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THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA  
POLICY STUDIES INSTITUTE

STRATEGY SUPPORT PROGRAM | WORKING PAPER 155

DECEMBER 2020

# Variation in Women’s Attitudes Toward Intimate Partner Violence Across the Rural-Urban Continuum in Ethiopia

Mulubrhan Amare, Channing Arndt, Zhe Guo, and Greg Seymour

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## ABSTRACT

Little is known about the impacts of urbanization on women's attitudes toward intimate partner violence (IPV). The scarcity of empirical studies on this relationship can be partly attributed to the lack of an objective measure of urbanization levels. In this study, we investigate the effects of urbanization on both women's attitudes toward IPV using three continuous measures of urbanization: nightlight intensity, distance to urban areas, and total urban area within a 10-km radius. These measures are defined from satellite-based nighttime-light-intensity and multispectral-sensor data. We find that despite a generally strong positive association between urbanization and progressive attitudes among women toward IPV, some stages of urbanization show a more significant association than others. Such nonlinear relationships are apparent in all estimations and across different measurements of urbanization. The heterogeneities in the effect of urbanization on women's attitudes toward intimate partner violence further show that the effects of urbanization are sharply heterogeneous across wealth indicator terciles. While we find that urbanization is associated with an overall decrease in the acceptance of IPV, the effect is mostly concentrated in higher wealth terciles. For women in lower wealth terciles, urbanization is either insignificant or even associated with an increase in the acceptance of IPV.

**Keywords:** Women's attitudes toward intimate partner violence, urbanization, Ethiopia

# 1. INTRODUCTION

Urbanization is a fundamental phenomenon of multidimensional (social, economic, cultural, political, etc.) transformation that rural communities experience as they evolve into modernized societies (Cobbinah et al. 2015; Gerten et al. 2019). Urbanization is now increasing rapidly in developing countries at rates at which economic growth may not necessarily be keeping pace with the dynamics of urbanization (Winton 2004; Patel and Burkle 2012; Jedwab and Vollrath, 2015; Gollin et al. 2016). In three decades, urban dwellers in Africa are projected to outnumber rural residents for the first time. The rapid transformation from rural to urban settlement patterns is a natural part of development. However, imbalance in the growth and development of one or more features of evolving urban areas may lead to uncertainty among citizens and fear of socioeconomic inequity, which could result in a range of “urban problems”. These include a potential increase in violence against women and girls, including physical or sexual intimate partner violence (IPV).

IPV is an all-inclusive challenge that is not unique to any culture, ethnicity, region, or country. Attitudes toward IPV provide indicators of personal beliefs about the tolerability of IPV and the perceived norms associated with it. Women are more likely to experience IPV if they live in areas characterized by high levels of poverty, gender inequality, and normalization or acceptance of IPV (Jewkes 2002; Koenig et al. 2006; Jewkes et al. 2015; Gibbs et al. 2020). Attitudes toward IPV have been shown to positively correlate with the actual experience of IPV, particularly when women and their partners report concordant beliefs about the acceptability of IPV (Abramsky et al. 2011; Uthman et al. 2009; Jewkes et al. 2015).

Multiple channels exist through which urbanization can lead to either a decrease or increase in IPV. Urban environments tend to provide a wider range of economic and social opportunities relative to rural areas (Duranton 2008). By reducing barriers to education, employment, and participation in civil society organizations, urbanization can lead to improvements in gender equality and women’s empowerment and to a decrease in IPV (Tacoli 2012; World Bank 2013; Da Mata et al. 2007). However, urbanization that is not accompanied by sufficient structural and political transformation may not lead to reductions in IPV. Negative outcomes associated with urbanization, including increased risk of gender-based violence, are particularly a concern in African countries, where 62 percent of urban residents live in slums (World Bank 2013). Given this mix of potential positive and negative externalities to urbanization, it is important to identify the overarching effects of urbanization on women’s attitudes toward IPV in order to better regulate and monitor those outcomes in developing countries.

Attempts to understand urbanization’s impacts on women’s attitudes toward IPV are hindered by a lack of satisfactory objective measures of urban areas. Despite the importance and critical role of urban areas for economic growth and poverty reduction, there is still considerable uncertainty regarding their spatial boundaries. Spatially explicit data showing changes in urban boundaries and development intensity are hard to obtain, especially for shorter periods and finer spatial resolutions. Urbanization is typically defined using coarse binary urban-rural measures based on data obtained from censuses and household surveys. Binary measures cannot capture heterogeneities among urban areas (Champion and Hugo 2004; Dahly and Adair 2007; Combes et al. 2008; Abay and Amare 2018; Amare et al. 2020; Ameye and De Weerd 2020). In contrast, earth observation satellites capture multispectral data to measure land cover and land use changes using globally consistent and repeatable observations (Romero et al. 2016). Satellite-based observations provide objective and consistent measures that substantially improve upon binary definitions of urbanization, enabling researchers to better gauge and monitor urban change across time and space (Elvidge et al. 1997; Imhoff et al. 1997; Sutton 1997; Henderson et al. 2003; Small et al. 2005; Sutton et al. 2010; Amare et al. 2020).

Our study provides several contributions to the expanding literatures on measuring urbanization using satellite data and on assessing the impacts of urbanization on women's attitudes toward IPV. First, this paper advances previous research by improving the quality of the urbanization measures used. We develop a series of urbanization indicators using data from two types of remote-sensing satellites, namely multispectral sensors and nightlight (NL) sensors. These allow us to discern urban areas of different sizes and to quantify access to urbanization. In many developing countries, levels of urbanization are relatively low and not all cities and towns are fully covered by electricity. Hence, population concentrations that should be designated as urban but are without electricity may emit relatively little light. These zones cannot be identified as urban by NLs alone. Hence, the use of multispectral sensors to develop a robust measure of urbanization may be valuable. Second, since the strength of the relationships between urbanization and women's attitudes toward IPV could vary across stages of urbanization, we control for possible nonlinear effects by including in our analysis higher-order polynomials of the urbanization measures employed. Third, as the impacts of urbanization on women's attitudes toward IPV can be complex, highly varied, and context specific, we further uncover potential heterogeneous effects of urbanization across wealth indicators.

We find that, despite a generally strong positive association between urbanization and progressive attitudes among women toward IPV, every stage of urbanization is not equally important. Nonlinear relationships are apparent in all estimations and across different measures of urbanization. The heterogeneities in the effects of urbanization on women's attitudes toward IPV further show that the effects of urbanization are sharply heterogeneous across wealth indicator terciles. Attitudes toward IPV among women in the lower initial wealth index tercile are either negatively affected (i.e., leading to increased acceptance of IPV) or their attitudes toward IPV are unaffected by urbanization.

The remainder of the paper is organized as follows. Section 2 describes the data, the construction of our outcome variables and urbanization measures, and descriptive results. Section 3 presents our empirical strategy. In Section 4, we present our empirical results and discussion, while Section 5 provides concluding remarks.

## 2. DATA AND VARIABLE CONSTRUCTION

### 2.1. Data sources

Our analysis of the effect of urbanization on women's attitudes toward IPV is primarily based on data from the 2000, 2005, and 2011 rounds of the Ethiopia Demographic and Health Survey (EDHS).<sup>1</sup> The EDHS is representative for the nation, specific urban and rural areas, and for 11 administrative regions.<sup>2</sup> The 2000 and 2005 EDHS rounds are based on a sampling frame provided by the 1994 census, whereas the 2011 EDHS is based on the 2007 census. The unit of analysis for this study is women between the ages of 15 and 49 years. The EDHS survey rounds in 2000, 2005, and 2011 respectively include 15,367, 14,070, and 16,515 women in this age range.

The EDHS is not a panel wherein the same households are followed in each survey. Rather, the surveys are repeated cross-sections, and, thus, attempts at quantifying the overall effects of urbanization may suffer from endogeneity problems arising from omitted attributes and

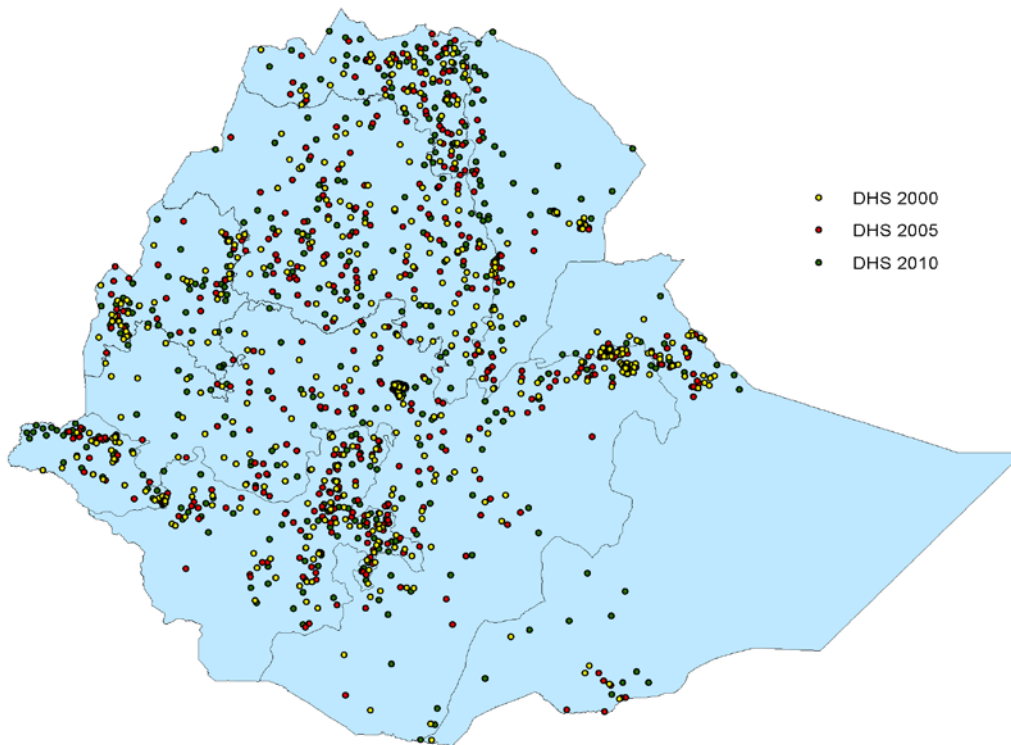
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<sup>1</sup> The most recent 2016 EDHS is not used in analysis due to comparability issues with the 2016 satellite data.

<sup>2</sup> The regions for which the surveys are representative are Tigray; Afar; Amhara; Oromiya; Somali; Benishangul-Gumuz; Southern Nations, Nationalities, and People's (SNNP); Gambella; Harari; Addis Ababa; and Dire Dawa. The regions of Somali and Afar may not be totally representative for several reasons, since areas of these regions were excluded from the 1994 census frame due to their primarily nomadic populations. This exclusion impacts both the 2000 and 2005 EDHS. Areas of Somali were excluded from the 2007 census frame due to security concerns. Additional areas of Somali were not interviewed for the 2011 EDHS due to drought and security issues.

measurement challenges. To minimize the effects of endogeneity and examine changes in urbanization and its impacts on women's attitudes toward IPV, we construct a pseudo-cluster panel based on the GIS coordinates of enumeration areas (EA) in each of the three surveys. Using the Stata routine *geonear*, we assign 2005 and 2011 EAs to the nearest 2000 EA. By this method, we find 441 (out of 535) EAs from the 2000 survey that correspond to 297 (out of 528) and 291 (out of 571) EAs from the 2005 and 2011 surveys, respectively. We retain the matched EAs for our analysis. There is no systematic difference between retained and dropped EAs. The final dataset includes 11,555, 7,091, and 7,468 women in the 2000, 2005, and 2011 surveys, respectively.

**Figure 1: Spatial distribution of Ethiopia Demographic and Health Survey clusters in 2000, 2005, and 2011**



Sources: Analysis of EDHS 2011, EDHS 2005, EDHS 2000.

Figure 1 maps the EDHS EAs in 2000, 2005, and 2011. EA locations are displaced using a random-direction and random-distance process in order to protect the confidentiality of survey respondents. The process adjusts latitude and longitude such that urban locations are displaced up to two kilometers and rural locations are displaced up to five kilometers, with an additional one percent of rural locations displaced up to ten kilometers.

## 2.2. Measuring urbanization

**Remote-sensing data for measuring urbanization:** We measure urbanization using data from two types of remote-sensing satellite sensors, namely nightlight (NL) sensors and multispectral sensors. Since both NL and multispectral data have advantages and disadvantages when monitoring urban changes, we merge urban areas identified using both sources to have a more complete footprint of urbanization over time.

In the first approach, urban areas are delineated based on NL intensity, which is defined by nighttime light emissions detected by the Defense Meteorological Satellite Program Operational Line Scan System (DMSP/OLS). This unique measurement of light intensity on the Earth's surface provides 22 years of data from 1992 to 2013 and offers a method for measuring long-term spatiotemporal aspects of the growth and evolution of human settlements and development. NL

data are useful in delineating urban areas because they directly capture light intensity emitted by urban areas. Nighttime light intensity is also useful as a proxy for economic activity in a region. However, NL data are not without limitations.<sup>3</sup> Of particular relevance to Ethiopia, where urbanization rates are relatively low and not all cities and towns have full access to electricity, is that urban areas without electricity supplies do not emit light and thus cannot be identified by NL sensors.

Another approach to defining urbanization is to use data from satellites with multispectral sensors. This approach is particularly useful in the context of Ethiopia, which has a high prevalence of small towns invisible in the NL data. Multispectral satellites delineate urban areas using sunlight. Urban or residential areas are characterized by higher concrete coverage and lower vegetation densities compared to natural land, which results in unique signature responses from sunlight that can be captured through satellite-based remote sensing. Though multispectral sensors have been widely applied in classifying land cover types based on remote sensing data, using them to identify urban areas still presents a few challenges. From a spectral perspective, bare land or low-fertility land with no or low vegetation coverage could be misclassified as urban pixels in satellite imagery. Furthermore, the classification process is computationally expensive and developing the models of land use and land cover requires high-quality training datasets.

We use NL data from the NOAA National Geophysical Data Center that eliminates noise from the presence of nonurban light sources or other ephemeral light sources, such as lightning and fires. We calibrate the annual nightlight data such that pixel values across generations of the satellites are comparable in different years. The inter-calibration process uses a polynomial regression approach involving four steps.<sup>4</sup> The calibration is applied to all pixels in the 2000, 2005, and 2011 EDHS data. After the inter-calibration, the NL values are more comparable across space and time. The calibrated NL data are then further developed to classify urban and rural pixels.

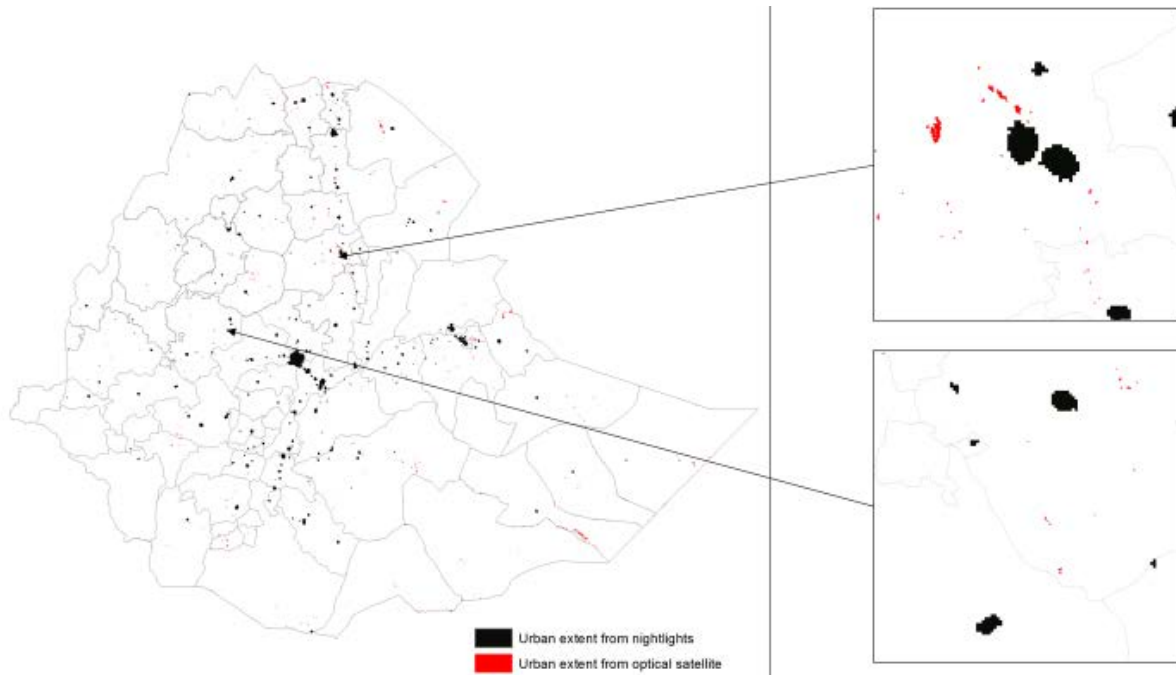
Urban areas are also extracted from the multispectral sensor land cover data of the Climate Change Initiative (CCI) produced by the European Space Agency. Urban areas without NL signals are more likely to be picked up by CCI products. The multispectral (CCI) and the NL datasets are merged and additional urban pixels from the multispectral dataset are added to the NL map. The final output is a set of urban maps of Ethiopia for 2000, 2005, and 2011 (Figures 2 and 3). The latitude and longitude of EAs provided in the EDHS survey allow this spatial data on urban areas to be merged with the EDHS data. We combine the urban areas identified from multispectral and NL data to develop a series of urbanization indicators for Ethiopia.

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<sup>3</sup> Nightlight data at each pixel are recorded as a digital number (DN) that ranges from 0 to 63. However, the value is not consistent over time since the sensors of the six generation DMSP/OLS satellites vary slightly, so the DN represents slightly different brightness levels among the satellites. DN values saturate at 63 for very bright areas and cannot reach a value higher than 63.

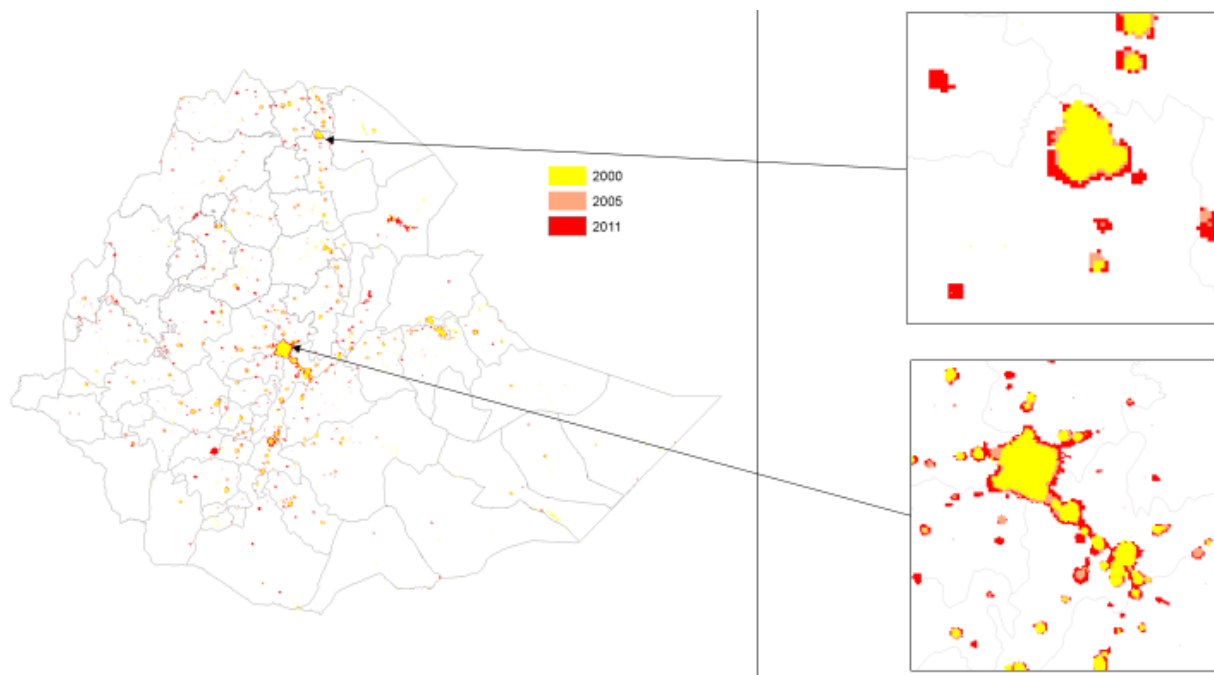
<sup>4</sup> First, calibration equations are generated across years. Second, forward adjustments are accounted for. Third, backward adjustments are estimated. Fourth, an average of forward and backward adjustments is taken.

**Figure 2: Urban areas in Ethiopia from night light and multispectral sensors for 2011**



Source: Analysis by authors.

**Figure 3: Extent of urban areas in Ethiopia in 2000, 2005, and 2011 based on both night light and multispectral sensors**



Source: Analysis by authors.

**Nightlight intensity:** After the inter-calibration, NL intensity is comparable across years. The EDHS EAs are overlaid with calibrated NL values of the corresponding year. NL values are directly extracted based on the location of the EDHS EA. The resulting indicator returns the NL intensity of each EA location in each year. NL intensity is our primary indicator of urbanization.

**Distance to urban areas:** Since a considerable proportion of EDHS EAs are located in rural areas or small towns, many EAs are associated with NL values that are at or are very close to zero. However, two different EAs each with zero NL could have different proximities to urban areas, and,

thus, urbanization could have different implications for each of these EAs. In order to distinguish between EAs in very rural areas and EAs in close proximity to identifiable urban areas, we measure the physical distance in kilometers between an EDHS EA and the nearest urban area identified from the satellite imagery.

Since measurements of distance are most accurate when data is in an equidistant projection coordinate system, both the EDHS EA layer and the urban areas layer derived from NL and multispectral sensors are projected to a meter-based projection. The geodesic distance that results takes into account the curvature of the earth, so is more suitable when measuring distance that spans a large geographic area. Distance from an EDHS location to the nearest urban area is calculated to the boundary of the urban area, not to its center. One EA could be equally close to several urban areas. Multiple features may be equally closest to another feature. When this occurs, one of the equally closest urban areas is randomly selected as the closest. When the EA contains or is within the urban areas, the distance between them is considered to be zero. The calculation of the distances of EAs to urban areas is performed for all the survey round years independently.

**Total urban area within 10-kilometer radius:** The total urban area within a specific radius around each EDHS EA provides additional information on urbanization intensity. The impact of EA point displacements on raster-based analyses can be moderated through the generation of covariates representing average values from neighborhood buffers. Since the range of the displacement between rural and urban EAs differs, a buffer zone with a radius of 10 km around the EA point is appropriate for the EDHS. The total urban area within a 10-km radius of each EA is measured in square kilometers.

**Urbanization Index:** These three measures of urbanization described are interlinked. Thus, we use principal component analysis (PCA) to construct an aggregate urbanization index as a fourth measure. We then standardize this index to facilitate interpretation. This urbanization index is a linear combination of the other three measures of urbanization.

### 2.3. Construction of dependent and other analytical variables

**Attitudes toward intimate partner violence:** We define women's attitudes toward IPV through an index based on their responses to survey questions about various scenarios that could potentially end in abuse. Specifically, the questions ask whether a husband is justified in hitting or beating his wife if she: (i) goes out of the household without telling her husband; (ii) neglects the children; (iii) argues with her husband; (iv) refuses to have sex with her husband; and (v) burns the food. The component indicators of the index are binary variables, where 0 indicates the woman agrees that violence is justified and 1 indicates she feels it is not justified. Index measurements are the average value of all component indicators and take on a value between 0 and 1, where 0 indicates violence is justified in every scenario and 1 indicates violence is never justified. Previous studies used a binary approach for qualifying women's attitudes toward IPV based on their responses to these questions (Koenig 2006; Kishor and Johnson 2013; Jewkes et al. 2015; Tran et al. 2016).

**Wealth indicators:** We also include two household wealth indices in the analysis. These are based on the characteristics of the housing for the household and on asset ownership by the household, respectively. Each is derived from a set of indicators that identify whether a household is deprived in a specific aspect of wellbeing.<sup>5</sup> The housing index is based on the following binary indicators: housing for household has improved floors (made of cement, brick, tiles, finished wood, synthetic materials, carpet); fewer than five people per room; and household uses improved cooking fuel (electricity, gas, kerosene). The asset ownership index tracks ownership of several household items—television, electric *mitad* (grill), lamp, telephone, and table or bed. The index is

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<sup>5</sup> Note that these indices are a proxy of wealth and not a direct measure.

defined as the share of component indicators in which the individual is not deprived. These indices allow us to rank households. We categorized households by tercile based on the housing and on the asset indices, respectively.

## 2.4. Descriptive statistics

Table 1 provides a descriptive summary of the variables employed in our parametric and conditional regressions. Average nighttime light intensity for Ethiopia across 2000, 2005, and 2011 is 4.84 DN. Average nighttime light intensity across Ethiopia increased by about 22 percent from 2000 to 2011. Average distance to urban areas across Ethiopia decreased by about 27 percent from 2000 to 2011. Average total urban area within a 10-kilometer radius across Ethiopia increased by about 57 percent from 2000 to 2011.

**Table 1: Descriptive statistics of the sample**

	Full sample	2000	2005	2011	% change (2000-11)
<b>Urbanization indicators</b>					
Nightlight intensity (DN)	4.84 (14.13)	4.22	5.37	5.18	22.6
Distance to urban area (km)	15.11 (15.13)	17.17	15.10	12.56	-26.8
Urban area within 10-km radius (km <sup>2</sup> )	29.46 (110.10)	22.53	32.55	35.58	58.0
Urbanization Index (standardized PCA index)	1.63e-11 (0.99)	-0.03	0.04	0.03	200
<b>Outcome variable: Women's attitudes toward intimate partner violence (IPV) index, 0/1</b>					
Index components, 0/1					
Goes out	0.46	0.44	0.36	0.58	31.8
Neglects children	0.40	0.35	0.34	0.49	40.0
Argues	0.45	0.39	0.40	0.55	41.0
Refuses sex	0.54	0.47	0.54	0.62	31.9
Burns food	0.42	0.36	0.39	0.53	47.2
<b>Control variables</b>					
Mother's educational attainment, years	1.36 (3.00)	1.22	1.32	1.57	28.7
Age of mother, years	29.53 (6.79)	29.67	29.44	29.33	-1.1
Age of mother at first birth, years	18.81 (3.51)	18.88	18.64	18.87	-0.0
Father's educational attainment, years	2.56 (3.93)	2.37	2.56	2.85	20.2
Housing index	0.24 (0.26)	0.23	0.24	0.25	8.7
Asset index	0.22 (0.22)	0.17	0.25	0.26	52.9
Reads newspaper, 0/1	0.09	0.09	0.09	0.08	-8.5
Visited family planning agents, 0/1	0.10	0.03	0.08	0.24	701.0

Source: Authors and Ethiopia Demographic and Health Survey (EDHS) 2000, 2005, and 2011, The National Geophysical Data Center (NGDC) of the United States National Oceanic and Atmospheric Administration.

Note: Figures in parentheses are standard deviations.

Table 1 indicates that the average index for IPV was 0.40 in 2000. In other words, women reported IPV was not justified, on average, in 2 out of 5 scenarios. Nationally, women's rejection of IPV increased between 2000 and 2011. The IPV index increased by 38 percent between 2000 and 2011, indicating a substantial decrease in the acceptance of IPV among Ethiopian women over this period.

The top panel of Table 2 shows the percentage change in the share of women living in the four rural-urban NL categorizations between 2000 and 2011. In 2000, 84 percent of women lived in rural areas with no NL, and between about four and six percent lived in each of the categories with measurable NL. In 2011, 80 percent of women lived in rural areas with no NL, with a bit more than six percent living in each of the categories with measurable NL, implying rapid rates of urbanization.

**Table 2: Women’s attitudes toward intimate partner violence, by night light intensity in Ethiopia, 2000 and 2011**

		None	Low NL intensity	Moderate NL intensity	High NL intensity
Share of women (%) living in night light intensity zone	2000	84.1	5.2	4.5	5.9
	2011	80.1	6.6	6.6	6.4
	% change	-4.8	26.9	46.7	8.5
Women’s attitudes toward IPV	2000	0.36	0.50	0.70	0.74
	2011	0.50	0.68	0.79	0.89
	% change	38.9	36.0	12.9	20.3

Source: Authors and Ethiopia Demographic and Health Survey (EDHS) 2000, 2005, and 2011, The National Geophysical Data Center (NGDC) of the United States National Oceanic and Atmospheric Administration.

Note: Nightlight (NL) intensity categories are defined as none (NL=0 DN); low NL intensity (NL>0 DN & NL≤9 DN); moderate NL intensity (NL>9 DN & NL≤35 DN); and high NL intensity (NL>35 DN).

Tables 2 and 3 show that attitudes toward IPV are heterogeneous across the rural-urban continuum and across regions in Ethiopia. Acceptance of IPV declines by NL intensity. Regionally, acceptance of IPV is highest in Somali and Southern Nations, Nationalities, and People’s (SNNP) regions, and neither area saw much improvement between 2000 and 2011. Notably, and counter to national trends, women’s acceptance of IPV increased by 12 percentage points in Harari between 2000 and 2011 to 63 percent.

**Table 3: Women’s attitudes toward intimate partner violence, by region**

Region	2011	Percentage point change, 2000-2011
	Women’s attitudes toward IPV	Women’s attitudes toward IPV
Tigray	0.59	0.16
Afar	0.48	0.20
Amhara	0.55	0.20
Oromiya	0.56	0.16
Somali	0.42	0.00
Benishangul-Gumuz	0.63	0.26
SNNP	0.41	0.06
Gambella	0.61	0.14
Harari	0.63	-0.12
Addis Ababa	0.91	0.14
Dire Dawa	0.71	0.17
National	0.55	0.15

Source: Authors and Ethiopia Demographic and Health Survey (EDHS), 2000, 2005 and 2011. The National Geophysical Data Center (NGDC) of the United States’ National Oceanic and Atmospheric Administration (NOAA)

Note: SNNP = Southern Nations, Nationalities, and People’s region.

Table 4 presents the share of women living in the four NL intensity categorizations of each region. Before considering these regional breakdowns, it is important to note that the majority of Ethiopia’s population lives in three regions, Amhara, Oromiya, and SNNP, that account for 81 percent of the pooled sample. These regions are followed by Tigray (8 percent) and Addis Ababa (6 percent). The remaining regions are sparsely populated with each accounting for 1 percent or less of the pooled sample. Table 4 also shows the percentage point change in the share of women living in the four rural-urban NL categorizations. In 2011, 80 percent of women lived in rural areas with no NL, and about 13 percent lived in areas with moderate and high NL intensity. Though there was a shift to areas with some NL from no NL, this change occurred primarily in sparsely populated regions.

**Table 4: Women living in each night light intensity zone, by region, percentage share**

	2011				Percentage point change, 2000-2011			
	None	Low NL intensity	Moderate NL intensity	High NL intensity	None	Low NL intensity	Moderate NL intensity	High NL intensity
Tigray	70	8	16	6	-16	8	12	-3
Afar	69	24	7	0	-14	7	7	0
Amhara	88	9	3	0	-2	1	1	0
Oromiya	89	2	9	0	1	-7	6	0
Somali	62	0	24	14	-19	-2	7	14
Benishangul-Gumuz	90	0	10	0	-10	0	10	0
SNNP	84	13	3	0	-11	13	-2	0
Gambella	81	19	0	0	10	-10	0	0
Harari	30	6	58	6	-4	-2	0	6
Addis Ababa	0	0	6	94	0	0	-8	8
Dire Dawa	34	4	3	60	9	2	-57	46
National	80	6.6	6.6	6.4	-4	1.4	2.1	0.5

Source: Authors and Ethiopia Demographic and Health Survey (EDHS) 2000, 2005, and 2011, National Geophysical Data Center (NGDC) of the United States National Oceanic and Atmospheric Administration.

Note: Nightlight (NL) intensity categories are defined as none (NL=0 DN); low NL intensity (NL>0 DN & NL≤9 DN); moderate NL intensity (NL>9 DN & NL≤35 DN); and high NL intensity (NL>35 DN). SNNP = Southern Nations, Nationalities, and People's region.

### 3. EMPIRICAL STRATEGIES

The strength of the effects of urbanization on women's attitudes toward IPV could vary across stages of urbanization. We allow for nonlinearities in our estimations by including higher-order polynomial terms associated with urbanization. To understand urbanization's impact, we estimate an equation of the form:

$$Y_{iEAt} = \sum_{n=1}^2 \gamma_n (Urban_{EAt})^n + \theta_1 W_{iEAt} + \theta_2 X_{iEAt} + T_{iEAt} + EA_{EAt} + \varepsilon_{iEAt} \quad (1)$$

where  $Y_{iEAt}$  stands for the outcome variables: women's attitude toward IPV index for household  $i$  from a given enumeration area  $EA$  and round  $t$ .  $Urban_{EAt} X_{ict}$  is measured by our three urbanization measures in each  $EA$  and in the three time periods. To facilitate interpretation of our linear and nonlinear terms in our regressions, we centered (de-mean) our key variables of interest: the natural logarithmic value of NL intensity, distance to urban areas, and total urban area within a 10-km radius.  $W_{iEAt}$  encompasses the housing and asset indices.  $X_{ict}$  represents a vector of household characteristics associated with IPV.  $T_{ic}$  represents region-by-survey-year fixed effects, which may capture aggregate shifts in outcome variables or correlated shifts in our explanatory variables. The three urbanization measures vary at the  $EA$  level in three periods. The survey enumeration area dummies in Equation 1 implement an enumeration-area-level fixed effects estimation.

Previous evidence shows that the effects of urbanization on women's attitudes toward IPV are highly varied and context specific, and are influenced by factors such as location, education, household characteristics, and wealth (Chant 2013; Henderson et al. 2013; Gollin et al. 2016). For example, the attitudes of women with more education and access to public services are more likely to be positively affected by urbanization. Thus, we explore the heterogeneous effects of urbanization on our outcome variables and estimate the following empirical specification:

$$Y_{iEAt} = \sum_{n=1}^2 \alpha_n (Urban_{EAt})^n + \beta_1 W_{iEAt} + \beta_2 (Urban_{EAt} * wealth_{tercile_{2000}}) + \beta_3 X_{iEAt} + T_{iEAt} + EA_{EAt} + \varepsilon_{iEAt} \quad (2)$$

The interaction terms between urbanization and initial wealth index tercile, based on 2000 EDHS data, are the new variables of interest in Equation 2. All other terms are as described for Equation 1. The vector of parameters captured by  $\beta_2$  quantifies the role of wealth indicators in mediating the marginal effect of urbanization. This allows us to explore the possibility that the effects of urbanization might vary across groups depending on the initial distribution of wealth. We hypothesize that women in lower housing and asset terciles may not benefit from urbanization because of unequal access to basic services and opportunities, including, among others, health clinics, employment, information, and financial services.

## 4. RESULTS AND DISCUSSIONS

We first report nonparametric local polynomial regressions to explore relationships between urbanization measures and women's attitudes toward IPV. We then report conditional and unconditional regression estimates.

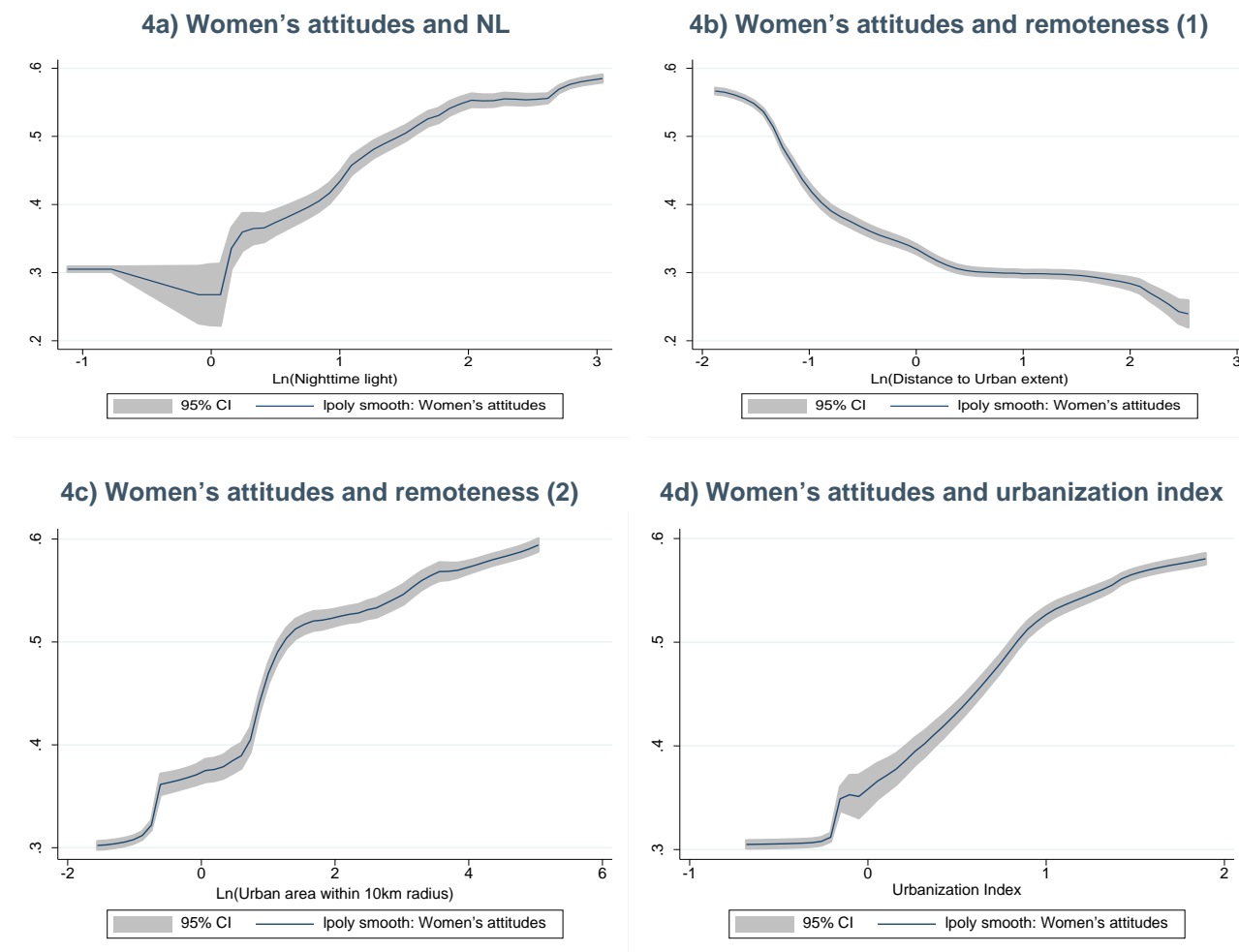
### 4.1. Nonparametric associations between urbanization and women's attitudes toward intimate partner violence

Nonparametric local polynomial regression results (Figure 4a) suggest a strong and positive association between NL intensity and women's attitudes toward IPV, indicating that as NL intensity increases, women's acceptance of IPV declines. Importantly, the magnitude and strength of these relationships varies significantly across the distribution (range) of NL intensity. There is no apparent association between women's attitudes toward IPV and NL intensity at the lower end of the range, while the association between NL intensity and women's attitudes toward IPV is strongly positive in the middle of the range before weakening at the upper end.

Next, we explore the relationship between distance to urban areas and women's attitudes toward IPV (Figure 4b). Nonparametric local polynomial regression results suggest a negative association between distance to urban areas and women's attitudes toward IPV, indicating that as distance to urban areas decreases, women's acceptance of IPV declines. The magnitude and strength of these relationships vary significantly across the distribution of distance to urban areas. Figure 4c illustrates the relationship between area within a 10-km radius that is urban and women's attitudes toward IPV with a similar pattern illustrated. Lastly, in Figure 4d we explore the relationship between the urbanization index and women's attitudes toward IPV.

For all four measures of urbanization, the nonparametric local polynomial regression results suggest a strong association between urbanization and women's attitudes toward IPV—indicating a decrease in women's acceptance of IPV as urbanization proceeds. The figures illustrate rapid changes in attitudes at early stages of urbanization and continued change at later stages though at a slower rate.

**Figure 4: Plots of polynomial associations between urbanization indicators and women's attitudes toward intimate partner violence**



Source: Authors and Ethiopia Demographic and Health Survey (EDHS) 2000, 2005, and 2011, The National Geophysical Data Center (NGDC) of the United States National Oceanic and Atmospheric Administration.

## 4.2. Women's attitudes toward intimate partner violence and urbanization with controls

Next, we run regressions of women's attitudes toward IPV as a function of our urbanization indicators, later extending the specification by adding parental characteristics and EA fixed effects.<sup>6</sup> By doing so, we gain insights on the roles of some of the potential channels through which urbanization can affect women's attitudes toward IPV. For instance, by including or excluding household wealth status, we may judge covariations between households' wealth and urbanization and, hence, their implications for the relationships between urbanization and women's attitudes toward IPV. We further uncover potential heterogeneous effects of urbanization on women's attitudes toward IPV by interacting urbanization indicators with wealth indicators.

<sup>6</sup> Women living in the same village are exposed to similar markets for food and infrastructure, implying that they may share some unobservable effects. Thus, we cluster standard errors by EA.

**Table 5: Effect of urbanization on women's attitudes toward intimate partner violence**

	Dependent variable: ln (women's attitudes toward IPV index)					
	1	2	3	4	5	6
ln(NL)	0.056*** (0.005)	0.029*** (0.005)	0.024*** (0.006)			
ln(NL) <sup>2</sup>	-0.004*** (0.001)	-0.003*** (0.001)	-0.003*** (0.001)			
ln(distance to urban)	-0.031*** (0.006)	-0.018*** (0.006)	-0.015*** (0.006)			
ln(distance to urban) <sup>2</sup>	-0.019*** (0.003)	-0.021*** (0.003)	-0.022*** (0.003)			
ln(urban area within 10-km radius)	0.010* (0.005)	0.013** (0.005)	0.014*** (0.005)			
ln(urban area within 10-km radius) <sup>2</sup>	0.011*** (0.002)	0.009*** (0.002)	0.008*** (0.002)			
ln(urbanization index)				0.121*** (0.017)	0.074*** (0.016)	0.061*** (0.016)
ln(urbanization index) <sup>2</sup>				0.025 (0.019)	0.028 (0.017)	0.026 (0.017)
ln(housing)		0.076*** (0.013)			0.071*** (0.018)	
ln(asset)		0.118*** (0.014)			0.128*** (0.017)	
Dependency ratio		-0.018*** (0.005)	-0.023*** (0.005)		-0.020*** (0.005)	-0.022*** (0.005)
Primary education		0.039*** (0.004)	0.037*** (0.004)		0.039*** (0.006)	0.038*** (0.006)
Married		0.044*** (0.004)	0.042*** (0.004)		0.003 (0.003)	0.002 (0.003)
Widowed, divorced, or separated		-0.040*** (0.005)	-0.040*** (0.005)		-0.044*** (0.004)	-0.043*** (0.004)
Housing index (base = upper tercile)						
Poor tercile housing index			-0.049*** (0.008)			-0.068*** (0.011)
Middle tercile housing index			-0.052*** (0.007)			-0.027*** (0.007)
Asset index (base = upper tercile)						
Poor tercile asset index			-0.051*** (0.005)			0.052*** (0.007)
Middle tercile asset index			-0.032*** (0.005)			0.011** (0.005)
Enumeration area fixed effects	Yes	Yes	Yes			
Constant	0.361*** (0.012)	0.362*** (0.016)	0.501*** (0.016)	0.357*** (0.019)	0.352*** (0.022)	0.443*** (0.020)
Observations	26,114	26,114	26,114	26,114	26,114	26,114

Source: Authors and Ethiopia Demographic and Health Survey (EDHS) 2000, 2005, and 2011. The National Geophysical Data Center (NGDC) of the United States National Oceanic and Atmospheric Administration.

Notes: Standard errors are clustered at EA and given in parentheses. \*\*\* p<0.01; \*\* p<0.05; \* p<0.10.

Table 5 reports both unconditional and conditional fixed effect regressions of women's attitudes toward IPV using the four urbanization indicators. The fixed effect results control for EA-level fixed effects, which can capture time-invariant community-level heterogeneity across space. Column 3 presents our preferred empirical specification for women's attitudes toward IPV. In the first and fourth column, we report unconditional estimates, including only urbanization indicators and time

dummies. In the second, third, fifth and sixth columns, we report the conditional estimates, which add individual and household-level characteristics and regional dummies. Comparing the unconditional and conditional estimates in Table 5 provides insights on potential mechanisms by which urbanization can influence women's attitudes toward IPV. For instance, the estimates on the effect of nightlight intensity and urbanization index in the regressions almost halve when we control for socioeconomic and wealth indicators, suggesting, as expected, that part of the link between urbanization and women's attitudes toward IPV is mediated through these channels. Nevertheless, the estimated coefficients on measures of urbanization remain sizeable and strongly statistically significant even after controlling for these socioeconomic characteristics.

The estimation results show that nightlight intensity and urban area within 10-km radius are strongly associated with a decrease in women's acceptance of IPV. We also find that distance of the EA to an urban area is negatively associated with women's attitudes toward IPV. In all estimations, nightlight intensity and urban area within 10-km radius strongly and consistently predict women's attitudes toward IPV. Similar, the estimation results show that the urbanization index is strongly associated with a decrease in women's acceptance of IPV. Using this index, the results show that an increase in the sample average level of urbanization index by 10 percent is associated with a 6 to 7 percent shift in women's attitudes toward IPV.

Moreover, the coefficients associated with the second-order polynomial terms of urbanization index show substantial nonlinearity in the relationship between urbanization index and women's attitudes toward IPV. The results indicate that the magnitude and strength of these relationships vary significantly with the level of the urbanization index. There are several possible explanations for substantial nonlinearity in the relationship between urbanization and women's attitudes toward IPV and for the finding that urbanization improves attitudes only up to an intermediate stage. First, a substantial proportion of urban populations (60 percent of the population in mega cities) in most sub-Saharan African countries lives in slum areas (UNECA 2017). Second, urbanization in sub-Saharan African countries has been accompanied by the rapid development of unplanned settlements with high concentrations of poor people.

Note that the nonlinear patterns observed in both non-parametric and parametric regression results are consistent with evolving evidence on the potential role of smaller urban agglomerations (e.g., secondary towns) in realizing development objectives. (e.g., Christiaensen and Todo 2014; Christiaensen and Kanbur 2017; Gibson et al. 2017; Amare et al. 2020). Areas where urbanization measures increase from relatively low levels tend to be associated with rapid gains in outcome measures, such as reduced acceptance of IPV. The findings imply that small towns deserve serious consideration as governments allocate budgets to urbanization initiatives.

The remaining covariates presented in Table 5 assume expected signs. An increase in the dependency ratio implies greater burden to the household and women in particular. Relative to the reference group (no education), the likelihood of disapproving of IPV was significantly higher among women who have at least primary education. Studies have shown that women who are empowered and engage in livelihood diversification are less likely to be victims of IPV (Chant 2013; Heath 2014). Married women are less likely to accept IPV compared to non-married counterparts. The likelihood of disapproving of IPV was also significantly higher among households at higher socioeconomic levels, as measured by housing and asset ownership. The results indicate that IPV is more severe in lower wealth groups than in higher groups, suggesting that adverse economic pressure plays a role in precipitating IPV and that poverty can significantly exacerbate IPV, even though IPV occurs regardless of socioeconomic position (Jewkes 2002; Koenig et al. 2006).

### **4.3. Women’s attitudes toward intimate partner violence: Heterogeneous effects of urbanization**

In Table 6 and 7, we explore the heterogeneous effects of urbanization on women’s attitudes toward IPV by estimating the empirical specifications in Equation 2. Women’s ability to benefit from urbanization could depend on factors such as living space, household profile, and wealth. We hypothesize that poor women may not benefit from urbanization because of unequal access to economic opportunities, such as decent work, human capital acquisition, and financial and physical assets. We add interaction terms between the four urbanization measures and initial wealth index terciles to isolate the heterogeneous effects with respect to initial wealth indicators terciles. The differential analysis by initial wealth indices terciles shows significant differences in response to urbanization measures, indicating that the effects of the return for urbanization on women’s attitudes toward IPV vary across the initial wealth distribution.

Table 6 presents the estimation results of the heterogeneous effects of NL intensity, total urban area within a 10-km radius, and distance to urban areas on women’s attitudes toward IPV. We find a negative and significant effect of NL intensity for women in the lower housing index tercile (column 1 in Table 6). A percentage point increase in NL intensity decreases the IPV index by 2 percent for women in the lower housing index tercile, indicating an increase in the acceptability of IPV. This relationship reverses for women in the middle housing index tercile. A percentage point increase in NL intensity increases the IPV index by 1 percentage point, indicating a decrease in the acceptability of IPV. The results reveal no significant impact on IPV in the lower two asset index terciles (column 2 in Table 6). Results in columns 3 and 4 of Table 6 show the effects of distance to urban areas. A percentage point increase in access to urban areas increases the IPV index by 3 and 1 percent for women in the lower housing index and asset index terciles, respectively. Results in columns 5 and 6 of Table 6 show varying effects of total urban area within a 10-km radius by wealth indices terciles. It has no significant effect on IPV for women in the lower asset index tercile.

**Table 6: Heterogenous impact of urbanization indicators on women's attitudes toward intimate partner violence**

	Dependent variable: ln (women's attitudes toward IPV index)					
	1	2	3	4	5	6
ln(NL)-centered	0.028*** (0.006)	0.035*** (0.006)	0.029*** (0.006)	0.033*** (0.005)	0.028*** (0.006)	0.034*** (0.005)
ln(NL)-centered-square	0.002 (0.004)	0.002 (0.004)	0.002 (0.004)	0.002 (0.004)	0.002 (0.004)	0.002 (0.004)
ln(distance to urban)-centered	-0.018*** (0.006)	-0.020*** (0.006)	-0.029*** (0.007)	-0.025*** (0.007)	-0.018*** (0.006)	-0.020*** (0.006)
ln(distance to urban)-square	-0.022*** (0.003)	-0.021*** (0.003)	-0.025*** (0.003)	-0.022*** (0.003)	-0.023*** (0.003)	-0.021*** (0.003)
ln(urban area within 10-km radius)-centered	0.015*** (0.005)	0.013** (0.005)	0.014*** (0.005)	0.013** (0.005)	0.017*** (0.006)	0.014** (0.005)
ln(urban area within 10-km radius)-square	0.009*** (0.002)	0.009*** (0.002)	0.009*** (0.002)	0.008*** (0.002)	0.008*** (0.002)	0.008*** (0.002)
Housing index (base = upper tercile)						
Poor tercile housing index * ln(NL)	-0.018*** (0.005)					
Middle tercile housing index * ln(NL)	0.011** (0.005)					
Asset index (base = upper tercile)						
Poor tercile asset index * ln(NL)	-0.003 (0.003)					
Middle tercile asset index * ln(NL)	0.003 (0.003)					
Housing index (base = upper tercile)						
Poor tercile housing index * ln(distance to urban)	0.026*** (0.006)					
Middle tercile housing index * ln(distance to urban)	0.006 (0.005)					
Asset index (base = upper tercile)						
Poor tercile asset index * ln(distance to urban)	0.007** (0.003)					
Middle tercile asset index * ln(distance to urban)	-0.001 (0.004)					
Housing index (base = upper tercile)						
Poor tercile housing index * ln(urban area within 10-km radius)	-0.015*** (0.004)					
Middle tercile housing index * ln(urban area within 10-km radius)	0.005 (0.003)					
Asset index (base = upper tercile)						
Poor tercile asset index * ln(urban area within 10-km radius)	-0.002 (0.002)					
Middle tercile asset index * ln(urban area within 10-km radius)	0.002 (0.002)					
Enumeration area fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.350*** (0.016)	0.363*** (0.016)	0.361*** (0.016)	0.366*** (0.016)	0.354*** (0.016)	0.363*** (0.016)
Observations	26,114	26,114	26,114	26,114	26,114	26,114

Source: Authors and Ethiopia Demographic and Health Survey (EDHS) 2000, 2005, and 2011, The National Geophysical Data Center (NGDC) of the United States National Oceanic and Atmospheric Administration.

Notes: Standard errors are clustered at EA and given in parentheses. \*\*\* p<0.01; \*\* p<0.05; \* p<0.10.

Additional controls include, age, educational level of women, dependency ratio, marital status, endowment variables, etc.

Table 7 presents the heterogeneous effects of urbanization index on women’s attitudes toward IPV. We find a negative and significant effect of the urbanization index for women in the lower housing index tercile and asset index tercile (column 1 and 2 in Table 7). A percentage point increase in urbanization index decreases the IPV index by 3 and 2 percent for women in the lower housing index tercile and asset index tercile, respectively, indicating an increase in the acceptability of IPV.

**Table 7: Heterogenous impact of urbanization index on women’s attitudes toward intimate partner violence**

	Dependent variable: ln (women’s attitudes toward IPV index)	
	1	2
ln(urbanization index)	0.074*** (0.018)	0.060*** (0.016)
ln(urbanization index)^2	0.028 (0.017)	0.026 (0.017)
Housing index (base = upper tercile)		
Poor tercile housing index* ln(urbanization index)	-0.025** (0.010)	
Middle tercile housing index* ln(urbanization index)	-0.020*** (0.004)	
Asset index (base = upper tercile)		
Poor tercile asset index* ln(urbanization index)		-0.017*** (0.006)
Middle tercile asset index* ln(urbanization index)		0.021*** (0.005)
Enumeration area fixed effects	Yes	Yes
Constant	0.346*** (0.016)	0.361*** (0.016)
Observations	26,114	26,114

Source: Authors and Ethiopia Demographic and Health Survey (EDHS) 2000, 2005, and 2011, The National Geophysical Data Center (NGDC) of the United States National Oceanic and Atmospheric Administration.

Notes: Standard errors are clustered at EA and given in parentheses. \*\*\* p<0.01; \*\* p<0.05; \* p<0.10

Additional controls include, age, educational level of women, dependency ratio, marital status, endowment variables, etc.

In sum, while we find that urbanization is associated with an overall decrease in the acceptance of IPV, the effect is stronger in the higher housing or asset index terciles for a given urbanization level. This is plausible given that previous studies have shown substantial heterogeneity in the effects of urbanization depending on socioeconomic factors, such as housing and asset ownership (Chant 2013; Henderson et al. 2013; Gollin et al. 2016).

## 5. SUMMARY AND CONCLUSIONS

Little is known about the impacts of urbanization on women's attitudes toward IPV. The scarcity of empirical studies on this relationship can be partly attributed to the lack of an objective measure of urbanization levels. Recently, however, an increasing and consistent supply of satellite data has added accurate and sophisticated geospatial information into urban development and socioeconomic studies. Thanks to advances in sensor technology, modern satellites can capture multispectral and nightlight-intensity data, which can be used to augment our understanding of urban and economic growth in a variety of ways (Romero et al. 2016). Here, satellite-based observations are deployed for measuring urbanization and its processes (Elvidge et al. 1997; Imhoff et al., 1997; Sutton 1997; Henderson et al. 2003; Sutton et al. 2010; Amare et al. 2020).

Measuring urbanization using various continuous indicators allows us to discern urban areas of different sizes and to quantify urbanization from alternative perspectives. Indicators beyond nightlight alone are of particular relevance to developing countries—where urbanization rates are relatively low and not all cities and towns are fully covered by electricity.

We investigate the effects of urbanization on women’s attitudes toward IPV using three core measures of urbanization and one composite index constructed from the core measures. The core measures are nightlight intensity, distance to urban areas, and total nearby urban area within a 10-km radius as continuous measures of urbanization. These measures are defined from satellite-based nighttime-light-intensity data and multispectral-sensor data. We merge this satellite data with the geo-referenced and nationally representative 2000, 2005, and 2011 Ethiopia Demographic and Health Survey (EDHS). With these data, we examine the heterogeneous effects of urbanization on women’s attitudes toward IPV across a continuous spectrum of urbanization (as opposed to a binary categorization) and by wealth tercile.

Our empirical analysis reveals several insights. Importantly, despite the generally strong positive effect of urbanization on women’s attitudes toward IPV—leading to a decrease in the acceptance of IPV—every stage of urbanization is not equally important in driving that effect. Nonlinear relationships are apparent in all estimations and across different measures of urbanization. As expected, the coefficient estimates on the effects of urbanization across all regressions substantially shrink when we control for socioeconomic and wealth indicators because part of the link between urbanization is mediated through these channels. However, even after these and other standard controls are applied, coefficients associated with urbanization remain substantial in size and are frequently statistically significant, including coefficients on squared terms. Furthermore, the multiple measures of urbanization deployed here remain statistically significant even when all three (plus squared terms) are included in the same regression, indicating that each measure provides unique information.

Broadly, acceptance of IPV declines rapidly when one begins from relatively low levels of urbanization. Acceptance continues to decline at higher levels of urbanization but at a less rapid rate. The effects of urbanization on women’s attitudes toward IPV are also heterogeneous across wealth indicator terciles. Among women in lower initial wealth index tercile, reductions in acceptance of IPV are less powerful (but still strongly positive) as urbanization proceeds. Our results suggest that urbanization strategies should include targeting specific urban development efforts to smaller agglomerations and that urban expansion should ideally be accompanied by development programs specifically targeting women in poor households.

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## ABOUT THE AUTHORS

**Mulubrhan Amare** is a Research Fellow in the Development Strategy and Governance Division (DSGD) of the International Food Policy Research Institute (IFPRI), based in Washington, DC.

**Channing Arndt** is Director of the Environment and Production Technology Division (EPTD) of IFPRI, based in Washington, DC. **Zhe Guo** is a Senior GIS Coordinator in EPTD of IFPRI, based in Washington, DC. **Greg Seymour** is a Research Fellow in EPTD of IFPRI, based in Washington, DC.

### INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

1201 Eye St, NW | Washington, DC 20005 USA  
T. +1-202-862-5600 | F. +1-202-862-5606  
Email: [ifpri@cgiar.org](mailto:ifpri@cgiar.org) | [www.ifpri.org](http://www.ifpri.org) | [www.ifpri.info](http://www.ifpri.info)

### IFPRI-ESSP ADDIS ABABA

P.O. Box 5689, Addis Ababa, Ethiopia  
T. +251-11-617-2000 | F. +251-11-667-6923  
Email: [ifpri-essp@cgiar.org](mailto:ifpri-essp@cgiar.org) | <http://essp.ifpri.info>

### POLICY STUDIES INSTITUTE

P.O. Box 2479, Addis Ababa, Ethiopia  
T. +251.11-550-6066; +251-11-553-8633 | F. +251-11-550-5588  
<http://psi.gov.et/>



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The Ethiopia Strategy Support Program (ESSP) is managed by the International Food Policy Research Institute (IFPRI); is jointly implemented with the Policy Studies Institute (PSI); and is financially supported by the United States Agency for International Development (USAID), the Foreign, Commonwealth & Development Office (FCDO) of the government of the United Kingdom, and the European Union (EU). Additional financial support for the research presented here was provided by the Bill and Melinda Gates Foundation (BMGF). This research was conducted as part of the CGIAR Research Program on Policies, Institutions, and Markets (PIM), which is led by IFPRI.

This publication has been prepared as an output of ESSP and has not been independently peer reviewed. Any opinions expressed belong to the author(s) and are not necessarily representative of or endorsed by IFPRI, PSI, USAID, FCDO, EU, BMGF, PIM, or CGIAR.

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