0.1; **p<0.05; ***p<0.01

5 Robustness Tests

5.1 Robustness test 1: Propensity to 'light up'

Summary *One potential concern is that the propensity to "light up" in response to treatment by a concession might differ across grid cells. In this section, we present additional analyses to account for such variation. The findings indicate that our results are robust to incorporating potential differences in the propensity to light up.*

The models presented in the manuscript assume that any 1km × 1km grid cell will respond in the same manner if exposed to a concession. However, this might not be the case: the propensity to "light up" in response to treatment by a concession might differ across grid cells. We exploit spatial variation in the distance to transportation networks to account for these differences across locations. Specifically, we include an interaction of the treatment variable with the distance to existing roads. The results of this exercise show that our findings remain largely consistent after including this additional control variable.

We have thus far assumed that any 1km × 1km grid cell will respond in the same manner if exposed to a concession. However, this might not be the case: the propensity to "light up" in response to treatment by a concession might differ across grid cells. We now exploit spatial variation in the distance to transportation networks to account for these differences across locations. This choice is motivated by three considerations.

First, as we previously noted, the Liberian government requires concessionaires to build infrastructure. However, if an investor is going to build, say, an additional road, it is reasonable to assume that the investor may begin where existing road networks already exist. Second, investment projects require inputs (Aragón & Rud, 2013; Fafchamps, Koelle & Shilpi, 2016). These inputs range from intermediate goods to a pool of readily available labor. Both are more easily available if a firm or individual entrepreneur is located close to major transportation networks. Third, access to road networks and other transportation networks is a good proxy for market access (Chomitz & Gray, 1996; Arima, 2016). It quantifies the difficulty with which producers can reach consumers and thus a location's "market potential". For all of these reasons, one might expect that the propensity of a location to 'light up' when exposed to a new concession will be higher when a location is physically proximate to major transportation networks, and it will decline with increasing distance to transportation networks.

Therefore, by interacting a grid cell's treatment status with a measure of that grid cell's distance from the pre-treatment road network, our goal is to test the robustness of our findings related to the unconditional, direct effects of treatment. It is not to determine whether the growth impacts of concessions are larger in areas with better access to roads — where local markets can be reached at a lower cost. Our outcome variable (nighttime light intensity) strongly correlates with local economic development outcomes when the full range of possible economic development outcomes are measured (across the 0-63 scale of luminosity). However, in very poor, unlit areas (grid cells with values of 0 on the luminosity scale), it is more difficult to detect (modest) changes in local economic development outcomes with the outcome measure we have selected (Jean et al., 2016). Therefore, if very poor, totally unlit grid cells are also located in the grid cells with limited access to roads (markets), a negative and statistically significant interaction effect between treatment status (concession or no concession) and access to roads (markets) likely reflects the "underlying propensity of a given grid cell to light up" rather than a market access amplification of the treatment effect.[18]

We implement this robustness check by rerunning all of our statistical models with this interaction effect. One can think of this interaction effect as a powerful control

[18]We thank Ariel BenYishay for his insights on the distinction between detecting changes on the extensive margin (zero to low) and the intensive margin (low to high).

variable. That is to say, if the direct, unconditional effects of treatment (that we previously identified) still hold after we account for the underlying propensity of grid cells to light up, we can have greater confidence in these findings.

The results from these robustness tests are presented below. In short, our findings remain largely consistent. Mining concessions continue to exert a consistently positive effects on local growth, while agricultural concessions do not. The differential effects of Chinese and U.S. concessions also remain unchanged. In model specifications where the interaction term registers a statistically significant effect, it is always a negative, as expected. A negative interactive term implies that there is less nighttime light growth in treated areas located further away from roads (markets). We interpret these effects as evidence that our outcome measure is better able to detect treatment effects in areas with a higher propensity to light up (and vice-versa).

5.1.1 Robustness 1: All Concessions

Table 28: All Concessions (2006-2012), 25 km

	Whole	Early	Late
Treatment	0.04	0.115	−0.234
	(0.17)	(0.195)	(0.283)
Urban/Rural	2.566***	0.704	−0.877
	(0.729)	(0.557)	(1.067)
Elevation	−0.001	0.002	0.005
	(0.001)	(0.001)	(0.012)
Pop. Density	0.003***	0.006***	0.003
	(0.001)	(0.001)	(0.005)
Aid Projects	0.00001	−0.00000	−0.00003
	(0.000)	(0.000)	(0.00004)
Nat. Resource Location	−0.00001*	0.00001	0.00001
	(0.00001)	(0.00001)	(0.00004)
Home Regions	0.049	0.066	−0.546
	(0.12)	(0.148)	(1.25)
Dist. to Roads	0.000	−0.00005	0.0001
	(0.0001)	(0.0001)	(0.0002)
Slope	−0.049	−0.019	−0.668
	(0.038)	(0.066)	(0.966)
Urban Travel Time	−0.0001	−0.001	0.001
	(0.0003)	(0.001)	(0.001)
Pre-Period Precipitation	−0.002	−0.004	−0.021*
	(0.007)	(0.007)	(0.011)
Pre-Period Temperature	0.225	0.151	−1.056***
	(0.181)	(0.123)	(0.32)
Pre-Period NTL (Avg)	−0.472	−0.284*	−1.210***
	(0.382)	(0.158)	(0.104)
Pre-Period NTL (Trend)	4.794	3.011**	13.056***
	(3.355)	(1.528)	(4.082)
Household Numbers	−0.076	0.019	−0.067
	(0.066)	(0.033)	(0.064)
Gender	−1.379	1.000*	1.174
	(0.897)	(0.583)	(1.128)
Age	0.016	−0.015***	−0.063
	(0.013)	(0.005)	(0.058)
Edu. (Primary)	−0.050	0.358*	−0.137
	(0.14)	(0.202)	(0.669)
Edu. (Secondary)	0.896*	−0.877	−0.981*
	(0.538)	(0.54)	(0.519)
Wealth	−0.00000	0.00000**	0.000
	(0.000)	(0.000)	(0.000)
Employment (Yes)	−0.730	−0.291	0.655
	(0.499)	(0.19)	(0.649)
Religion	−0.126	0.329	4.171
	(0.363)	(0.31)	(5.786)
Occupation (44)	−0.121	0.320	−6.585
	(0.427)	(0.584)	(6.189)

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Table 28 – Continued

	Whole	Early	Late
Occupation (62)	0.012	0.566	−2.977
	(0.351)	(0.356)	(2.116)
DHS - North Central	1.549	13.289***	−4.931
	(3.039)	(3.789)	(17.357)
DHS - North Western	1.444	13.659***	−6.890
	(3.048)	(3.852)	(15.17)
DHS - South Central	2.939	13.903***	−4.657
	(2.676)	(3.788)	(16.913)
DHS - S. East A	1.997	13.939***	−2.753
	(2.997)	(3.891)	(17.801)
DHS - S. East B	1.944	14.002***	−3.403
	(2.968)	(4.039)	(18.252)
Treatment:Dist. to Roads	−0.00003	−0.00001	−0.0002
	(0.0001)	(0.0001)	(0.0002)
Constant	−5.611	−17.427***	39.956**
	(4.702)	(4.748)	(17.375)

5.1.2 Robustness 1: Agriculture, Forestry, and Mining Concessions

Table 29: Agriculture, Forestry, and Mining Concessions (2006-2012), 25 km

	Agriculture		Forestry			Mining		
	All	Late	All	Early	Late	All	Early	Late
Treatment	0.105	−0.558***	-0.092	0.045	-0.098	0.154**	0.000**	0.262***
	(0.278)	(0.149)	(0.107)	(0.031)	(0.064)	(0.064)	(0.000)	(0.089)
Urban/Rural	0.475	1.412	-0.001**	-0.001**	-0.0001	2.417***	−5.571***	0.681
	(1.195)	(0.989)	(0.0004)	(0.0003)	(0.0002)	(0.469)	(0.000)	(0.445)
Elevation	−0.010**	−0.003**	0.001**	0.002**	-0.0001	0.0003	0.0000	−0.0003
	(0.004)	(0.002)	(0.001)	(0.001)	(0.0002)	(0.001)	(0.000)	(0.001)
Pop. Density	0.002***	0.002	0.00000***	0.00000*	0.0000	0.002***	0.000*	0.001
	(0.001)	(0.002)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)
Aid Projects	0.0000	0.000	0.0000	-0.00001***	0.0000	−0.00000	−0.000	−0.00000
	(0.00001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Nat. Resource Location	0.00004**	0.00001	-0.058	-0.006	-0.033	0.0000	0.000	−0.00000
	(0.00002)	(0.00001)	(0.052)	(0.032)	(0.033)	(0.000)	(0.000)	(0.000)
Home Regions	0.127	0.141***	0.0000	0.00003**	-0.00002	0.213***	0.0000	0.025
	(0.094)	(0.054)	(0.00002)	(0.00001)	(0.00001)	(0.072)	(0.000)	(0.056)
Dist. to Roads	0.0003**	0.0001	0.014	0.001	0.004	−0.00000	0.0000	0.00005
	(0.0001)	(0.0001)	(0.018)	(0.013)	(0.006)	(0.00003)	(0.000)	(0.00004)
Slope	0.273**	0.215***	-0.0002	-0.0001	0.00003	−0.044	−0.000	−0.041
	(0.132)	(0.078)	(0.0002)	(0.0001)	(0.0001)	(0.041)	(0.000)	(0.038)
Urban Travel Time	−0.005	−0.002	0.981	1.591**	-0.478	−0.0002	−0.000	−0.0001
	(0.004)	(0.003)	(0.956)	(0.718)	(0.6)	(0.0001)	(0.000)	(0.0002)
Pre-Period Precipitation	−0.067**	−0.020	0.003	−0.0009	0.002	0.007	−0.000	0.012
	(0.031)	(0.024)	(0.003)	(0.002)	(0.003)	(0.005)	(0.000)	(0.008)
Pre-Period Temperature	1.039	0.344	−0.682	−0.02	−0.072	0.062	0.0000	−0.096
	(0.903)	(0.286)	(0.079)	(0.03)	(0.078)	(0.118)	(0.000)	(0.098)
Pre-Period NTL (Avg)	−0.125	−1.069***	-0.088	-0.304**	0.138***	−0.421***	−0.039***	−0.816***
	(0.236)	(0.155)	(0.122)	(0.151)	(0.044)	(0.067)	(0.003)	(0.014)
Pre-Period NTL (Trend)	1.523	16.811***	-0.025	-0.017	-0.007	8.022***	6.312**	6.923***
	(2.316)	(1.869)	(0.02)	(0.011)	(0.01)	(2.101)	(2.115)	(1.763)
Household Numbers	0.074	0.138**	-0.042	-0.013	-0.039	0.059	−0.000	0.003
	(0.064)	(0.07)	(0.096)	(0.057)	(0.053)	(0.06)	(0.000)	(0.038)
Gender	1.098	1.354***	-0.001	-0.001	0.001	0.694	0.0000	0.911*
	(0.73)	(0.459)	(0.005)	(0.003)	(0.002)	(0.57)	(0.000)	(0.529)
Age	−0.050**	−0.029**	0.301**	0.043	0.116	−0.003	−0.000	0.006
	(0.021)	(0.012)	(0.14)	(0.061)	(0.073)	(0.004)	(0.000)	(0.005)
Edu. (Primary)	0.954***	0.639***	1.234	-0.588*	0.408	0.009	0.0000	−0.0005
	(0.286)	(0.186)	(0.784)	(0.333)	(0.278)	(0.077)	(0.000)	(0.093)
Edu. (Secondary)	1.455**	1.043	0.00000*	0.00000***	0.0000	0.042	0.0000	−0.271
	(0.666)	(0.855)	(0.000)	(0.000)	(0.000)	(0.446)	(0.000)	(0.281)
Wealth	−0.00001***	−0.00001***	-0.114	-0.057	-0.041	0.0000	0.000**	0.0000
	(0.000)	(0.000)	(0.101)	(0.071)	(0.046)	(0.000)	(0.000)	(0.000)
Employment (Yes)	0.353	−0.105	-0.033	0.034	-0.032	−0.132	−0.000	−0.313*
	(0.427)	(0.224)	(0.113)	(0.082)	(0.058)	(0.161)	(0.000)	(0.183)
Religion	0.917*	0.545	-0.132	-0.224*	0.137	0.624*		1.021
	(0.528)	(0.519)	(0.202)	(0.123)	(0.092)	(0.374)		(0.731)
Occupation (44)	−1.778**	−1.025**	-0.156	-0.122	0.087	0.134	−0.000	0.154
	(0.809)	(0.453)	(0.155)	(0.088)	(0.068)	(0.16)	(0.000)	(0.159)
Occupation (62)	−2.068***	−1.354***	-0.089	-0.2	0.114	0.085	0.0000	−0.095
	(0.749)	(0.451)	(0.251)	(0.192)	(0.148)	(0.183)	(0.000)	(0.155)
Occupation (65)	1.202		2.461	-0.244	0.09	0.21		0.268
	(3.163)		(2.863)	(2.963)	(0.548)	(0.223)		(0.225)
DHS - North Central		−1.595	2.389	-0.178	0.002	6.569***	0.000*	−0.380
		(1.123)	(2.894)	(2.974)	(0.576)	(2.243)	(0.000)	(2.087)
DHS - North Western	0.735	−0.351	3.125	-0.078	0.332	6.024***	0.000**	−1.359
	(3.492)	(0.469)	(2.829)	(2.938)	(0.521)	(2.316)	(0.000)	(2.438)
DHS - South Central	1.712	−0.066	2.744	-0.045	0.133	6.437***	−0.000	−0.609
	(3.212)	(0.405)	(2.89)	(2.981)	(0.549)	(2.225)	(0.000)	(2.057)

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Table 29 – Continued

	Agriculture		Forestry			Mining		
	All	Late	All	Early	Late	All	Early	Late
DHS - S. East A		0.865	2.339	-0.199	0.017	6.360***	0.0000	−0.392
		(1.314)	(2.88)	(2.97)	(0.549)	(2.281)	(0.000)	(2.126)
DHS - S. East B	−1.616	−1.520*	-0.00002	-0.0001**	0.00003	6.429***	−0.000	−0.416
	(3.889)	(0.865)	(0.00003)	(0.00002)	(0.00002)	(2.221)	(0.000)	(2.021)
Treatment: Dist. to Roads	−0.001***	−0.0001	-2.073	0.879	-0.428	0.00001	−0.000	−0.0001
	(0.0002)	(0.0001)	(2.862)	(2.985)	(0.57)	(0.00004)	(0.000)	(0.00005)
Constant	−15.787	−5.066				−9.354**		0.712
	(18.041)	(5.635)				(3.793)		(3.41)

5.1.3 Robustness 1: Iron Ore and Non-Iron Ore Mining Concessions

Table 30: Iron Ore and Non-Iron Ore Concessions (2006-2012), 25 km

	Iron Ore		Non-Iron Ore Mining	
	All	Late	All	Late
Treatment	0.369**	0.199*	−0.013	0.075
	(0.159)	(0.126)	(0.07)	(0.08)
Urban/Rural	2.177***	1.023**	2.370***	1.104***
	(0.527)	(0.46)	(0.367)	(0.425)
Elevation	0.001	0.001*	0.001	0.0005
	(0.001)	(0.001)	(0.001)	(0.001)
Pop. Dens.	0.002**	0.001**	0.001***	0.001***
	(0.001)	(0.0004)	(0.0005)	(0.001)
Aid Proj.	0.0000	0.00000*	−0.00000	−0.00000
	(0.000)	(0.000)	(0.000)	(0.000)
Nat. Resource Location	0.0000	−0.00000	0.00000*	0.0000
	(0.000)	(0.000)	(0.000)	(0.000)
Home Regions	−0.056	0.012	0.173**	0.01
	(0.038)	(0.034)	(0.083)	(0.073)
Dist. to Roads	0.0001**	0.00003	0.00002	0.00005**
	(0.00003)	(0.00002)	(0.00002)	(0.00002)
Slope	−0.020	−0.059	−0.008	−0.019
	(0.046)	(0.039)	(0.019)	(0.02)
Urban Travel Time	−0.0004	−0.0004	−0.0001	−0.00001
	(0.0003)	(0.0003)	(0.0001)	(0.0001)
Pre-Precipitation	0.008	0.0003	−0.0003	0.004
	(0.005)	(0.004)	(0.005)	(0.005)
Pre-Temperature	−0.029	−0.056	−0.008	−0.198*
	(0.105)	(0.09)	(0.093)	(0.108)
Pre-NTL (Avg)	−0.340***	−0.774***	−0.394***	−0.895***
	(0.117)	(0.114)	(0.086)	(0.098)
Pre-NTL (Trend)	10.012***	12.737***	8.432***	13.200***
	(2.513)	(2.054)	(0.977)	(2.308)
Household Numbers	0.002	−0.0004	0.036	0.038
	(0.022)	(0.019)	(0.041)	(0.032)
Gender	0.048	0.246	0.487*	0.351
	(0.361)	(0.31)	(0.264)	(0.257)
Age	0.003	0.003	−0.00001	−0.001
	(0.004)	(0.004)	(0.003)	(0.003)
Edu. (Primary)	0.514**	0.412**	0.131	0.339
	(0.219)	(0.178)	(0.3)	(0.365)
Edu. (Secondary)	0.907***	1.051***	0.106*	0.072
	(0.234)	(0.26)	(0.059)	(0.059)
Wealth	0.0000	−0.00000	1.151**	0.773***
	(0.000)	(0.000)	(0.465)	(0.272)
Employment (Yes)	−0.313**	−0.324**	0.0000	−0.00000
	(0.153)	(0.164)	(0.000)	(0.000)
Religion	0.083	0.095	−0.058	−0.012
	(0.15)	(0.137)	(0.157)	(0.133)
Occupation (44)	0.431*	0.126	0.199	0.222
	(0.257)	(0.171)	(0.338)	(0.301)
Occupation (62)	−0.003	−0.009	0.184	0.23
	(0.13)	(0.127)	(0.333)	(0.325)
Occupation (65)	−0.411	−0.152	−1.529***	−0.191
	(0.616)	(0.443)	(0.347)	(0.748)
DHS - North Central	7.081**	1.921	0.426**	0.216
	(3.212)	(1.861)	(0.189)	(0.134)
DHS - North Western	7.129**	2.264	0.148	0.159
	(3.215)	(1.85)	(0.124)	(0.124)
DHS - South Central	7.728**	2.784	−3.316***	−0.464

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Table 30 – Continued

	Iron Ore		Non-Iron Ore Mining	
	All	Late	All	Late
	(3.187)	(1.809)	(0.767)	(0.685)
DHS - S. East A	7.329**	2.44	3.924***	2.027
	(3.241)	(1.872)	(1.501)	(1.612)
DHS - S. East B	6.900**	2.175	3.939**	1.749
	(3.221)	(1.848)	(1.597)	(1.837)
Treatment:Distance to Roads	−0.0001	−0.00001	0.00001	−0.00002
	(0.0001)	(0.0001)	(0.00004)	(0.00004)
Constant	−7.942*	−1.518	4.183***	2.264
	(4.119)	(2.776)	(1.412)	(1.576)

5.1.4 Robustness 1: US and Chinese Concessions

Table 31: US and Chinese Concessions (2006-2012), 25 km

	China		USA	
	All	Late	All	Late
Treatment	1.008***	0.685**	0.071	0.047
	(0.228)	(0.271)	(0.107)	(0.097)
Urban/Rural	−0.473	−6.663**	−0.0004	−0.001
	(2.898)	(3.103)	(0.001)	(0.0005)
Elevation	−0.003	−0.0002	0.001***	0.001***
	(0.002)	(0.003)	(0.0003)	(0.0004)
Pop. Density	0.002***	0.002***	0.00001***	0.00000**
	(0.001)	(0.001)	(0.000)	(0.000)
Aid Projects	0.000	0.00001	−0.00000	−0.00000
	(0.00001)	(0.00001)	(0.000)	(0.000)
Nat. Resource Location	0.00001	−0.00002*	−0.143***	−0.095***
	(0.00001)	(0.00001)	(0.038)	(0.035)
Home Regions	0.005	0.019	−0.00000	0.0000
	(0.08)	(0.06)	(0.00002)	(0.00002)
Dist. to Roads	−0.00004	−0.00003	−0.013	−0.005
	(0.0001)	(0.0001)	(0.021)	(0.017)
Slope	−0.004	−0.063	−0.0002	−0.0002
	(0.07)	(0.065)	(0.0002)	(0.0002)
Urban Travel Time	−0.005**	−0.003	0.002	0.002
	(0.002)	(0.002)	(0.003)	(0.003)
Pre-Period Precipitation	−0.031**	0.021	−0.061	−0.067
	(0.014)	(0.018)	(0.072)	(0.064)
Pre-Period Temperature	−0.198	−0.462*	−0.118	−0.667***
	(0.2)	(0.24)	(0.089)	(0.209)
Pre-Period NTL (Avg)	−0.580***	−0.865***	4.436***	11.727***
	(0.085)	(0.096)	(0.987)	(3.149)
Pre-Period NTL (Trend)	10.049***	13.600***	−0.021	−0.030*
	(1.946)	(1.792)	(0.019)	(0.018)
Household Numbers	−0.126*	−0.053	−0.272	−0.036
	(0.065)	(0.063)	(0.259)	(0.202)
Gender	−0.498	−0.556	0.004	0.003
	(0.687)	(0.704)	(0.003)	(0.003)
Age	0.014	0.017	0.264**	0.220**
	(0.01)	(0.011)	(0.121)	(0.106)
Religion	−0.292	0.244	0.651**	0.624***
	(0.317)	(0.454)	(0.303)	(0.24)
Edu. (Primary)	1.233***	1.139***	0.00000***	0.0000
	(0.342)	(0.396)	(0.000)	(0.000)
Edu. (Secondary)	−1.275	0.571	−0.327**	−0.284**
	(1.103)	(0.962)	(0.135)	(0.123)
Wealth	0.000	−0.00000	−0.061	−0.902**
	(0.000)	(0.000)	(0.286)	(0.353)
Employment (Yes)	0.504*	0.928**	0.266	−0.670*
	(0.299)	(0.467)	(0.308)	(0.389)
Marital Status	0.716*	0.966*	−0.218	−1.090***
	(0.375)	(0.504)	(0.479)	(0.373)
Occupation (44)	1.210***	1.715***	0.112	0.093
	(0.405)	(0.613)	(0.194)	(0.139)
Occupation (62)			0.082	0.044
Occupation (65)	−1.594***	−1.456***		
	(0.531)	(0.529)		
DHS - North Central	−0.601*	−0.971**	0.485	2.752***
	(0.351)	(0.451)	(0.857)	(0.716)
DHS - North Western	0.747	0.482	0.155	2.394***
	(1.26)	(0.515)	(0.813)	(0.722)
DHS - South Central	0.598	−2.707	0.99	3.055***

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Table 31 – Continued

	China		USA	
	All	Late	All	Late
	(1.296)	(1.906)	(0.809)	(0.662)
DHS - S. East A	1.757	−2.651	0.869	3.010***
	(1.291)	(1.955)	(0.884)	(0.708)
DHS - S. East B	2.991**	−1.859	0.273	2.629***
	(1.303)	(1.966)	(0.861)	(0.697)
Treatment:Distance to Roads	−0.0003**	−0.0001	−0.00003	−0.00002
	(0.0001)	(0.0001)	(0.00004)	(0.00003)
Constant	7.598*	9.447*	1.184	−0.207
	(4.456)	(5.211)	(1.935)	(1.694)

5.1.5 Robustness 1: US and Chinese Mining Concessions

Table 32: US and Chinese Mining Concessions (2006-2012), 25 km

	China		USA	
	All	Late	All	Late
Treatment	1.395***	0.645***	0.044	0.008
	(0.272)	(0.225)	(0.115)	(0.089)
Urban/Rural	6.737***	−6.752***	1.996***	0.972**
	(0.666)	(2.522)	(0.554)	(0.394)
Elevation	0.002	−0.001	−0.0003	−0.0003
	(0.002)	(0.002)	(0.001)	(0.0005)
Pop. Density	0.003***	0.003***	0.002***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Aid Projects	−0.00001	0.00001	0.00001***	0.00000**
	(0.00001)	(0.00001)	(0.000)	(0.000)
Nat. Resource Location	0.00004***	−0.00000	−0.00000	−0.00000
	(0.00001)	(0.00001)	(0.000)	(0.000)
Home Regions	0.129	0.096	−0.123***	−0.052
	(0.082)	(0.064)	(0.041)	(0.038)
Dist. to Roads	0.00003	−0.0001	0.00001	0.000
	(0.0001)	(0.0001)	(0.00002)	(0.00002)
Slope	−0.103*	−0.108	−0.014	−0.010
	(0.06)	(0.077)	(0.022)	(0.019)
Urban Travel Time	−0.003	−0.001	−0.0005**	−0.0002
	(0.002)	(0.001)	(0.0002)	(0.0001)
Pre-Period Precipitation	−0.024*	−0.009	0.003	0.001
	(0.013)	(0.014)	(0.004)	(0.003)
Pre-Period Temperature	−0.022	−0.126	0.015	−0.029
	(0.224)	(0.202)	(0.072)	(0.06)
Pre-Period NTL (Avg)	−0.562***	−0.844***	−0.179*	−0.902***
	(0.082)	(0.113)	(0.098)	(0.122)
Pre-Period NTL (Trend)	9.926***	12.394***	5.000***	14.991***
	(1.998)	(1.605)	(1.152)	(1.749)
Household Numbers	−0.099	−0.004	−0.029	−0.026
	(0.073)	(0.062)	(0.021)	(0.018)
Gender	−0.686	−0.549	0.058	−0.038
	(0.688)	(0.756)	(0.302)	(0.24)
Age	0.036***	0.041***	0.003	0.003
	(0.01)	(0.011)	(0.004)	(0.004)
Religion	−0.742*	−0.475	0.027	0.123
	(0.409)	(0.379)	(0.143)	(0.141)
Edu. (Primary)	1.151***	0.970***	0.326**	0.206**
	(0.306)	(0.264)	(0.143)	(0.103)
Edu. (Secondary)	−1.458	1.382*	0.666**	0.379
	(1.053)	(0.729)	(0.284)	(0.232)
Wealth	0.00000*	−0.00000	0.00000**	0
	(0.000)	(0.000)	(0.000)	(0.000)
Employment (Yes)	0.235	0.186	−0.310*	−0.217
	(0.363)	(0.453)	(0.174)	(0.148)
Marital Status	0.518	1.185*	−0.368	−0.563**
	(0.397)	(0.675)	(0.239)	(0.224)
Occupation (44)	1.214***	2.022***	0.021	−0.291
	(0.461)	(0.658)	(0.276)	(0.255)
Occupation (62)	−2.046***			
	(0.513)			
Occupation (65)	−0.260	−0.609	0.255	0.065
	(0.343)	(0.489)	(0.224)	(0.15)
DHS - North Central	10.102***	−0.344	0.122	0.141
	(2.661)	(0.42)	(0.174)	(0.149)
DHS - North Western	11.286***	0.492		
	(2.777)	(1.12)		

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Table 32 – Continued

	China		USA	
	All	Late	All	Late
DHS - South Central	11.839***	0.893		
	(2.592)	(1.043)		
DHS - S. East A	11.748***	1.41	−0.301*	−0.223
	(2.604)	(1.235)	(0.18)	(0.139)
DHS - S. East B	10.194***	1.579	0.594**	0.424**
	(2.878)	(1.061)	(0.259)	(0.191)
Treatment:Distance to Roads	−0.0004*	0.00002	−0.00003	−0.00002
	(0.0002)	(0.0001)	(0.00004)	(0.00003)
Constant	−9.192*	0.461	−0.360	0.99
	(5.065)	(4.02)	(1.824)	(1.412)

5.2 Robustness test 2: Rural versus urban areas

Summary *A further potential concern is that we ignore a small number of grid cells as we feat that they might be 'contaminated' due to concessions granted prior to our treatment period. As a robustness test, this section presents the results if the analyses include these previously omitted observations. The findings are robust to this change.*

The models reported in the manuscript identify the treatment effect of concessions granted between 2006 and 2012, but not for concessions granted prior to 2006. Admittedly, only very few such concessions exist, as the Ellen Johnson-Sirleaf administration entered office only in 2006. Yet, to avoid contaminating our analysis with these pre-2006 observations, we exclude them from our analysis as the observational penalty (i.e., number of grid cells ignored) is quite small.

However, most of these pre-2006 concessions were granted to urban areas, presumably because they were more easily administered by the transitional administration after a long civil war. Ignoring these concessions implies that the results we have presented so far essentially disproportionately capture concessions in rural areas. While most lands in Liberia are in rural areas, an additional robustness check involves including urban areas in the samples of matched location pairs that we analyze. The tables below report the findings of this exercise. In short, the results are not affected by these changes in sample composition.

5.2.1 Robustness 2: All Concessions

Table 33: All Concessions (2006-2012), 25 km

	Whole	Early	Late
Treatment	0.453***	0.02	0.349**
	(0.141)	(0.044)	(0.172)
Urban/Rural	0.837	1.053***	1.247
	(0.677)	(0.387)	(0.775)
Elevation	−0.006*	0.0004	−0.003
	(0.004)	(0.0003)	(0.002)
Pop. Density	0.003***	0.005***	0.006***
	(0.001)	(0.001)	(0.002)
Aid Projects	0.00003***	0.0000	0.00002***
	(0.00001)	(0.000)	(0.00001)
Nat. Resource Location	−0.00004**	−0.000	−0.00002*
	(0.00002)	(0.000)	(0.00001)
Home Regions	0.22	0.01	0.360*
	(0.379)	(0.027)	(0.187)
Dist. to Roads	−0.0001	0.0000	−0.00002
	(0.0001)	(0.00002)	(0.0001)
Slope	0.276**	−0.001	0.137
	(0.134)	(0.011)	(0.111)
Urban Travel Time	0.001	−0.0002	0.002***
	(0.001)	(0.0002)	(0.001)
Pre-Period Precipitation	0.006	0.003	−0.015
	(0.021)	(0.002)	(0.019)
Pre-Period Temperature	−0.280	0.078*	−0.027
	(0.396)	(0.042)	(0.327)
Pre-Period NTL (Avg)	−0.896	−0.550***	−0.594**
	(0.792)	(0.147)	(0.248)
Pre-Period NTL (Trend)	5.563	6.702***	−6.522
	(11.747)	(1.569)	(6.599)
Household Numbers	−0.103	−0.005	−0.065
	(0.153)	(0.008)	(0.082)
Gender	0.128	0.21	0.265
	(0.87)	(0.181)	(0.617)
Age	0.065	−0.004**	0.018
	(0.05)	(0.002)	(0.025)
Edu. (Primary)	0.357	0.058	0.1
	(0.323)	(0.07)	(0.309)
Edu. Level (Secondary)	−0.897	−0.241*	−1.327
	(1.449)	(0.134)	(0.886)
Wealth	0.0000	0.0000	0.0000
	(0.000)	(0.000)	(0.000)
Employment (Yes)	−2.023*	−0.083	−3.033***
	(1.135)	(0.066)	(0.653)
Religion	−0.868	−0.048	−0.886
	(0.617)	(0.071)	(0.573)
Occupation (44)	0.98	0.035	1.522*
	(1.326)	(0.179)	(0.912)

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Table 33 – Continued

	Whole	Early	Late
Occupation (62)	-0.034	0.054	1.014^{*}
	(0.809)	(0.097)	(0.579)
Occupation (65)	-0.165	-0.381	
	(2.188)	(0.427)	
DHS - North Central		12.703^{***}	
		(2.623)	
DHS - North Western	-1.352	12.719^{***}	-0.530
	(1.451)	(2.623)	(0.918)
DHS - South Central	0.024	12.697^{***}	1.056
	(1.418)	(2.63)	(0.85)
DHS - S. East A	2.341^{*}	12.793^{***}	1.518^{**}
	(1.4)	(2.658)	(0.619)
DHS - S. East B	1.322	12.781^{***}	1.364^{**}
	(0.998)	(2.652)	(0.576)
Constant	3.783	-15.060^{***}	0.759
	(9.36)	(2.975)	(7.04)

5.2.2 Robustness 2: Agriculture, Forestry, and Mining Concessions

Table 34: Agriculture, Forestry, and Mining Concessions (2006-2012), 25 km

	Agriculture			Forestry			Mining		
	All	Early	Late	All	Early	Late	All	Early	Late
Treatment	−0.244	0.242	−0.327*	-0.116	0.032**	-0.148*	0.199***	−0.004	0.172***
	(0.166)	(0.172)	(0.172)	(0.093)	(0.015)	(0.084)	(0.061)	(0.032)	(0.056)
Urban/Rural	2.024***	2.485***	0.829*	-0.0004	-0.0001	-0.0003	2.029***	0.594*	0.823**
	(0.72)	(0.887)	(0.451)	(0.0004)	(0.0001)	(0.0003)	(0.407)	(0.355)	(0.359)
Elevation	0.001	0.006	−0.0001	0.002**	-0.001	0.001	0.0001	0.0002	−0.0003
	(0.002)	(0.006)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.0002)	(0.001)
Pop. Density	0.004***	0.002	0.001*	0.000*	0.0000	0.0000	0.002***	0.001***	0.002
	(0.002)	(0.002)	(0.001)	(0.000)	(0.000)	(0.000)	(0.0005)	(0.0003)	(0.001)
Aid Projects	−0.000	−0.000	−0.000	0.0000	0.0000	0.0000	−0.000	−0.000	0.0000
	(0.000)	(0.00001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Nat. Resource Location	−0.000	0.00002	0.0000	-0.031	0.02	0.014	−0.000	0.0000	−0.000
	(0.00001)	(0.00001)	(0.00001)	(0.04)	(0.023)	(0.033)	(0.000)	(0.000)	(0.000)
Home Regions	0.092**	0.015	0.05	-0.00002	0.0000	0.0000	0.229**	−0.059	−0.048
	(0.044)	(0.023)	(0.04)	(0.00002)	(0.00001)	(0.00001)	(0.089)	(0.039)	(0.059)
Dist. to Roads	−0.00003	0.0001	−0.00001	-0.005	0.003	-0.003	0.00001	−0.000	0.0000
	(0.0001)	(0.0001)	(0.00005)	(0.018)	(0.004)	(0.015)	(0.00002)	(0.00001)	(0.00002)
Slope	−0.030	−0.096	−0.041	-0.0001	-0.00004	-0.0002	−0.042	0.006	−0.042
	(0.054)	(0.168)	(0.056)	(0.0002)	(0.0001)	(0.0002)	(0.037)	(0.006)	(0.037)
Urban Travel Time	−0.001	−0.002	−0.001	0.822	-0.018	0.283	−0.0002*	−0.00002	−0.0002
	(0.001)	(0.002)	(0.001)	(0.899)	(0.192)	(0.687)	(0.0001)	(0.0001)	(0.0001)
Pre-Period Precipitation	−0.016	0.038	−0.009	0.003	0.012	0.08	0.002	0.007***	0.006
	(0.015)	(0.033)	(0.013)	(0.003)	(0.001)	(0.002)	(0.006)	(0.003)	(0.005)
Pre-Period Temperature	−0.542**	−0.064	−0.155	−0.026	0.027	0.025	0.016	−0.004	−0.125
	(0.252)	(0.444)	(0.22)	(0.08)	(0.033)	(0.05)	(0.151)	(0.036)	(0.14)
Pre-Period NTL (Avg)	−0.129	−0.285	−1.145***	-0.014	-0.228	-0.326***	−0.440***	−0.259*	−0.794***
	(0.133)	(0.432)	(0.106)	(0.115)	(0.334)	(0.077)	(0.067)	(0.136)	(0.16)
Pre-Period NTL (Trend)	3.827**	5.431	18.299***	-0.026	0.002	-0.013	9.468***	4.366**	12.184***
	(1.566)	(4.18)	(1.757)	(0.019)	(0.002)	(0.016)	(1.921)	(2.209)	(3.022)
Household Numbers	−0.006	0.175**	−0.012	-0.039	0.032	0.039	0.035	0.002	0.001
	(0.058)	(0.083)	(0.058)	(0.109)	(0.03)	(0.099)	(0.061)	(0.012)	(0.038)
Gender	1.019**	0.216	0.388	-0.002	0.001	-0.002	1.034*	0.152	0.66
	(0.457)	(0.593)	(0.464)	(0.005)	(0.001)	(0.004)	(0.54)	(0.101)	(0.506)
Age	0.002	−0.002	0.0001	0.266*	0.082	0.241	0.001	−0.001	0.006
	(0.012)	(0.009)	(0.013)	(0.152)	(0.075)	(0.147)	(0.004)	(0.002)	(0.004)
Edu. (Primary)	0.869**	0.262	0.824**	-0.267		1.117*	0.009	0.069*	0.059
	(0.382)	(0.271)	(0.396)	(0.543)		(0.644)	(0.077)	(0.038)	(0.074)
Edu. Level (Secondary)	−0.480		0.384	0.000**	0.000**	0.0000	0.125	−0.262	−0.277
	(0.793)		(0.827)	(0.000)	(0.000)	(0.000)	(0.412)	(0.18)	(0.367)
Wealth	−0.000	0.0000	−0.000	-0.171	-0.039	-0.213**	0.0000	0.0000	
	(0.000)	(0.000)	(0.000)	(0.119)	(0.025)	(0.108)	(0.000)	(0.000)	
Employment (Yes)	−0.011	2.102	0.071	-0.028	-0.044	0.095	−0.217	−0.088	0.0000
	(0.232)	(1.768)	(0.233)	(0.127)	(0.064)	(0.105)	(0.144)	(0.062)	(0.000)
Religion	0.269	1.231	0.026	-0.108	0.032	-0.205	0.286	−0.007	−0.345**
	(0.26)	(0.976)	(0.214)	(0.187)	(0.055)	(0.163)	(0.254)	(0.109)	(0.16)
Occupation (44)	−0.441	−1.675	−0.389	0.068	-0.005	-0.039	0.261	0.382**	0.113
	(0.465)	(1.431)	(0.375)	(0.143)	(0.023)	(0.139)	(0.168)	(0.173)	(0.251)
Occupation (62)	0.046	−1.483	−0.188	0.108		-0.142	0.077	0.074	0.162
	(0.312)	(1.492)	(0.267)	(0.232)		(0.298)	(0.172)	(0.066)	(0.148)
Occupation (65)	0.271	1.674	−2.071***	3.199	-0.001		0.414*	0.038	−0.005
	(0.444)	(1.669)	(0.768)	(3.575)	(0.041)		(0.222)	(0.089)	(0.153)
DHS - North Central		0.129		3.178	0.012	2.722*	4.858***	−0.921	0.307*
		(0.797)		(3.609)	(0.034)	(1.62)	(1.626)	(1.375)	(0.157)
DHS - North Western	−0.226	−1.127	−0.330	3.74	-0.001	2.568	4.569***	−1.111	2.963
	(0.337)	(1.211)	(0.384)	(3.538)	(0.028)	(1.678)	(1.654)	(1.371)	(4.358)
DHS - South Central	0.38		0.054	3.56	0.241	3.106*	4.979***	−0.816	2.573
	(0.401)		(0.361)	(3.601)	(0.178)	(1.588)	(1.594)	(1.386)	(4.443)
DHS - S. East A	0.483	−5.620	−0.222	3.177		2.930*	4.983***	−0.974	3.202

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Table 34 – Continued									
	Agriculture			Forestry			Mining		
	All	Early	Late	All	Early	Late	All	Early	Late
	(0.751)	(10.223)	(0.465)	(3.594)		(1.641)	(1.681)	(1.387)	(4.384)
DHS - S. East B	−0.005		−0.761		0.053	2.749*	4.934***	−1.046	3.459
	(0.655)		(0.596)		(0.107)	(1.635)	(1.612)	(1.37)	(4.476)
Constant	14.047**		5.363	-2.971		-2.454	−6.545	0.207	−1.311
	(6.603)		(6.331)	(3.616)		(1.697)	(4.288)	(1.53)	(5.462)

5.2.3 Robustness 2: Iron Ore and Non-Iron Ore Mining Concessions

Table 35: Iron Ore and Non-Iron Ore Concessions (2006-2012), 25 km

	Iron Ore			Non-Iron Ore Mining		
	All	Early	Late	All	Early	Late
Treatment	0.226**	0.176*	0.123	0.08	0.06	0.044
	(0.102)	(0.093)	(0.082)	(0.055)	(0.096)	(0.044)
Urban/Rural	2.146***	2.312***	0.986**	1.925***	0.586	1.164***
	(0.518)	(0.538)	(0.493)	(0.414)	(0.547)	(0.407)
Elevation	0.0005	0.00004	0.001	0.001	−0.001	−0.0003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Pop. Density	0.002**	0.002*	0.001**	0.002***	0.002***	0.002***
	(0.001)	(0.001)	(0.001)	(0.0004)	(0.0005)	(0.0005)
Aid Projects	0.000**	0.0000	0.0000	−0.000	0.0000	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Nat. Resource Location	−0.000	0.0000	−0.000	0.0000	−0.00001*	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Home Regions	−0.012	−0.016	0.026	−0.061	0.056	−0.121*
	(0.033)	(0.036)	(0.028)	(0.076)	(0.046)	(0.064)
Dist. to Roads	0.0001***	0.00004**	0.00003*	0.00001	−0.000	0.00003*
	(0.00002)	(0.00002)	(0.00002)	(0.00002)	(0.00002)	(0.00002)
Slope	−0.019	−0.013	−0.041	−0.007	0.032	0.003
	(0.038)	(0.045)	(0.033)	(0.019)	(0.02)	(0.016)
Urban Travel Time	−0.001**	−0.0005*	−0.0004*	−0.0001	−0.0002	0.00001
	(0.0003)	(0.0002)	(0.0002)	(0.0001)	(0.0002)	(0.0001)
Pre-Period Precipitation	0.006	0.007	0.0005	0.008**	0.001	0.009**
	(0.005)	(0.004)	(0.003)	(0.004)	(0.006)	(0.005)
Pre-Period Temperature	−0.007	0.032	−0.039	−0.041	0.072	−0.135
	(0.099)	(0.104)	(0.08)	(0.093)	(0.09)	(0.09)
Pre-Period NTL (Avg)	−0.304***	−0.283***	−0.776***	−0.395***	−0.463*	−0.884***
	(0.089)	(0.097)	(0.104)	(0.081)	(0.262)	(0.108)
Pre-Period NTL (Trend)	7.634***	8.715***	13.173***	7.808***	4.426	13.143***
	(1.524)	(1.713)	(1.91)	(1.385)	(3.779)	(2.651)
Household Numbers	−0.014	−0.008	−0.011	0.046	0.024	0.033
	(0.024)	(0.022)	(0.018)	(0.041)	(0.027)	(0.027)
Gender	0.261	0.476*	0.281	0.4	0.079	0.118
	(0.332)	(0.281)	(0.258)	(0.281)	(0.267)	(0.181)
Age	−0.0001	−0.004	−0.001	−0.001	−0.001	0.0004
	(0.005)	(0.005)	(0.004)	(0.003)	(0.004)	(0.002)
Edu. (Primary)	0.497**	0.479**	0.371**	0.303	−0.264	0.417
	(0.225)	(0.213)	(0.178)	(0.26)	(0.224)	(0.303)
Edu. Level (Secondary)	0.775***	0.984***	1.072***	0.061	0.026	0.04
	(0.238)	(0.233)	(0.274)	(0.056)	(0.089)	(0.047)
Wealth	0.0000	0.0000	−0.000	0.565	−0.488*	0.870***
	(0.000)	(0.000)	(0.000)	(0.375)	(0.25)	(0.292)
Employment (Yes)	−0.267**	−0.255*	−0.228*	0.0000	0.0000	−0.000
	(0.128)	(0.139)	(0.132)	(0.000)	(0.000)	(0.000)
Religion	0.047	0.068	0.083	−0.167	−0.209	−0.055
	(0.142)	(0.142)	(0.129)	(0.143)	(0.162)	(0.116)
Occupation (44)	0.513*	0.394	0.136	−0.198	0.052	0.47
	(0.264)	(0.244)	(0.143)	(0.403)	(0.146)	(0.378)
Occupation (62)	0.072	−0.031	0.048	−0.167	0.124	0.412
	(0.117)	(0.115)	(0.091)	(0.407)	(0.12)	(0.381)
Occupation (65)	−0.203	−0.723	−0.110	−0.149	−0.358	1.089**
	(0.614)	(0.725)	(0.452)	(0.485)	(0.244)	(0.481)
DHS - North Central	5.227*	6.134**	3.133	0.25	0.302	0.194
	(2.785)	(3.013)	(2.377)	(0.158)	(0.281)	(0.139)
DHS - North Western	5.230*	5.954**	3.292	0.093	0.057	0.13
	(2.78)	(2.989)	(2.38)	(0.126)	(0.11)	(0.118)
DHS - South Central	5.720**	6.359**	3.71	−0.382	−0.168	0.143
	(2.771)	(2.98)	(2.352)	(0.461)	(0.202)	(0.224)
DHS - S. East A	5.578**	6.153**	3.579	3.739***	−0.806	4.254***

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Table 35 – Continued

	Iron Ore			Non-Iron Ore Mining		
	All	Early	Late	All	Early	Late
	(2.823)	(3.03)	(2.399)	(1.242)	(2.009)	(1.642)
DHS - S. East B	5.311*	6.040**	3.44	3.208**	−0.773	3.576**
	(2.794)	(2.997)	(2.377)	(1.275)	(2.031)	(1.7)
Constant	−6.219*	−7.816*	−2.792	3.919***	−0.467	4.102**
	(3.778)	(4.011)	(2.893)	(1.18)	(1.956)	(1.645)

5.2.4 Robustness 2: US and Chinese Concessions

Table 36: US and Chinese Concessions (2006-2012), 25 km

	China		USA	
	All	Late	All	Late
Treatment	0.561***	0.412**	0.027	0.043
	(0.2)	(0.187)	(0.063)	(0.049)
Urban/Rural	2.876	1.904*	−0.001	−0.001*
	(2.171)	(1.043)	(0.0005)	(0.0004)
Elevation	−0.003	−0.001	0.001***	0.001**
	(0.002)	(0.002)	(0.0003)	(0.0003)
Pop. Density	0.003***	0.002***	0.000***	0.000**
	(0.001)	(0.0004)	(0.000)	(0.000)
Aid Projects	0.00001*	0.00001	−0.000	−0.000
	(0.00001)	(0.00001)	(0.000)	(0.000)
Nat. Resource Location	−0.000	−0.00001	−0.156***	−0.068**
	(0.00001)	(0.00001)	(0.041)	(0.028)
Home Regions	−0.017	0.028	−0.00001	0.0000
	(0.081)	(0.072)	(0.00002)	(0.00001)
Dist. to Roads	−0.0001	−0.00005	0.005	0.012
	(0.0001)	(0.0001)	(0.016)	(0.014)
Slope	0.025	−0.006	−0.0003*	−0.0002**
	(0.063)	(0.047)	(0.0001)	(0.0001)
Urban Travel Time	−0.004**	−0.003	0.002	0.001
	(0.002)	(0.002)	(0.003)	(0.003)
Pre-Period Precipitation	−0.009	0.013	−0.037	−0.055
	(0.014)	(0.012)	(0.065)	(0.057)
Pre-Period Temperature	−0.146	−0.343*	−0.104	−0.656***
	(0.147)	(0.19)	(0.089)	(0.17)
Pre-Period NTL (Avg)	−0.423***	−0.885***	4.148***	11.930***
	(0.093)	(0.119)	(1.039)	(2.506)
Pre-Period NTL (Trend)	8.367***	13.985***	−0.030*	−0.023
	(1.842)	(1.967)	(0.018)	(0.015)
Household Numbers	−0.077	−0.046	−0.358	−0.127
	(0.072)	(0.056)	(0.251)	(0.167)
Gender	−0.218	0.18	0.002	0.003
	(0.686)	(0.74)	(0.003)	(0.003)
Age	0.012	0.013	0.232**	0.195**
	(0.013)	(0.012)	(0.107)	(0.087)
Religion	−0.221	−0.168	0.385	0.771***
	(0.32)	(0.367)	(0.316)	(0.239)
Edu. (Primary)	0.767**	0.757*	0.000***	0.000*
	(0.351)	(0.388)	(0.000)	(0.000)
Edu. Level (Secondary)	0.198	1.267	−0.314**	−0.265***
	(0.934)	(0.778)	(0.141)	(0.086)
Wealth	0.0000	−0.000	−0.524*	−0.328
	(0.000)	(0.000)	(0.309)	(0.225)
Employment (Yes)	0.009	0.556	−0.333	−0.216
	(0.308)	(0.409)	(0.323)	(0.248)
Marital Status	0.126	0.507	−0.597	−0.585**
	(0.313)	(0.338)	(0.422)	(0.236)
Occupation (44)	0.539	1.000**	0.255	0.06
	(0.351)	(0.469)	(0.192)	(0.09)
Occupation (62)			0.126	0.09
			(0.122)	(0.078)
Occupation (65)	−0.482	−0.743	0.204	0.114
	(0.473)	(0.457)	(0.155)	(0.085)
DHS - North Central	−0.180	−0.544	1.142	0.612
	(0.351)	(0.378)	(0.746)	(0.917)
DHS - North Western	−2.347	−1.997	0.72	0.306
	(2.285)	(1.489)	(0.727)	(0.923)

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Table 36 – Continued

	China		USA	
	All	Late	All	Late
DHS - South Central	10.393**	4.264**	1.547**	0.873
	(4.391)	(1.656)	(0.738)	(0.884)
DHS - S. East A	9.837**	4.198**	1.408*	0.835
	(4.412)	(1.638)	(0.751)	(0.909)
DHS - S. East B	10.846**	4.831***	0.832	0.462
	(4.29)	(1.58)	(0.724)	(0.908)
Constant	−5.456	0.918	0.686	1.284
	(5.818)	(4.476)	(1.891)	(1.645)

5.2.5 Robustness 2: US and Chinese Mining Concessions

Table 37: US and Chinese Mining Concessions (2006-2012), 25 km

	China		USA	
	All	Late	All	Late
Treatment	0.792***	0.456**	−0.011	−0.009
	(0.21)	(0.196)	(0.052)	(0.05)
Urban/Rural	0.097	0.293	2.022***	0.952***
	(1.146)	(0.993)	(0.415)	(0.312)
Elevation	0.0002	−0.002	−0.0004	−0.001
	(0.003)	(0.002)	(0.0004)	(0.0004)
Pop. Density	0.002***	0.003***	0.004***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Aid Projects	0.0000	0.00001	0.000***	0.000**
	(0.00001)	(0.00001)	(0.000)	(0.000)
Nat. Resource Location	−0.00001	−0.00001	−0.000*	−0.000*
	(0.00001)	(0.00001)	(0.000)	(0.000)
Home Regions	0.046	0.144**	−0.093***	−0.062**
	(0.103)	(0.07)	(0.029)	(0.026)
Dist. to Roads	−0.0002*	−0.00002	0.0000	0.00001
	(0.0001)	(0.0001)	(0.00001)	(0.00001)
Slope	−0.015	−0.012	−0.007	−0.005
	(0.063)	(0.065)	(0.012)	(0.012)
Urban Travel Time	−0.005	−0.001	−0.0002**	−0.0003**
	(0.003)	(0.001)	(0.0001)	(0.0001)
Pre-Period Precipitation	−0.011	0.01	0.002	0.002
	(0.017)	(0.018)	(0.003)	(0.002)
Pre-Period Temperature	−0.226	−0.362	0.011	−0.034
	(0.263)	(0.278)	(0.047)	(0.05)
Pre-Period NTL (Avg)	−0.508***	−0.823***	−0.303***	−0.834***
	(0.101)	(0.127)	(0.08)	(0.108)
Pre-Period NTL (Trend)	7.899***	13.056***	5.904***	13.361***
	(2.12)	(2.288)	(1.061)	(1.781)
Household Numbers	−0.168**	−0.019	−0.021	−0.030*
	(0.073)	(0.062)	(0.02)	(0.017)
Gender	−0.093	−0.364	−0.102	−0.110
	(0.719)	(0.72)	(0.202)	(0.214)
Age	0.038***	0.038***	0.002	0.004
	(0.012)	(0.011)	(0.003)	(0.004)
Religion	−0.269	−0.564	0.015	0.047
	(0.463)	(0.41)	(0.104)	(0.112)
Edu. (Primary)	1.483***	1.096***	0.221***	0.177**
	(0.451)	(0.373)	(0.086)	(0.074)
Edu. Level (Secondary)	0.999	1.798**	0.739**	0.947***
	(1.593)	(0.847)	(0.354)	(0.271)
Wealth	0.000*	−0.000	0.000**	0.0000
	(0.000)	(0.000)	(0.000)	(0.000)
Employment (Yes)	−0.796*	0.194	−0.235**	−0.207**
	(0.463)	(0.566)	(0.099)	(0.099)
Marital Status	0.056	0.599	−0.197	0.078
	(0.353)	(0.561)	(0.259)	(0.254)
Occupation (44)	0.366	1.368**	−0.022	0.186
	(0.427)	(0.62)	(0.259)	(0.264)
Occupation (62)	0.006	−1.310*		
	(0.553)	(0.713)		
Occupation (65)	0.366	−0.233	0.174	0.059
	(0.464)	(0.534)	(0.141)	(0.095)
DHS - North Central	0.166	−0.077	0.138	0.112
	(1.381)	(0.481)	(0.095)	(0.094)
DHS - North Western	3.735	−0.776	0.126	0.139
	(3.229)	(1.24)	(0.132)	(0.133)

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Table 37 – Continued

	China		USA	
	All	Late	All	Late
DHS - South Central	3.506	7.664***	11.385***	8.465***
	(3.204)	(2.573)	(3.236)	(2.182)
DHS - S. East A	4.338	7.928***	11.130***	8.226***
	(3.056)	(2.618)	(3.242)	(2.222)
DHS - S. East B	6.856**	8.474***	11.724***	8.760***
	(3.061)	(2.316)	(3.237)	(2.173)
Constant	2.894	−3.298	−11.605***	−7.872***
	(6.155)	(6.339)	(3.542)	(2.507)

5.3 Robustness test 3: Reduced caliper

Summary *This section presents the findings of an analysis using a stricter criteria for determining whether two locations qualify as a matched pair. The findings are robust to this change in the matching criteria.*

This logit model is then used to derive the propensity that the units will 'receive the treatment' of exposure to the concession. The propensity score is, in turn, used in a nearest-neighbor matching routine. To conduct this matching process, we use a caliper of 0.25. The caliper determines the degree of similarity two locations must have to be counted as a matched pair. A 0.25 caliper is best practice in studies using propensity score matching for causal inference (Lunt, 2013; Rosenbaum & Rubin, 2012).

However, as a robustness test, we re-estimate all models using a caliper of 0.1. This stricter criteria for identifying matched pairs results in a reduced sample size. However, our results do not change substantively; see the Online Appendix for accompanying results. Utilizing a different caliper essentially amounts to creating a different dataset; implementing the matching algorithm and subsequent analysis is therefore quite time intensive. For this reason, we implement the new caliper for the iron ore mining concessions, as these — according to the Liberian government's expectation — should be the most important for stimulating local agglomeration processes. The results show that a stricter caliper of 0.1 does not adversely affect our results.

Table 38: Iron Ore Concessions (2006-2012)

	Caliper = 0.25	Caliper = 0.1
Treatment	0.253**	0.278***
	(0.104)	(0.103)
Urban/Rural	2.247***	2.644***
	(0.513)	(0.539)
Elevation	0.001	0.002*
	(0.001)	(0.001)
Pop. Density	0.003***	0.002***
	(0.001)	(0.0005)
Aid Projects	0.000	−0.000
	(0.000)	(0.000)
Nat. Resource Location	0.000	0.00001*
	(0.000)	(0.000)
Home Regions	−0.050	−0.025
	(0.038)	(0.057)
Dist. to Roads	0.00004*	0.00004*
	(0.00002)	(0.00003)
Slope	−0.021	-0.042
	(0.045)	(0.050)
Urban Travel Time	−0.0005*	−0.001**
	(0.0003)	(0.0003)
Pre-Period Precipitation	0.006	0.0005
	(0.004)	(0.006)
Pre-Period Temperature	−0.064	−1.007
	(0.097)	(1.491)
Pre-Period NTL (Avg)	−0.339***	−0.155
	(0.108)	(0.120)
Pre-Period NTL (Trend)	9.676***	5.759**
	(2.248)	(2.278)
Household Numbers	0.004	0.008
	(0.022)	(0.028)
Gender	0.183	−0.301*
	(0.354)	(0.157)
Age	0.002	0.001
	(0.004)	(0.005)
Edu. (Primary)	0.523**	0.675***
	(0.213)	(0.250)
Edu. Level (Secondary)	0.857***	1.206***
	(0.244)	(0.307)
Wealth	0.000	0.000
	(0.00000(	(0.00000)
Employment (Yes)	−0.313**	−0.286*
	(0.144)	(0.158)
Religion	0.068	−0.036
	(0.145)	(0.162)
Occupation (44)	0.467*	0.524**
	(0.26)	(0.224)
Occupation (62)	−0.012	0.097
	(0.132)	(0.163)

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Table 38 – Continued		
	Caliper = 0.25	Caliper = 0.1
Occupation (65)	−0.436	(.)
	(0.64	
DHS - North Central	9.158***	6.215***
	(2.625)	(1.714)
DHS - North Western	9.307***	6.452***
	(2.611)	(1.745)
DHS - South Central	9.842***	6.953***
	(2.601)	(1.664)
DHS - S. East A	9.415***	6.316***
	(2.653)	(1.692)
DHS - S. East B	9.223***	6.108***
	(2.613)	(1.665)
Constant	−9.071**	−4.899**
	(3.689)	(2.138)

5.4 Robustness test 4: Different thresholds

Summary *We define locations within 25km of a concession as treated, while those beyond 25km are untreated. This section presents additional estimates utilizing different thresholds. These robustness tests are generally consistent with the results presented in the paper.*

We define locations within 25km of a concession as treated, while those beyond 25km are untreated. On a theoretical level, our choice is guided by the expected range across which economic effects of FDI projects might diffuse. We use workers' commuting distance as a proxy. While no information is available for Liberia, data from neighboring Ivory Coast suggest that 25km is a reasonable estimate Kung et al. (2014, p. 6). Empirically, we face constraints that limit the use of certain thresholds. For instance, the larger a radius used to define which locations are treated, the lower the number of available locations suitable as controls. Without a reasonable number of untreated locations available for matching, we cannot conduct the statistical analysis. In a country of Liberia's size, we cannot calculate estimates for most models if we use a radius of 30km and above. Similarly, the smaller the radius used to define which locations are treated, the lower the number of treated observations. In this case, plenty control locations are available for matching, but the lack of treated locations implies that there may not be a sufficient number of matched pairs for the statistical analysis. Taken together, we face both an upper and a lower limit with respect to possible radii. We have chosen 25km because it is the only distance at which we can calculate effects across all our models (across sectors, nationalities, etc.).

As a robustness test, however, we estimate all models for which we have sufficient data. These results, which are reported in the Online Appendix, are largely consistent with the results based on a 25 km-based measure of exposure to treatment. Some differences are to be expected considering the number of estimations performed: Following the frequentist interpretation of confidence intervals, we expect 95%, or 95 of 100, analyses to contain the actual unknown value of the coefficient. In our case, we report 23 models in the manuscript and estimate an additional 92 extensions with different thresholds. Of these 115 models, only 6 models (equivalent to 5% of all models) are significantly different (that is, statistically significant and opposite sign) from the estimates reported in the manuscript.

Note, for reasons of space, the tables below omit all control variables and focus on the treatment effect only. In addition, note that we were unable to estimate some models due to the upper/lower limits on thresholds noted above. For this reason, the tables show all models that our data allowed to be estimated; models that the data did not allow to estimate are noted with 'n/a.'

Table 39: All Concessions (Full Period, 2006-2012)

	5km	10km	15km	20km	25km	30km
Treatment	−0.003	0.034	−0.005	0.142**	0.035	n/a
	0.063)	(0.070)	(0.088)	(0.066)	(0.124)	(n/a)

Table 40: All Concessions (Early Period, 2005-2009)

	5km	10km	15km	20km	25km	30km
Treatment	−0.056	0.028	0.059	0.059	0.120	0.240**
	(0.207)	(0.143)	(0.132)	(0.201)	(0.140)	(0.117)

Table 41: All Concessions (Late Period, 2009-2013)

	5km	10km	15km	20km	25km	30km
Treatment	0.038	0.092	0.105	0.113**	0.350***	n/a
	(0.052)	(0.059)	(0.080)	(0.051)	(0.105)	(n/a)

Table 42: Agriculture Concessions (Full Period, 2006-2012)

	5km	10km	15km	20km	25km	30km
Treatment	n/a	−0.026	−0.002	0.118	−0.346*	0.368**
	(n/a)	(0.205)	(0.212)	(0.184)	(0.188)	(0.150)

Table 43: Agriculture Concessions (Early Period, 2005-2009)

	5km	10km	15km	20km	25km	30km
Treatment	n/a	n/a	n/a	n/a	n/a	n/a
	(n/a)	(n/a)	(n/a)	(n/a)	(n/a)	(n/a)

Table 44: Agriculture Concessions (Late Period, 2009-2013)

	5km	10km	15km	20km	25km	30km
Treatment	n/a	−0.106	−0.116	−0.161	−0.595***	−0.039
	(n/a)	(0.210)	(0.217)	(0.193)	(0.146)	(0.113)

Table 45: Forestry Concessions (Full Period, 2006-2012)

	5km	10km	15km	20km	25km	30km
Treatment	0.005	0.016	-0.016	0.086	-0.103	-0.094
	(0.031)	(0.011)	(0.018)	(0.064)	(0.086)	(0.083)

Table 46: Forestry Concessions (Early Period, 2005-209)

	5km	10km	15km	20km	25km	30km
Treatment	n/a	n/a	n/a	0.054	0.050	n/a
	(n/a)	(n/a)	(n/a)	(0.035)	(0.035)	(n/a)

Table 47: Forestry Concessions (Late Period, 2009-2013)

	5km	10km	15km	20km	25km	30km
Treatment	0.007	0.001	-0.017	-0.0001	-0.079	0.009
	(0.006)	(0.006)	(0.012)	(0.029)	(0.056)	(0.030)

Table 48: Mining Concessions (Full Period, 2006-2012)

	5km	10km	15km	20km	25km	30km
Treatment	−0.077	−0.049	−0.120	0.096	0.174***	n/a
	(0.100)	(0.100)	(0.106)	(0.063)	(0.052)	(n/a)

Table 49: Mining Concessions (Early Period, 2005-2009)

	5km	10km	15km	20km	25km	30km
Treatment	n/a	n/a	−0.464	0.000	0.000*	−0.042
	(n/a)	(n/a)	(0.623)	(0.000)	(0.000)	(0.116)

Table 50: Mining Concessions (Late Period, 2009-2013)

	5km	10km	15km	20km	25km	30km
Treatment	0.019	0.076	0.045	0.095	0.131**	0.247**
	(0.083)	(0.084)	(0.088)	(0.063)	(0.056)	(0.113)

Table 51: Iron Ore Concessions (Full Period, 2006-2012)

	5km	10km	15km	20km	25km	30km
Treatment	−0.184	−0.048	−0.021	0.288***	0.253**	0.185*
	(0.121)	(0.091)	(0.068)	(0.110)	(0.104)	(0.100)

Table 52: Iron Ore Concessions (Early Period, 2005-2009)

	5km	10km	15km	20km	25km	30km
Treatment	n/a	n/a	n/a	n/a	n/a	n/a
	(n/a)	(n/a)	(n/a)	(n/a)	(n/a)	(n/a)

Table 53: Iron Ore Concessions (Late Period, 2009-2013)

	5km	10km	15km	20km	25km	30km
Treatment	−0.094	0.005	0.015	0.171*	0.165*	0.155*
	(0.097)	(0.071)	(0.066)	(0.094)	(0.089)	(0.089)

Table 54: Mining Non-Iron Ore Concessions (Full Period, 2006-2012)

	5km	10km	15km	20km	25km	30km
Treatment	−0.043	−0.026	−0.095	−0.051	0.005	0.177*
	(0.102)	(0.098)	(0.095)	(0.105)	(0.050)	(0.096)

Table 55: Non-Iron Ore Concessions (Early Period, 2005-2009)

	5km	10km	15km	20km	25km	30km
Treatment	n/a	n/a	n/a	n/a	n/a	n/a
	(n/a)	(n/a)	(n/a)	(n/a)	(n/a)	(n/a)

Table 56: Mining Non-Iron Ore Concessions (Late Period, 2009-2013)

	5km	10km	15km	20km	25km	30km
Treatment	0.080	0.100	0.073	0.044	0.047	0.146**
	(0.084)	(0.077)	(0.074)	(0.094)	(0.052)	(0.074)

Table 57: USA Concessions (Full Period, 2006-2012)

	5km	10km	15km	20km	25km	30km
Treatment	0.089	0.019	0.037	−0.007	0.017	0.118
	(0.099)	(0.106)	(0.091)	(0.080)	(0.072)	(0.080)

Table 58: USA Concessions (Early Period, 2005-2009)

	5km	10km	15km	20km	25km	30km
Treatment	n/a	n/a	n/a	n/a	n/a	n/a
	(n/a)	(n/a)	(n/a)	(n/a)	(n/a)	(n/a)

Table 59: USA Concessions (Late Period, 2009-2013)

	5km	10km	15km	20km	25km	30km
Treatment	0.167*	0.121	0.159*	0.112	0.045	0.121
	(0.091)	(0.097)	(0.083)	(0.072)	(0.060)	(0.075)

Table 60: Chinese Concessions (Full Period, 2006-2012)

	5km	10km	15km	20km	25km	30km
Treatment	n/a	n/a	n/a	0.987***	0.829***	0.815***
	(n/a)	(n/a)	(n/a)	(0.195)	(0.200)	(0.174)

Table 61: Chinese Concessions (Early Period, 2005-2009)

	5km	10km	15km	20km	25km	30km
Treatment	n/a	n/a	n/a	n/a	n/a	n/a
	(n/a)	(n/a)	(n/a)	(n/a)	(n/a)	(n/a)

Table 62: Chinese Concessions (Late Period, 2009-2013)

	5km	10km	15km	20km	25km	30km
Treatment	n/a	n/a	n/a	0.742***	0.614***	0.699***
	(n/a)	(n/a)	(n/a)	(0.187)	(0.199)	(0.183)

Table 63: USA Mining Concessions (Full period, 2006-2012)

	5km	10km	15km	20km	25km	30km
Treatment	0.103	−0.028	0.031	−0.027	−0.006	0.063
	(0.103)	(0.120)	(0.102)	(0.095)	(0.078)	(0.071)

Table 64: USA Mining Concessions (Early Period, 2005-2009)

	5km	10km	15km	20km	25km	30km
Treatment	n/a	n/a	n/a	n/a	n/a	n/a
	(n/a)	(n/a)	(n/a)	(n/a)	(n/a)	(n/a)

Table 65: USA Mining Concessions (Late Period, 2009-2013)

	5km	10km	15km	20km	25km	30km
Treatment	0.183	0.185*	0.202**	0.103	−0.006	0.048
	(0.112)	(0.107)	(0.095)	(0.082)	(0.061)	(0.063)

Table 66: Chinese Mining Concessions (Full period, 2006-2012)

	5km	10km	15km	20km	25km	30km
Treatment	n/a	n/a	n/a	1.222***	1.032***	0.769***
	(n/a)	(n/a)	(n/a)	(0.188)	(0.194)	(0.173)

Table 67: Chinese Mining Concessions (Early Period, 2005-2009)

	5km	10km	15km	20km	25km	30km
Treatment	n/a	n/a	n/a	n/a	n/a	n/a
	(n/a)	(n/a)	(n/a)	(n/a)	(n/a)	(n/a)

Table 68: Chinese Mining Concessions (Late Period, 2009-2013)

	5km	10km	15km	20km	25km	30km
Treatment	n/a	n/a	n/a	0.876***	0.599***	0.550***
	(n/a)	(n/a)	(n/a)	(0.261)	(0.154)	(0.180)

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