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Local Governance Quality and the Environmental Cost of Forced Migration☆

Cevat Giray Aksoy [a,c,d,*], Semih Tumen [b,d,e]

[a] European Bank for Reconstruction and Development, United Kingdom
[b] TED University, Turkey
[c] King's College London, United Kingdom
[d] IZA Institute of Labour Economics, Germany
[e] Economic Research Forum, Egypt

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ABSTRACT

Can high-quality local governance alleviate the environmental impact of large-scale refugee migration? The recent surge in refugee flows has brought additional challenges to local governments in Europe, the Middle East, and certain regions of Africa and Asia. In this paper, we focus on the case of Syrian refugees in Turkey and show that quality of local governance plays a critical role in mitigating environmental deterioration. Following the World Bank's Local Governance Performance Index, we employ text analysis methods to construct a unique data set on local governance quality from the independent audit reports on municipalities. Using an instrumental variable strategy, we show that the Syrian refugee influx has worsened environmental outcomes along several dimensions in Turkey. Specifically, we find that the deterioration in environmental outcomes is almost entirely driven by provinces with poor-quality governance. Those provinces fail to invest sufficiently in waste management practices and environmental services in response to increased refugee settlements. We argue that good local governance practices can smooth out the refugee integration process and complement the efforts of central governments.

1. Introduction

Socio-economic effects of international migration have been much-debated over the last decade. According to recent figures from the United Nations (UN), the number of international migrants—including both voluntary migration and forced displacement—has grown rapidly and reached 258 million individuals worldwide in 2017, up from 153 million in 1990. Forced displace-ment across international borders has also continued to rise in absolute figures: the total number of refugees increased from 17 million in 1990 to 20 million in 2017. This rise is unprecedented, at least since World War II.

According to Muggah and Abdenur (2018), more than 60 percent of all refugees and 80 percent of all internally displaced people are living in urban areas. Only 30 percent of all refugees live in rural camps. These figures imply that many cities around the world are overwhelmed by sudden mass influxes of forced migrants and face considerable pressure in providing municipal services. When the arrival of migrant flows is poorly managed, the new arrivals can exacerbate existing issues and generate new ones altogether (Brandt and Katz, 2017). Poor service provision to host communities often causes the perception that refugees are a threat to public order, which eventually leads to strong anti-migration sentiment and attitudes, making it more difficult for migrants to integrate. As policymakers try to make sense of a complex reality, it is important to understand the role of local governance practices in maintaining service standards and integrating refugees. This is the focus of our paper. In particular, we challenge the "refugee burden" myth by showing that good local governance practices can mitigate the negative environmental effects of higher population density due to mass refugee influx.

Improving the quality of local governance has been an important pillar in promoting inclusive and sustainable economic development. Local economic development is a major building block of aggregate

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* Corresponding author. European Bank for Reconstruction and Development, United Kingdom.
E-mail addresses: aksoyc@ebrd.com (C.G. Aksoy), semih.tumen@tedu.edu.tr (S. Tumen).

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economic development and this link is particularly important for emerging economies. The recent surge in refugee concentration in the Middle East, as well as certain regions of Europe, Africa, and Asia, has brought additional challenges to local governance quality in those regions. With increased refugee settlements, the demand for locally-provided goods and services has in-creased substantially, access to common resources has become more limited, public services have been overburdened, and municipality-level standards—such as the quality of waste management and environmental protection services have been under pressure. Therefore, the quality of local governance is very likely a key determinant of refugee accommodation capacity at a municipality level.

In this paper, we focus on three main outcome variables, per capita waste water (daily average, net of recycling), per capita distributed fresh water (from natural resources, such as lake or groundwater reservoirs), per capita solid waste (net of recycling), under the general heading of environmental municipal services. Waste water from households and businesses represent a substantial pressure on the environment and treatment is normally required before discharge. However, in many countries a large proportion of waste water is discharged to the environment with little or no treatment leading to: (*i*) algal blooms; (*ii*) depleted dissolved oxygen, which results in fish kills; (*iii*) destruction of aquatic habitats with sedimentation and debris; and (*iv*) toxicity to aquatic life from chemical contaminants (UN, 2007). Overuse of water from natural resources also causes crucial changes to local water regimes that result in a variety of long-term impacts, including drying up and having poorer water quality because of lowered base-flow contributions (UNESCO, 2006).[1] Effective solid waste management is vital for reducing and eradicating negative impact of waste materials on human health and the environment (Ferronato and Vincenzo, 2019).

The contribution of this paper is three fold. First, we estimate the causal impact of refugee influx on the core environmental municipal services, which has not received much attention in the migration literature. In the absence of additional investment in infrastructure and other waste management facilities, a greater population density is likely to degrade environmental quality along several dimensions. This is also likely to have secondary effects on health and well-being in host communities. To identify a causal effect, we implement a distance-based instrumental variable approach in the spirit of Del Carpio and Wagner (2015).

Second, following the World Bank's Local Governance Performance Index (World Bank, 2016), we construct a unique local governance quality (LGQ) data set using text mining methods. There is no readily-available indicator set suitable for measuring LGQ in Turkish municipalities. Existing data sets do not include satisfactory information regarding local governance practices. To overcome this difficulty, text mining techniques are used to extract information from the Turkish Court of Accounts annual reports on province-level municipalities. Those reports include indepen-dent auditors' evaluations of a wide range of local governance practices for each province. Various measures on governance efficiency, corruption, transparency, and accountability are constructed using those reports. The reports also include annual balance sheets for the municipalities. The balance sheets offer standardized quantitative indicators, which supplement the information ob-tained through text mining. As a complementary analysis, we also use an unsupervised machine learning tool (that is, Latent Dirichlet Allocation) to examine the audit reports and provide deeper insights from the unstructured text data.

Third, we study the role of LGQ in understanding the challenges faced by municipalities related to increased refugee concentration. There is an ongoing strain on municipal infrastructure—such as water, sanitation, and solid waste—in countries like Germany, Jordan, Lebanon, and Turkey, which host a large number of refugees. The refugee influx has substantially increased the demand for higher quality infrastructure and related services in those countries. Therefore, any delayed response by local municipalities in improving the infrastructure and waste management outcomes will aggravate the congestion in environmental services, which is a significant threat to public health. The role that LGQ plays in sustaining the delivery of those services is a key issue and needs to be investigated thoroughly. The Turkish case is used to obtain the literature's first evidence on these issues.

Using province-level data and an instrumental-variable (IV) design, we find that the Syrian refugee influx has increased the per capita levels of solid waste, waste water, and distributed clean water, on average, in Turkey. However, per capita expenditures on waste management and water supply services have not changed. These findings suggest that the refugee crisis limits the municipalities' capacity (*i*) to provide key local services and (*ii*) to respond to the crisis with additional investment—which may have political, environmental, and public health consequences. We go one step further and perform our empirical analysis using sub-samples with high versus low LGQ scores. We find that the deterioration in environmental outcomes in response to refugee inflows is almost entirely driven by municipalities with low LGQ, while there is no change in those variables in mu-nicipalities with high LGQ. Our analysis suggests that additional investment in waste treatment plants in well-governed municipalities explains these results. When there is a visible worsening in some key local services, the refugee accommodation capacity of localities might decline and this may also reduce the effectiveness of macro-level refugee integration efforts. We conclude that good local governance practices can smooth out the refugee integration process and complement the efforts of central governments.

Broadly speaking, our paper can be positioned within the literature investigating the impact of forced migration on natives and host communities. This literature has grown rapidly parallel to the increase in the number of displaced individuals all over the world. Most of the papers in this literature aim to address the labor market, product market, and human capital effects of forced migration.[2] There is also a vast literature studying the impact of the Syrian crisis on hosting communities along these lines.[3]

Only three papers have explored the effects of forced displacement on environmental outcomes and mainly focused on land use transformations. Maystadt, Mueller, Van Den Hoek, and Van Weezel (2020) investigate the refugee-driven landscape changes in Africa. The authors find that refugees cause a small increase in vegetation condition, while contributing to increased deforestation. In a related study, using satellite data on forest cover and loss, Salemi (2020) shows that refugee camp openings have no effect on deforestation. Alix-Garcia et al. (2013) examine land-use changes in the presence of civil conflict in Sudan and find regrowth of vegetation in rural areas accompanied by a decrease in vegetation vigor closer to cities. To the best of our knowledge, there has been no systematic attempt to investigate the broad environmental consequences of massive refugee inflows in host countries. Our paper aims to fill this gap.

Our study is also closely related to the growing literature studying the impact of immigration on environmental outcomes. The existing

[1] According to European Environment Agency (2019), long-term climate and hydrological assessments indicate that there was a 24 percent decrease in renewable water resources per capita across Europe between 1960 and 2010, particularly in southern Europe.

[2] Early examples include Card (1990), Hunt (1992), and Carrington and de Lima (1996).

[3] The main papers in this literature include Del Carpio and Wagner (2015), Tumen (2016), Balkan and Tumen (2016), Ceritoglu et al. (2017), Akgunduz, Hassink, and Van den Berg (2018), Akgunduz and Torun (2018), Assaad et al. (2018), Balkan et al. (2018), Malaeb and Wahba (2018), Alhawarin et al. (2018), Altindag et al. (2020), Fallah et al. (2019), Ajzenman et al. (2020), and Tumen (2019b). Policy implications are discussed in more detail by Zimmermann (2016), Hatton (2017), and Aksoy and Poutvaara (2019). For more detailed literature reviews, see Becker and Ferrara (2019), Verme and Schuettler (2019), and Maystadt et al. (2019).

evidence related to the environmental consequences of greater population density mostly indicates that immigration has no significant impact on environ-mental pollution. There is only a handful of papers in this literature.[4] Cramer (1998) investigates the impact of population growth through internal migration on air pollution in California and re-ports that population growth does not negatively affect air quality. Similarly, Squalli (2009, 2010) shows that regions with higher foreign-born population in the US have lower nitrogen dioxide (NO2) and sulfur dioxide (SO2) emissions. Price and Feldmeyer (2012) also find that immigration is not associated with higher levels of environmental pollution using data from 183 Metropolitan Statistical Areas in the US.

There is an extensive literature investigating the complex relationship between decentralization, local governance quality, electoral outcomes, local provision of public goods, and economic development.[5] Although the findings are mixed, the main consensus in this literature is that improving the quality of local governance is an important driver of more efficient allocation/provision of public resources. We contribute to this literature by arguing that increased refugee settlements in host localities impose severe challenges on local governance. In particular, we show that municipalities with higher-quality local governance handle the refugee shock more effectively and, therefore, refugee accommodation/integration capacity is higher in regions with better local governments. This means that central-level integration policies should be combined with local measures to im-prove the efficiency of integration policies and mitigate the negative environmental consequences of refugee shocks.

The structure of the paper is as follows. Section 2 describes the data and explains the construction of local governance indicators. Section 3 provides details of the identification strategy. Section 4 discusses the main results. Section 5 presents the robustness checks and Section 6 concludes.

2. Data and background

In this section, we explain in detail how we construct our local governance indicators using text mining methods, we describe the data used in the empirical analysis, and we present the summary statistics for the key variables.

2.1. Construction of local governance data

The local governance indicators used in this paper are generated from a narrative-based text analy-sis of the Turkish Court of Accounts (TCA) auditors' reports from 2013 to 2016 for each province.[6] The TCA is an independent supreme audit and judicial institution aiming to establish better public administration in Turkey. It is important to note that TCA auditors prepare their independent reports based on the evidence gathered in accordance with widely accepted international audit standards. In particular, they follow the practical guidance provided in International Standards of Supreme Audit Institutions (ISSAI) to conduct audits in public sector organizations.[7]

Turkey is divided into 81 provinces and we use auditors' reports for each province to construct our local governance indicators. Throughout the paper we refer to each province as a "municipality." The auditors are independently assigned to provinces based on their expertise and experience. The analysis covers more than 300 reports ranging from 30 to 200 pages each. Each report presents the results/findings of the auditors' examination of annual activities and financial records of a municipality at the province level. Detailed balance sheets of municipalities are also attached to the reports.

"Narrative-based text analysis" means that the reports are analyzed in detail by the authors and the indicators are constructed accordingly. Each report includes a comprehensive "findings" section, which highlights the auditors' specific observations, detailing the corresponding municipality's practices contrary to law and/or written rules. Following the World Bank's Local Governance Performance Index (World Bank, 2016), we construct four qualitative and two quantitative indi-cators that capture various dimensions of local governance quality. The qualitative components are: (*i*) Corruption; (*ii*) Transparency; (*iii*) Governance Effectiveness (Service Delivery); and (*iv*) Accountability. Each indicator is constructed as a binary variable taking 0 if there is a governance problem for the corresponding indicator and 1 otherwise. The findings of the auditors' report are examined carefully and scored on a uniform basis by the authors. As an example, if the local bus transportation services are granted to a company without a transparent auction, then this is a sign of corruption and lack of transparency; if there is no internal auditing unit in a municipality or no internal auditor is hired, then this is a sign of lack of accountability, and so on.

Two quantitative indicators are constructed using the annual balance sheets of each municipality, which are: (*i*) ratio of interest payments to total expenditures and (*ii*) ratio of labor cost to total expenditures.[8] A majority of the Turkish municipalities are highly indebted (mostly in FX terms); thus, the first indicator roughly proxies financial prudence and risk exposure. The second indicator shows how efficient a municipality is at keeping its labor costs low while providing municipal services. This is particularly important in the context of Turkey as some municipalities may be politically incentivized to get local unemployed citizens into municipal workforce (that is, they may become instruments of political patronage). Therefore, we view the low ratio as a positive sign. These two indicators are also constructed as binary variables taking 0 if the corresponding province-level value is equal or above the median value and 1 otherwise.

Finally, the six binary local governance indicators are brought together to form an aggregate Local Governance Quality Index (LGQI). To perform this task, an equally weighted sum of the six indicators is constructed as an index ranging from 0 to 100—low values indicate better local governance quality, while high values mean bad governance.

Fig. 1 displays the extent of province-level variation in the LGQI as of 2016, which is also used as a static measure throughout the analysis. Notably, Fig. 1 shows no distinctive gradient toward Syria in terms of local governance quality. In addition, Appendix Table A1 presents balancing test for low and high quality governance municipalities by available observable measures. We find that well-governed and badly-governed municipalities are not statistically different from each other in terms of their population and economic activities. Table 1 reports summary statistics for all the variables used in the analysis.

2.2. Functions of municipalities

Turkish municipalities are mainly responsible for land development, infrastructure, transportation, waste management, cemeteries, and fire-fighting (Union of Municipalities of Turkey, 2020). While they also have other functions such as education, culture and sports, and social aid, central government ministries or agencies are in charge of large-scale social services and poverty alleviation programs. Therefore, *a priori*, we expect no statistically significant relationship between refugees' destination choices and municipal governance quality in Turkey. We also

[4] A vast majority of papers in this literature investigate the immigration induced long-term environmental changes.

[5] See Bardhan (2002) for a review of the early literature.

[6] The auditors' reports can be downloaded from https://www.sayistay.gov.tr/tr/?p=2&CategoryId=103.

[7] These standards include: ISSAI 1 (Lima Declaration), ISSAI 10 (Mexico Declaration on Supreme Audit Institutions Independence), ISSAI 30 (Code of Ethics), ISSAI 40 (Quality Control for Supreme Audit Institutions), Bangalore Principles of Judicial Conduct, and the Budapest Guidelines. More details on manuals and standards can be found at https://www.sayistay.gov.tr/en/?p=2&CategoryId=54.

[8] It is not possible to construct additional relevant quantitative indicators from the balance sheets due to non-standard reporting.

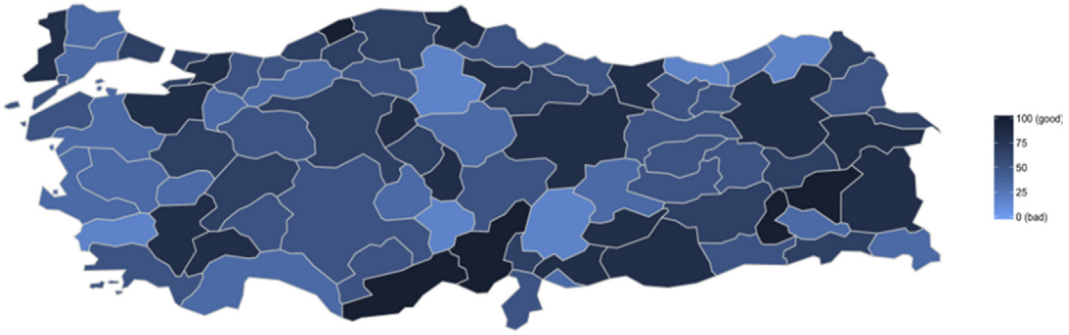


Fig. 1. Local Governance Quality Index. This figure shows the variation in the Local Governance Quality Index as of 2016.

Table 1
Means (standard deviations). The sample sizes for outcome variables are different as they are not reported on an annual basis by the TurkStat. The sample sizes for log of imports and log of exports are different due to missing data. OLS Estimation: Impact of refugee influx on environmental outcomes.

Sample characteristics	
Variables	Mean (Standard deviation)
Dependent variables	4.95 (0.35) – *N*: 729
Log of per capita waste water	3.40 (0.64) – *N*: 486
Log of per capita distributed water Log of per capita waste collected	12.04 (1.12) – *N*: 729
Log of per capita exp. on municipal waste water management services	0.87 (2.14) – *N*: 986
Log of per capita exp. on municipal water supply works and services	2.55 (1.51) – *N*: 1113
Log of per capita exp. on municipal waste management services	2.94 (1.06) – *N*: 1125
Local governance index characteristics	
Composite index (LGQI) score (0–100)	57.61 (22.84) – *N*: 1215
Accountability index score (0–100)	76.54 (42.39) – *N*: 1215
Corruption index score (0–100)	49.38 (50.01) – *N*: 1215
Governance efficiency index score (0–100)	56.79 (49.55) – *N*: 1215
Interest payment index score (0–100)	50.61 (50.01) – *N*: 1215
Labor cost index score (0–100)	53.08 (49.92) – *N*: 1215
Transparency index score (0–100)	59.25 (49.15) – *N*: 1215
Province level characteristics	
Log of exports	11.22 (2.60) – *N*: 1126
Log of imports	10.94 (2.66) – *N*: 1130
Log of nighttime light density	1.21 (0.80) – *N*: 1215
Log of population	13.15 (0.99) – *N*: 1215

formally check this in Table A2 and find no evidence that refugees systematically sort themselves into well-governed municipalities.

2.3. Latent Dirichlet Allocation

We also use an unsupervised machine learning algorithm to examine the audit reports for patterns as this approach offers deeper insights of the unstructured text data. In particular, we configured topic modeling to produce top latent topic distributions.[9] Latent Dirichlet Allocation (LDA) is a probabilistic model of word counts that analyzes a set of documents.[10] In our analysis, LDA calculates probabilistic regularities or topics from the audit reports and examine how these topics are connected. By doing so, we identify topics that best describes the underlying text of the LGQI.

Before conducting the LDA analysis we pre-processed the text, which involves the following steps:

1. As many Turkish characters could not be recognised by the algorithm, we removed all non- English characters (non-ASCII characters).
2. We excluded additional words (a set of commonly used words, such as "the", "a", "an", "of" in Turkish) using the SpaCy tokeniser model.[11]
3. We further removed various redundant words, special characters, and punctuation from the audit reports by running several LDA models as they did not help with detecting any patterns.

The LDA approach produces commonly connected words and also classifies them into different topics. Based on highest coherence scores, we focus on 7 main topics, which are broadly defined as "transparency", "revenue and accountability", "tax collection", "debt management", "financial accountability", "essential services", and "regulation". Fig. 2 shows the number of documents with a dominant topic and suggests that "transparency", "revenue and accountability", and "debt management" are the most frequently discussed items in auditors' reports.

To provide further evidence on the underlying terms used in the auditors' reports, we present the frequency distribution of top 30 words in Fig. 3. We find that "contract", "auction", "rent", "car park", "road construction", "debt", "permit", "license", and "loan" appear at least 1000 times in the audit reports.

Fig. 4 presents a network graph, which shows how terms are related across provinces (i.e., auditors' reports). This is useful in understanding how provinces' governance quality is related to each other. Each edge is a word and distance is indication of how close the words are in the LDA transformation. The length of all edges between nodes determine how the nodes are placed in the 3D-space. The main interpretation is that provinces closer together on the graph have terms that are more likely to cluster around a common topic.

Overall, the patterns that emerged from the LDA analysis are in line with the local governance quality dimensions captured by the LGQI.

2.4. Life in Transition Survey

We also use data from the Life in Transition Survey (LiTS) to check the internal consistency of our local governance index. If the index is internally consistent, then one would expect a meaningful correlation between the index and the variables measuring trust in government or satisfaction with government/public services—both at local and central levels. The LiTS is carried out by the European Bank for Reconstruction and Development (EBRD) and the World Bank. It is a nationally

[9] Topic modeling is widely used to gain a descriptive understanding of unstructured text-based data in social science research.

[10] LDA method was applied in machine learning by Blei et al. (2003). We use the toolkit "Gensim," which is available in Python.

[11] See more details here: https://spacy.io/.

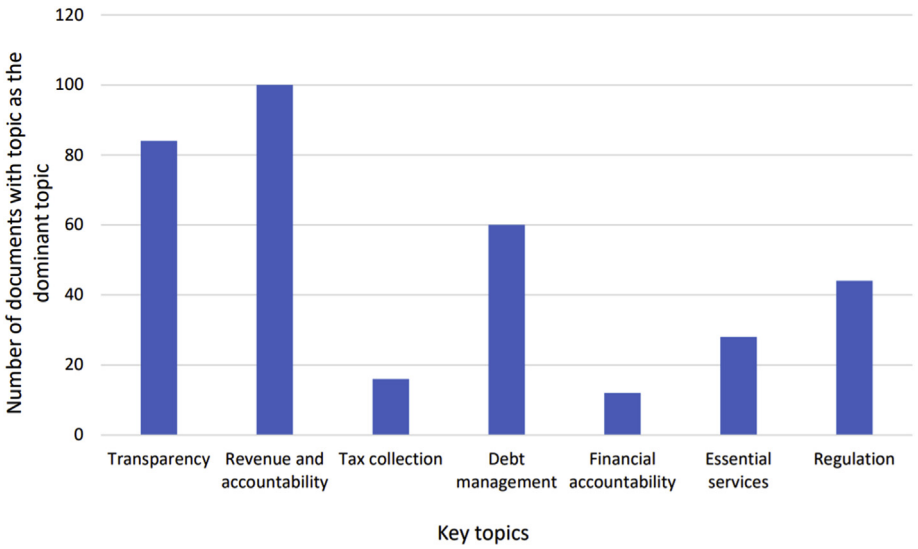


Fig. 2. This figure documents the number of reports with a dominant topic along with the names of those topics.

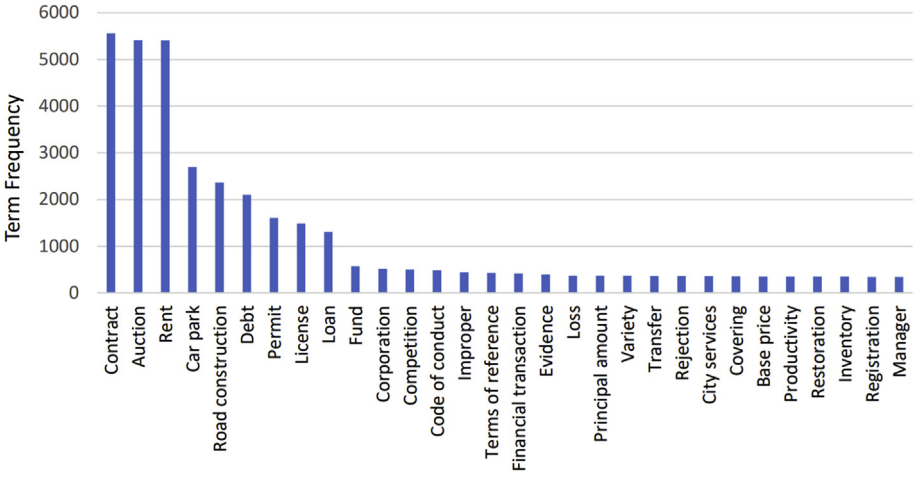


Fig. 3. This figure shows the frequency distribution of top 30 terms used in the auditors' reports.

representative household and attitudinal survey. It collects information on the socio-economic characteristics of the respondents and interviews individuals on a wide-range of topics. In this paper, we use the LiTS III (approximately 1500 households), which was conducted in 2016 in Turkey. Specifically, the LiTS provides detailed information on each respondent's demographic characteristics, household assets, work history, and unemployment history. Importantly, for our purposes, it also includes a raft of questions on institutional trust, satisfaction with government, and life satisfaction. These questions were completed by the head of the household or any other household member who was knowledgeable of the household characteristics and finances at the time of the interview. The LiTS only contains a face-to-face survey mode. The results of our internal consistency check exercise can be found in Section 4.1.

2.5. Other data and variables

The empirical analysis is built on six outcome variables collected at municipality level: per capita waste water (daily average, net of recycling), per capita distributed clean water (from natural re-sources, such as lake or groundwater reservoirs), per capita solid waste (net of recycling), per capita expenditure on municipal waste water management services, per capita expenditure on municipal water supply works and services, and per capita expenditure on municipal waste management services. These variables capture the municipality-level waste management outcomes, and also municipal expenditures (including investment) in waste management outcomes and practices. The unit of analysis is m^3/year for per capita waste water and per capita distributed water, while it is kilogram/year for per capita solid waste. All outcome variables enter the regressions in natural logarithms.

The data source is the Turkish Statistical Institute's (TurkStat) Environment Statistics, which are collected and compiled in line with the Eurostat and OECD guidelines on environmental statistics. The data period is 2001–2016.[12] The province-level refugee numbers are obtained from the Ministry of Interior, Directorate General of Migration Management. The province-level refugee-to- population ratios are then constructed using the population statistics obtained from the TurkStat.[13]

To construct our instrument, we use Google Maps Geo-location API and obtain shortest distance between Turkish provinces and Syrian governorates—that is, by connecting the geo-coordinates of central nodes for each pair.

[12] Note that some outcome variables are not reported on an annual basis by the TurkStat.

[13] See also Tumen (2018) for the details of data construction.

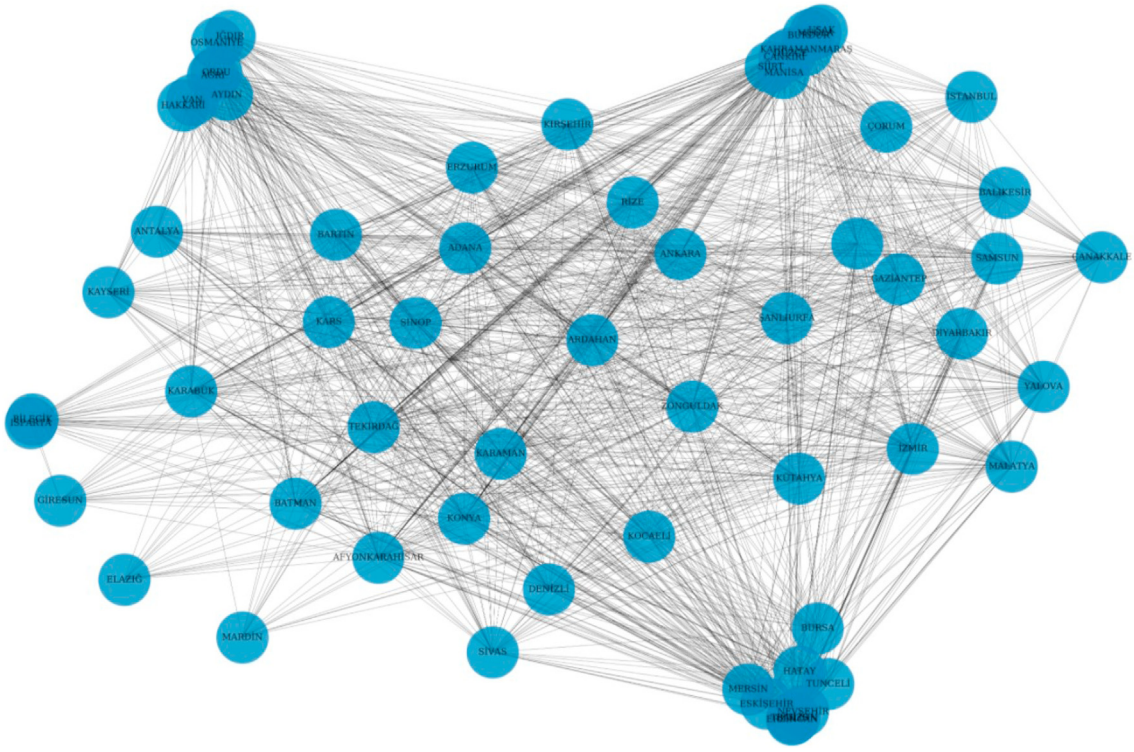


Fig. 4. Network representation. This figure shows how certain key terms in the reports are related across provinces.

To control for province-level economic activity, we use nighttime light density (that is, luminosity) data. These data come from DMSP-OLS and VIIRS.[14] The DMSP-OLS data span until 2013. The VIIRS data are available for later years. As the nighttime light density data come from different sources (and thus are not directly comparable), we normalize each value to a 0–1 range within each year.

3. The empirical strategy

3.1. Model

To assess the relationship between refugee influx and the environmental outcomes, we start by estimating a series of OLS models. This empirical setup exploits the variation in Syrian refugee settlements over time and across provinces. Province-level refugee-to-population ratio is our treatment variable. It is potentially endogenous as the refugees self-select into provinces/regions based on their location preferences, and if there are unobserved factors leading to higher refugee settlements in more or less polluted areas, then the estimates would be biased. Fig. 5 roughly displays Syrian refugees' location-choice patterns in Turkey. There is a clear tendency to move toward the western regions of the country over time, which is explained by Tumen (2016) in detail.

Based on this brief description, our baseline regression equation can be specified as follows:

$$y_{it} = \alpha + \beta_1 R_{it} + \beta_2^{'} \cdot X_{it} + f_i + f_t + f_r \times f_t + f_{trend} + \in_{it}, \quad (1)$$

where i, r, and t index provinces, sub-regions (NUTS2-level), and years, y_{it} is the outcome variable of interest, R_{it} is the refugee-to-population ratio (i.e., the refugee share), $\boldsymbol{X}_{it}$ is a vector of observed covariates, and $\in_{it}$ is the error term.

The province fixed effects, f_i, control for any time-invariant difference in unobserved factors that vary across provinces. Year fixed effects, f_t, capture the impact of aggregate shocks that affect all provinces simultaneously. $f_r * f_t$ denotes sub-region by year fixed effects, which control for all potentially omitted variables that can vary across sub-regions and years. f_{trend} re-moves distinctive changes in outcomes in various provinces that might otherwise bias our estimates if they accidentally coincided with refugee influx-related changes.

We also control for a vector of province-level characteristics, $\boldsymbol{X}_{it}$, to minimize omitted variables bias. In particular, $\boldsymbol{X}_{it}$ includes log of exports, log of imports, log of population, and mean nighttime light density for each province. We follow Henderson et al. (2011, 2012) and use remote sensing techniques to proxy economic activity by high-resolution data on nighttime light density.

In all models, we cluster robust standard errors at the level of province to account for the potential correlation existing in the errors within the same province. Our results remain virtually the same, when standard errors are calculated using corrections for spatial correlation (Conley, 1999).[15] The cut-off window is 100 km, but the results are virtually unchanged for 75 km, 125 km, and 150 km.[16]

R is our main variable of interest and estimating β_1 with OLS may be subject to selection bias as we explain above. An instrumental variable (IV) strategy—motivated by the gravity models of international trade—is implemented to address the potential selection bias. Following Del Carpio and Wagner (2015) and Tumen (2018), a weighted average of the distance from each province in Turkey to 14 Syrian governorates is used as an instrument. In particular, the IV is specified as ollows:

$$IV_{it} = N_t \sum_j \pi_j \frac{1}{L_{ji}}, \quad (2)$$

[14] See details at these links: https://ngdc.noaa.gov/eog/dmsp/downloadV4composites.html and https://ngdc.noaa.gov/eog/viirs/download_dnb_composites.html.

[15] These results are reported in Appendix Table A9.

[16] In particular, we use statistical package, acreg, provided by Colella et al. (2019). The estimates with various distance cut-offs are not reported here but available upon request.

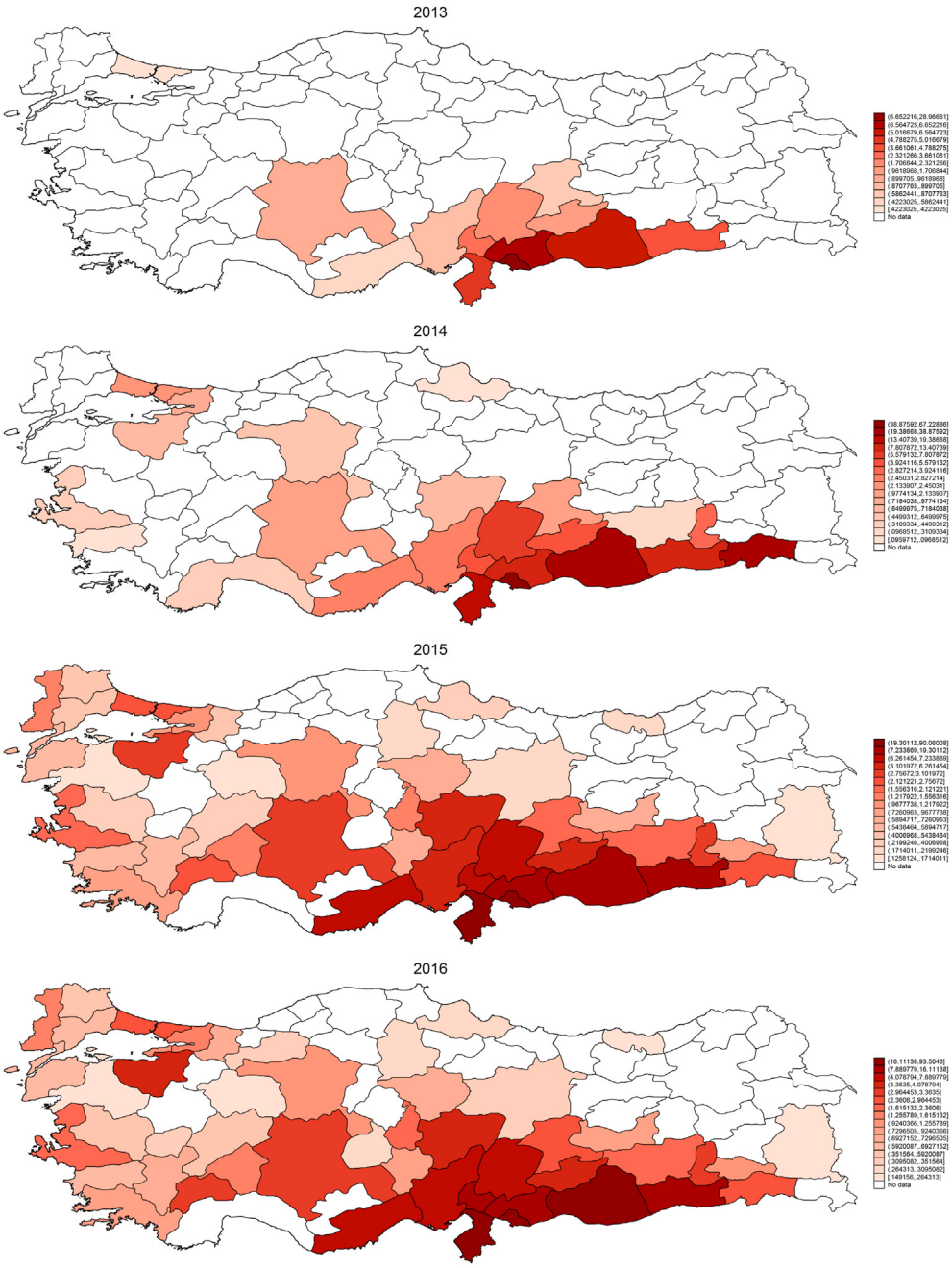


Fig. 5. Province-level refugee concentration. The figures display the refugee-to-population ratios in Turkish provinces from 2013 to 2016. To increase the visual accuracy of the figures, provinces with fewer than 1000 refugees are assumed to have zero refugee-to-population ratio, although the estimations are performed based on full data. Zero refugee-to-population ratio is indicated with white color. *Source:* Tumen (2018). (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

where j indexes Syrian governorates, N_t is the total number of refugees in Turkey in the corre-sponding year t, π_j is the fraction of Syrian population living in each Syrian governorate in the pre-conflict period (2010 is used), and L_{ji} is the shortest travel distance between each Syrian governorate and Turkish province.[17] The main identifying assumption is that the average distance from each province to Syrian governorates affects the outcome variable for each province only through its impact on the refugee-to-population ratio in the corresponding province.

In relation to this, Fig. 6 displays the association between our outcome variables measured in 2010 (the pre-influx period) and distance from each province to the nearest Syrian border crossing. In other words, we check whether there is any distinctive gradient toward Syria in terms of our environmental outcomes. We find that the outcomes are not systematically related to distance from Syrian border in the pre-treatment period, which can also be interpreted as supporting evidence for the relevance of our exclusion restriction. It is worth mentioning at this stage that the instrumental variable estimation delivers a local average treatment effect.

3.2. Identifying assumptions

In this subsection, we discuss the main identification assumptions—relevance, excludability, and monotonicity—that our instrumental variable estimations rely on.

1. Relevance: The first identification assumption that needs to be satisfied is relevance: our distance-based IV should be strongly correlated with the refugee-to-population ratio. To test this assumption, we present

[17] The Google Maps is used to pin down the shortest distances. There are 14 Syrian governorates and 81 Turkish provinces, which suggests that the distance is calculated between 1134 distinct routes.

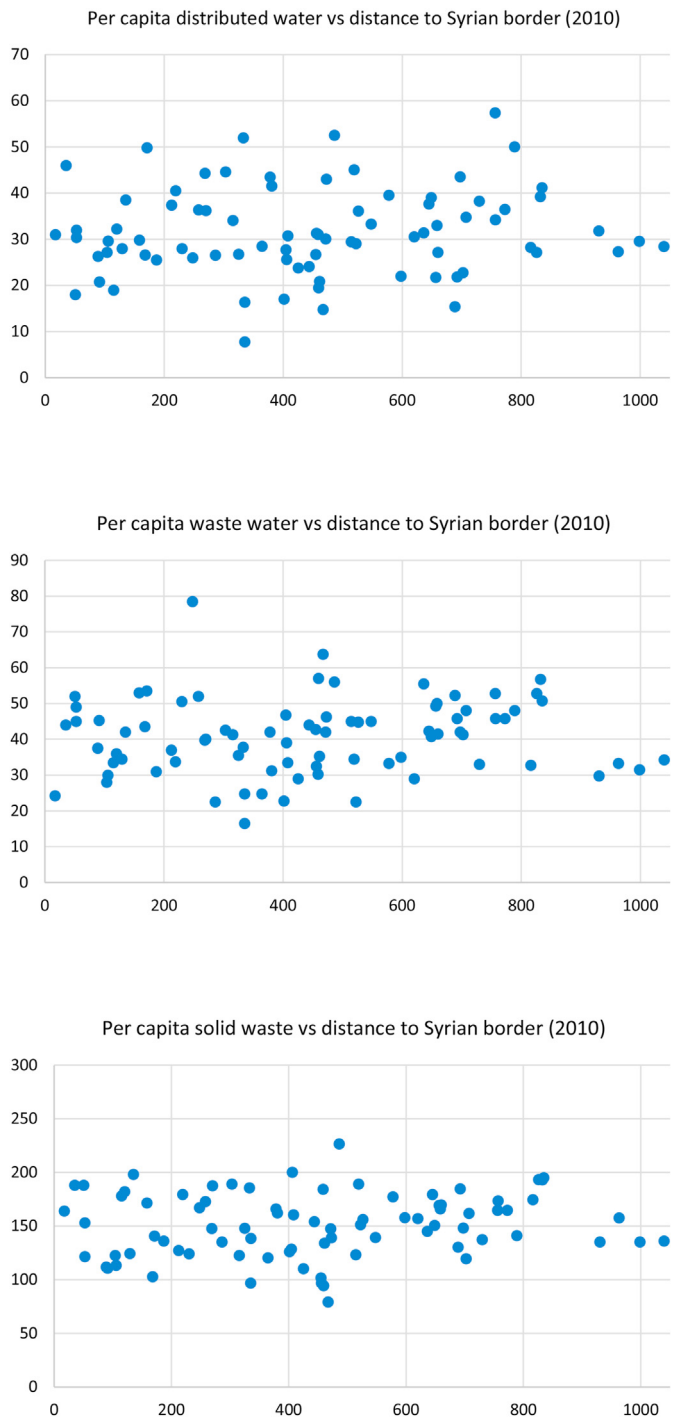


Fig. 6. The correlation between our outcomes and distance to Syrian border. The figures display the province-level relationship between our three outcome variables (distributed water, waste water, and solid waste—all in per capita terms) as of 2010, which is before the influx, and distance to nearest Syrian border-crossing. All three figures indicate that there is no meaningful statistical relationship between the outcomes and distance to Syrian border. The *p*-values are 0.71, 0.76, and 0.69, respectively. *Source:* TurkStat and authors' calculations.

F-statistics for excluded instruments for the first stage in all IV tables. The first stage *F*-statistics are substantially greater than 10 in most models, which suggests that the weak instruments problem should not be a concern in our case.

2. Excludability: The IV results are only valid if our distance-based instrument influences the outcome variables through its impact on the refugee-to-population ratio, rather than through other channels. As mentioned above, Fig. 6 provides suggestive evidence that the outcome variables are not systematically related to distance nearest Syrian border crossing in the pre-treatment period. This means that, in the absence of refugees, environmental outcomes do not naturally deteriorate in regions closer to the Syrian border.

Another potential threat to our identification strategy could arise if provinces that are closer to the Syrian border also had stronger trade links with Syria. If that were the case, our results could potentially be explained by trade-related shocks. To alleviate these concerns, we estimate models by using exports and imports as outcome variables and our instrument as the treatment variable. In Columns 1 and 2 of Table A3, we find that there is neither statistically nor economically significant association between our instrument and trade-related outcomes.

Similarly, one can also argue that a shock to economic activity in neighbouring provinces due to the civil war in Syria may also be a potential threat to identification. If that were the case, the effect on our outcomes would have been explained—at least partially—by changes in the economic conditions of the provinces close to the Syrian border. We directly test this hypothesis by regressing our instrument on our province level economic activity measure (that is, nighttime light density). The results are presented in Column 3 of Table A3. We find that the point estimate on the instrument is 0.000, suggesting that it does not directly affect the economic activity.

The fact that our instrument does not directly affect economic outcomes supports the va-lidity of the exclusion restriction of our IV. Nevertheless, in our preferred specification, we directly control for province-level exports and imports as well as nighttime light density. With the inclusion of these controls, it is plausible that our instrument is uncorrelated with any remaining unobserved variables that could affect our environment-related outcomes.

It is still possible that the correlation between our instrument and the error term is non-zero due to the effect of institutions. If, for example, provinces closer to Syria also develop institutions that influence environmental outcomes, then our instrumental variable approach would fail to identify a causal effect. However, we think that this notion is unlikely. First, we include province fixed effects that capture any time-invariant difference in unobserved factors across provinces. We also include subregion by year fixed effects and region-specific time trends to capture time-varying regional effects. Second, if such institutions exist, we would find systematic differences in observable characteristics of provinces. As mentioned before, Appendix Table A1 shows that well- and badly-governed municipalities are not systematically different from each other in terms of observable characteristics.

Taken together, evidence presented suggests that violation of exclusion restriction does not seem to be a crucial issue for our identification strategy.

3. Monotonicity: This assumption, which is fundamentally untestable, requires that the direction of the effect of the instrument should be the same for all provinces. In the context of our study, the monotonicity assumption means that increases in the level of the instrument (that is, higher distance to the Syrian border) cannot lead to a decrease in the refugee-to-population ratio for some provinces and an increase for others. We cannot rule out this possibility *a priori*, but we provide supporting evidence by regressing our instrument on the treatment variable across different sub-samples that are defined based on NUTS-1 regions of Turkey.

The estimates from these regressions presented in Table A4. We find a positive relationship between the instrument and endogenous variable in all columns. This finding is plausible as the Turkish provinces bordering Syria are amongst the least developed ones in the country and, therefore, it is likely that refugee-to-population ratio increases by distance over time due to endogenous sorting of refugees to the richer Western regions, which offer better labor market opportunities. Overall, the violation of the monotonicity assumption does not seem to be a serious threat to our identification.

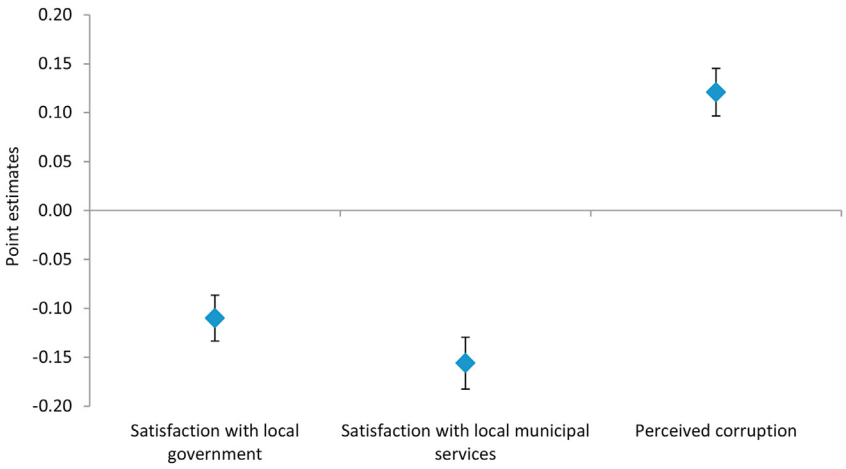


Fig. 7. Perceived corruption indicators. Based on 12 metropolitan provinces of Turkey. The level of analysis is individual-level. Each diamond shows the point estimate from Equation (3), which controls for demographic characteristics, labor market outcomes, and household assets. Standard errors are clustered at the locality level. *Source:* Life in Transition Survey (2016), Turkish Court of Accounts (2016), and authors' calculations.

4. Results and discussion

4.1. Evidence that the local governance index conveys meaningful information

In this paper, we are primarily interested in understanding to what extent the quality of local governance can mitigate the environmental impact of large-scale refugee migration. An issue that is key to the interpretation of any differentials is whether our measures of local governance index convey meaningful information from a normative perspective.

To provide evidence on this, we make use of the fact that we observe responses to various questions on satisfaction with local governance, perceived corruption and personal conditions in the Life in Transition Survey, 2016) (EBRD, 2016). We use these data to estimate straightforward OLS models controlling for detailed observable characteristics such as age, education, marital status, labor market status, household wealth, and location. We present this evidence in Figs. 7 and 8, which show the point estimates from Equation (3) given as follows:

$$y_i = \alpha + \beta LGQI_j + \theta^1 \mathbf{X}_i + \eta_i, \quad (3)$$

where *i* and *j* index individuals and localities, *y* is the outcome variable, *LGQI* is our Local Governance Quality Index, ***X*** is a vector of controls, and η is an error term. We consider satisfac-tion with local government, satisfaction with municipal services, and perceived corruption as our outcomes of interest in Fig. 7. In Fig. 8, we consider other related measures, which are whether an individual is happy with the political situation, satisfied with the regional government, satisfied with their life, and satisfied with the economy.

The results in Figs. 7 and 8 confirm that the outcomes we identify are statistically signif-icantly associated with our local governance index and with the expected direction of pairwise correlations. For example, we estimate that—conditional on all other covariates—a one standard deviation fall in local governance index (i.e. fall in the local governance quality) is associated with an 11 percentage point fall in satisfaction with local government, a 15.6 percentage point fall in satisfaction with local municipal services and a 12.1 percentage point increase in perceived corruption (Fig. 7). Finally, we also show that local governance quality is also significantly correlated with life and economic satisfaction (Fig. 8). Thus, taken as a whole, these results confirm that our objective measure of local governance quality is strongly related to perceived measures of local governance and life satisfaction. Therefore, the index is very likely to capture the meaningful differences in local governance quality. It is important to note that sub-components of our index are also highly correlated with related measures, such as perceived corruption and satisfaction with public services.[18]

4.2. Findings on refugee influx and environmental outcomes

In this subsection, we start by analyzing the effects of mass refugee migration on two sets of out-comes: (*i*) direct measures of pollution and resource use; and (*ii*) municipal spending on relevant environmental services. Table 2 presents the results from the OLS estimation, where the dependent variables are: log of per capita waste water—net of recycling (Column 1); log of per capita distributed clean water from natural resources (Column 2); and log of per capita solid waste-net of recycling (Column 3). Table 3 presents the results from the OLS estimation where the dependent variables are: log of per capita expenditures on municipal waste water management services (Column 1); log of per capita expenditures on municipal water supply works and services (Column 2); and log of per capita expenditures on municipal waste management services (Column 3). All models include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of nighttime light density, and log of population.

The results in Table 2 provide evidence that higher refugee concentration is associated with worse environmental outcomes. Contrary to expectations, there is no sign that growth in refugee concentration correlates with municipal spending on environmental services one way or the other in Table 3.[19]

Tables 4 and 5 present the IV estimates, in which we replicate the OLS specifications from Tables 2 and 3, respectively. We only report the coefficients on the main variable of interest. The first-stage F-statistics are well above 10 in all models.

The impact of higher refugee concentration on pollution outcomes is

[18] These results are not presented here but are available upon request.

[19] It is important to note that the data on municipal spending only covers the funds allocated by the central government. Therefore, none of the international grants/funds are included in the outcome variables. At the same time, the international aid only constitute a small share of funds spent for refugees by the Turkish government. For example, in terms of UNHCR's expenditures in Turkey, we find that the Agency spent 100,818,998 USD in 2014, 102,713,939 USD in 2015, and 128,746,135 USD in 2016. To put these figures in perspective, Istanbul Metropolitan Municipality's budget alone was about 4.3 billion USD in 2016. Therefore, the UNCHR's financial support represents a tiny fraction of the total municipal budget in Turkey—even if all the funds were directly transferred to the Turkish municipalities.

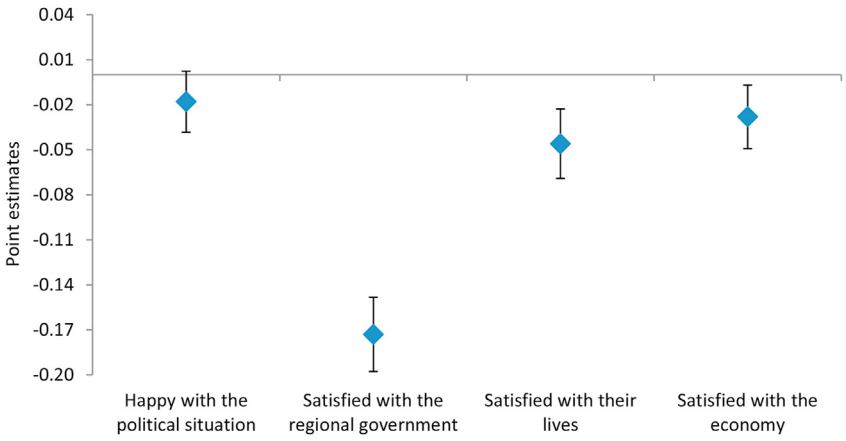


Fig. 8. Satisfaction indicators. Based on 12 metropolitan provinces of Turkey. The level of analysis is individual-level. Each diamond shows the point estimate from Equation (3), which controls for demographic char-acteristics, labor market outcomes, and household assets. *Source:* Life in Transition Survey (2016), Turkish Court of Accounts (2016), and authors' calculations.

Table 2
***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. Source: TurkStat and Turkish Directorate General of Migration Management.

OLS Estimation: Impact of refugee influx on municipal expenditures			
	Log of per capita waste water	Log of per capita distributed water	Log of per capita waste collected
Refugee/ population ratio	0.010*	0.018***	0.030*
	(0.005)	(0.005)	(0.016)
# of obs.	642	483	642

Table 3
***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. *Source:* TurkStat and Turkish Directorate General of Migration Management.

	Log of per capita exp. on municipal waste water management services	Log of per capita exp. on municipal water supply works and services	Log of per capita exp. on municipal waste management services
Refugee/ population ratio	−0.008	−0.003	0.001
	(0.032)	(0.027)	(0.005)
# of obs.	907	1026	1036

positive and significant, with a point estimate of 0.013 for the log of per capita waste water, 0.018 for the log of per capita distributed water, and 0.073 for the log of per capita waste collected. These estimates suggest that increased refugee share predicts worse environmental outcomes with high statistical and economic significance. High refugee concentration has also generated additional waste. However, IV estimates presented in Table 5 show that municipality-level investment in waste management and environmental services has not changed in a meaningful way. The findings, therefore, imply a substantial increase in the production of waste, with potentially negative implications for the health

Table 4
***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. *Source:* TurkStat, Turkish Directorate General of Migration Management and Google Maps.

IV Estimation: Impact of refugee influx on environmental outcomes			
	Log of per capita waste water	Log of per capita distributed water	Log of per capita waste collected
Refugee/ population ratio	0.013***	0.018**	0.073**
	(0.005)	(0.008)	(0.032)
First-stage coefficient	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)
First-stage *F* stat	19.46	16.74	19.46
# of obs.	642	483	642

Table 5
***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. Source: TurkStat, Turkish Directorate General of Migration Management and Google Maps. IV Estimation: Impact of refugee influx on environmental outcomes by LGQI.

IV Estimation: Impact of refugee influx on municipal expenditures			
	Log of per capita exp. on municipal waste water management services	Log of per capita exp. on municipal water supply works and services	Log of per capita exp. on municipal waste management services
Refugee/ population ratio	−0.018	0.061	0.006
	(0.087)	(0.076)	(0.011)
First-stage coefficient	0.002***	0.001***	0.002***
	(0.000)	(0.000)	(0.000)
First-stage *F* stat	71.89	83.39	45.04
# of obs.	907	1026	1036

of residents in the communities hosting refugees, and for refugees themselves. Back-of-the-envelope calculations suggest that a 10

percentage point increase in the refugee-to- population ratio leads to a 5.2 percent, 6.3 percent, and 14.1 percent increase in per capita waste water, per capita distributed water, and per capita waste collected, respectively, relative to the pre-treatment period on average across Turkey.

Taken together, the findings suggest that higher refugee concentration leads to congested munic-ipal services and increases pressures on already-strained municipal infrastructure services such as distribution of clean water, sanitation, and solid waste. Refugee inflows do not have significant effects on municipal spending. This is consistent with revenues allocated by the central government (typically accounting for the majority of municipal revenues) being based on municipal popula-tions and land area, which are often estimated with a lag and would thus not account for the sudden population growth due to refugee inflows. Given the structure and principles of budget determination, the quality of local governance stands out as a significant determinant of how the budget is used to accommodate the challenges caused by shocks and unexpected events such as the massive refugee influx experienced in Turkey after January 2012. We, therefore, investigate the importance of local governance quality in mitigating the environmental impact of large-scale refugee migration in the following subsection using our novel measure.

4.3. The role of local governance quality

In Table 6, we seek to gain further insights into the relationship between mass migration and measures of pollution by investigating the role of local government quality. Local governments in Turkey typically have primary responsibility for providing public services such as waste collection, waste water and water supply, and have some responsibility in the areas of housing and urban public transportation. This analysis is crucial as local governments are hidden but important partners for refugee integration. It is mainly because the conditions of the place where people live have an important impact on their perception of refugees. Competition for natural resources (such as fresh water) and services (such as waste collection and recycling) are an immediate concern. If not properly addressed, pollution accompanied by degradation in municipal services can cause conflict between refugees and resident populations. Refugees, however, cannot be expected to put environmental considerations ahead of their own safety and welfare (UNHCR, 2001). This is where municipalities can play a significant role in mitigating the negative impact of mass migration on the environment.

We estimate IV models separately for the municipalities with bad governance (LGQ index score greater than 50) in the top panel and municipalities with good governance (LGQ index score less than or equal to 50) in the bottom panel. The sample is roughly balanced between the two categories. All models again include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of nighttime light density, and log of population. The outcomes across the columns are as follows: log of per capita waste water (net of recycling) in Column 1; log of per capita distributed clean water from natural resources in Column 2; and log of per capita solid wastein Column 3. Each column shows coefficients on the refugee-to-population ratio. The first-stage F-statistics are above 10 in all models.

In top panel of Table 6, we find that the worse environmental outcomes reported in Table 4 come entirely from those municipalities with worse local governance quality. For municipalities with better governance, the increased refugee share does not lead to worse environmental outcomes: the estimated effects for all outcomes are small and insignificant. It is mainly because these municipalities often involve the private sector in the design, construction and maintenance of infrastructure, introducing new technologies and improving operational efficiency, in line with the evidence on the quality of governance and economic outcomes—see, for example, Stiglitz (2002).

4.4. Unbundling the local governance quality index

To understand which sub-components of local governance quality are the most significant determi-nants of the problems faced by municipalities in addressing the challenges caused by the massive refugee influx, we estimate separate IV models using a Corruption Index (Table 7), Transparency Index (Table 8), Governance Efficiency Index (Table 9), Accountability Index (Table 10), Interest Payment Index (Table 11), and Labor Cost Index (Table 12).> The format of these tables follow Table 6 in that the top panel shows results for the municipalities with bad governance (LGQ index score greater than 50), and the bottom panel

Table 6
***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. Source: TurkStat, Turkish Directorate General of Migration Management, Turkish Court of Accounts auditors' reports and Google Maps. IV Estimation: Impact of refugee influx on env. outcomes by Corruption Index.

	Log of per capita waste water	Log of per distributed	Capita water	Log of waste	per capita collected
Municipalities with bad governance (index score>50)					
Refugee/ population ratio	0.016**	0.034**	0.136***		
	(0.007)	(0.014)	(0.034)		
First-stage *F* stat	11.83	11.62	11.83		
# of obs.	301	226	301		
Municipalities with good governance (index score≤50)					
Refugee/ population ratio	0.009	0.009		0.001	
	(0.006)	(0.008)		(0.007)	
First-stage *F* stat	32.39	39.79		32.39	
# of obs.	341	257		341	

Table 7
***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. *Source:* TurkStat, Turkish Directorate General of Migration Management, Turkish Court of Accounts auditors' reports and Google Maps. IV Estimation: Impact of refugee influx on env. outcomes by Transparency Index.

	Log of per capita waste water	Log of per distributed	Capita water	Log of waste	per capita collected
Municipalities with bad governance (index score>50)					
Refugee/ population ratio	0.020***	0.030**	0.133***		
	(0.005)	(0.012)	(0.032)		
First-stage *F* stat	12.64	12.32	12.64		
# of obs.	318	239	318		
Municipalities with good governance (index score≤50)					
Refugee/ population ratio	0.009	0.009		−0.002	
	(0.006)	(0.008)		(0.008)	
First-stage *F* stat	34.68	44.78		34.68	
# of obs.	324	244		324	

Table 8
***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. *Source:* TurkStat, Turkish Directorate General of Migration Management, Turkish Court of Accounts auditors' reports and Google Maps. IV Estimation: Impact of refugee influx on env. outcomes by Gov. Efficiency Index.

	Log of per capita waste water	Log of per distributed	Capita water	Log of waste	per capita collected
Municipalities with bad governance (index score>50)					
Refugee/ population ratio	0.014***	0.025*	0.088**		
	(0.007)	(0.013)	(0.038)		
First-stage *F* stat	23.73	20.24	23.73		
# of obs.	381	286	381		
Municipalities with good governance (index score≤50)					
Refugee/ population ratio	0.015	0.005		0.021	
	(0.020)	(0.020)		(0.014)	
First-stage *F* stat	2.51	2.20		2.51	
# of obs.	261	197		261	

Table 9
***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. *Source:* TurkStat, Turkish Directorate General of Migration Management, Turkish Court of Accounts auditors' reports and Google Maps. IV Estimation: Impact of refugee influx on env. outcomes by Accountability Index.

	Log of per capita waste water	Log of per distributed	Capita water	Log of waste	per capita collected
Municipalities with bad governance (index score>50)					
Refugee/ population ratio	0.010*	0.018		0.071*	
	(0.006)	(0.013)		(0.037)	
First-stage *F* stat	13.07	9.85		13.07	
# of obs.	364	274		364	
Municipalities with good governance (index score≤50)					
Refugee/ population ratio	−0.010	0.112**			0.215
	(0.101)	(0.053)			(0.272)
First-stage *F* stat	7.26	5.80			7.26
# of obs.	278	209			278

examines municipalities with good governance (LGQ index score less than or equal to 50). In some models, the first-stage F-statistics are below 10.

The results presented in these tables suggest that the three most important qualitative sub-components are, in the order of importance, corruption, transparency, and accountability. More specifically, environmental outcomes suffered more in municipalities with higher corruption (for instance where contracts, permits or licenses were granted without due process), lower transparency (for instance where bidding procedures were rigged) and lower accountability (for instance where municipal spending was not registered in conformity with the legal framework). When it comes to the quantitative indicators, the ratio of labor cost to total expenditure seems to play an important role.

Table 10
***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. *Source:* TurkStat, Turkish Directorate General of Migration Management, Turkish Court of Accounts auditors' reports and Google Maps. IV Estimation: Impact of refugee influx on env. outcomes by Interest Index.

	Log of per capita waste water	Log of per distributed	Capita water	Log of waste	per capita collected
Municipalities with bad governance (index score>50)					
Refugee/ population ratio	0.017***	0.029***			0.055*
	(0.005)	(0.011)			(0.033)
First-stage *F* stat	31.22	27.41			31.22
# of obs.	493	370			493
Municipalities with good governance (index score≤50)					
Refugee/ population ratio	−0.002	0.002		0.054	
	(0.005)	(0.005)		(0.040)	
First-stage *F* stat	4.21	4.78		4.21	
# of obs.	149	113		149	

Table 11
***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. *Source:* TurkStat, Turkish Directorate General of Migration Management, Turkish Court of Accounts auditors' reports and Google Maps. IV Estimation: Impact of refugee influx on env. outcomes by Labor Cost Index.

	Log of per capita waste water	Log of per distributed	Capita water	Log of waste	per capita collected
Municipalities with bad governance (index score>50)					
Refugee/ population ratio	0.012**	0.016**			0.036
	(0.006)	(0.007)			(0.027)
First-stage *F* stat	17.79	16.12			17.79
# of obs.	317	238			317
Municipalities with good governance (index score≤50)					
Refugee/ population ratio	0.013	0.023		0.079*	
	(0.010)	(0.017)		(0.044)	
First-stage *F* stat	5.94	4.94		5.94	
# of obs.	325	245		325	

Our findings are consistent with the findings reported by the large body of literature investigating the link between governance quality and growth (Stiglitz, 2002; Kaufmann, 2005). Turkish municipalities with low corruption, high transparency and accountability are more successful in addressing the environmental and municipal service challenges posed by increased refugee concentrations. Municipalities with better governance practices are able to mitigate the negative effects; while bad governance generates worse outcomes. This may further have public health and political economy consequences in the sense that confidence in political institutions as well as the level of satisfaction with

Table 12
***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. *Source:* TurkStat, Turkish Directorate General of Migration Management, Turkish Court of Accounts auditors' reports and Google Maps. The effect of refugees on waste water treatment capacity. Panel A: Log of number of waste water treatment plants.

	Log of per capita waste water	Log of per distributed	Capita water	Log of waste	per capita collected
Municipalities with bad governance (index score>50)					
Refugee/ population ratio	0.033***		0.020*	0.083**	
	(0.010)		(0.010)	(0.033)	
First-stage *F* stat	6.48		5.94	6.48	
# of obs.	338		255	338	
Municipalities with good governance (index score≤50)					
Refugee/ population ratio	0.013**		0.015	0.038	
	(0.005)		(0.009)	(0.034)	
First-stage *F* stat	16.22		13.70	16.22	
# of obs.	304		228	304	

local/regional governments may change depending on the quality of municipalities' response to the refugee shock.

4.5. Why does high LGQ lead to low environmental impact of refugees?

In this sub-section, we propose a mechanism that explains the negative association between local governance quality and the environmental impact of refugees. Our main argument is that munic-ipalities with high LGQ reacted quickly to the refugee crisis by installing new waste treatment plants, which increased the volume of treated waste and, therefore, mitigated the environmental effects. The available data allow us to perform this analysis only for waste water; as recycling data are not available for solid waste.

The upper panel of Fig. 9 plots the change in the number of treatment plants in municipalities with high versus low LGQ between 2008 and 2016. The figure suggests that the number of waste water treatment plants increased more rapidly in municipalities with high LGQ. The lower panel of Fig. 9 plots the change in the volume of recycled water in municipalities with high versus low LGQ between 2008 and 2016, which suggests that, again, the volume of recycled water is higher in municipalities with high LGQ than the ones with low LGQ. At face value, these two plots suggest that municipalities with higher LGQ invested more heavily into their waste treatment plants in response to the refugee influx, which increased their recycling capacity.[20]

Next we investigate the causal link between the change in waste water treatment capacity and the change in refugee concentration between high-versus low-LGQ municipalities using our baseline empirical design. Table 13 reports the IV-2SLS results. The estimates are in line with the *prima facie* evidence shown in Fig. 9. Specifically, Panel A of Table 13 reports that a ten-percentage point increase in the refugee-to-population ratio increases the number of waste water treatment plants by 2.2 percent in high-LGQ municipalities, while there is no effect in low-LGQ ones.[21] The estimates reported in Panel B suggest that a ten-percentage point increase in the refugee-to- population ratio increases the volume of recycled water per capita by 6.9 percent in municipalities with good governance, while it declines by 19 percent in municipalities with bad governance. It should be noted that although we know the number of treatment plants per municipality, we do not know the plant-level recycling capacity—which may differ across municipalities and plants. However, this limitation is not a big concern since we can directly observe the volume (in billion m^3) of recycled water—both total and per capita—for each municipality. Both Panel A and Panel B confirm the validity of the proposed mechanism: LGQ is a strong determinant of the timeliness and effectiveness of municipalities' response to the refugee crisis.

4.6. Testing common trends

In this sub-section, we test whether municipalities with and without refugee influx display similar pre-trends. In particular, we follow the approach by Autor (2003) and Tumen (2018, 2019a) to investigate whether or not the refugee effect becomes effective during the post-influx period in the treated provinces.

Specifically, we construct five year dummies—2006, 2008, 2010, 2014, and 2016—equal to 1 only in the relevant year and 0 in others. Then we regress our outcome variables on the interactions between the year dummies and a dummy variable indicating the treated region. Following Tumen (2019a), we form the treated region by using the provinces with the highest refugee concentration as of 2016—namely, Kilis, Gaziantep, Mardin, Sanliurfa, Adana, Adiyaman, Kahramanmaras, Osmaniye, Sirnak, Batman, Siirt, Diyarbakir, Mersin, and Istanbul. The regressions also control for year and province dummies. Standard errors are clustered at province level. Figs. 10–14 plot the coefficients of the interaction terms along with the 95 percent confidence bands. The year 2006 is the omitted time category, so the coefficients should be interpreted relative to 2006. The results suggest that the coefficient estimates are significant only for the post-influx period and there is no pre-trend prior to mass refugee influx. The signs and coefficients of the estimates are also fully consistent with our main results.

5. Robustness

In this section, we report further analyses establishing the robustness of our findings.

5.1. Robustness to using an alternative IV: predicted refugee inflows

We construct an alternative instrument based on shift-share approach, which suggests that past migration patterns strongly predicts the subsequent migration waves for the same nationality or ethnic groups (Card, 2001). In particular, we follow Altindag and Kaushal (2020) and Altindag et al. (2020) and define predicted refugee inflows as:

$$\text{Pred.}Inflow_{it} = \left(ArabicSpeakingPop_{i,1965} \,/\, TotalPop_{i,1965}\right) \frac{1}{TotalSyrianDisplacement_t}, \quad (4)$$

where the instrument, $Pred.Inflows_{it}$, is constructed as the interaction of the share of Turkish citizens with an Arabic mother language in 1965 and the total number of individuals displaced out-side Syria in year *t*. As explained in detailed in Altindag et al. (2020), the instrument relies on the geographic distribution of Turkish citizens who speak Arabic to predict the settlement patterns of Syrian refugees across Turkish provinces. It is important to note that migration flows from Syria to Turkey were negligible before the start of the civil war and some Turkish citizens can speak Arabic due to the multi-ethnic structure of the Ottoman Empire—before the collapse of the Empire, various ethnic groups were

[20] This descriptive pattern is in line with what our local governance index captures: that is, poorly governed municipalities lack institutional capacity to make the right and timely investments to cope with adverse shocks.

[21] In results not reported here but available upon request, we find that a higher refugee share leads to a more (less) spending on waste management services in well (badly) governed municipalities.

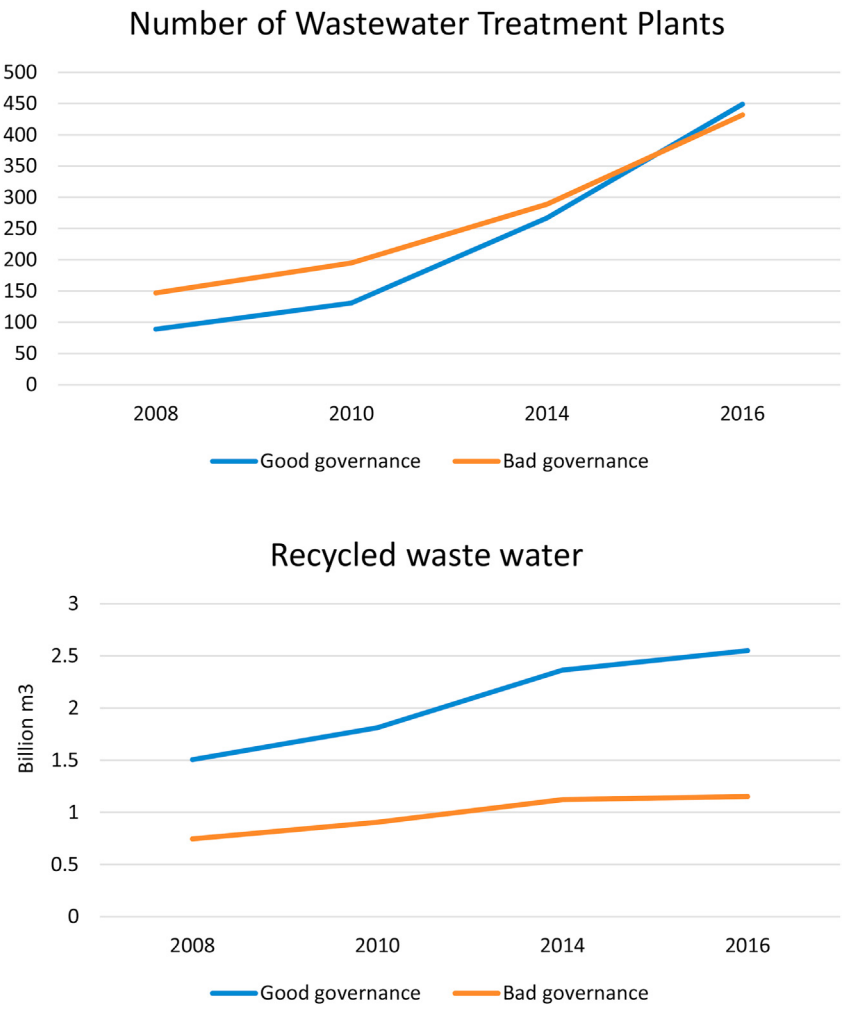


Fig. 9. Number of waste water treatment plants and volume of recycled water. The figures display the trends in the number of waste water treatment plants and the volume of recycled waste water from 2008 to 2016. *Source:* TurkStat.

Table 13
***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. *Source:* TurkStat, Turkish Directorate General of Migration Management, Turkish Court of Accounts auditors' reports, and Google Maps.

	Full-sample	Good governance	Bad governance
Refugee/population ratio	0.032**	0.048***	0.007
	(0.011)	(0.013)	(0.012)
First-stage *F* stat	23.18	33.23	12.14
# of obs.	729	387	342
Panel B: Log of per capita recycled water (billion m^3)			
Refugee/population ratio	0.014	0.069*	−0.190***
	(0.024)	(0.033)	(0.055)
First-stage *F* stat	23.18	33.23	12.14
# of obs.	729	387	342

living in today's Turkey. We do not discuss potential threats to exclusion restriction here in detail as it has been done by Altindag et al. (2020), who use the same instrument in a similar setting.

The results presented in Tables A5 and A6 show that our results remain mostly the same when we use a shift-share instrument.

5.2. Robustness to using comparable samples

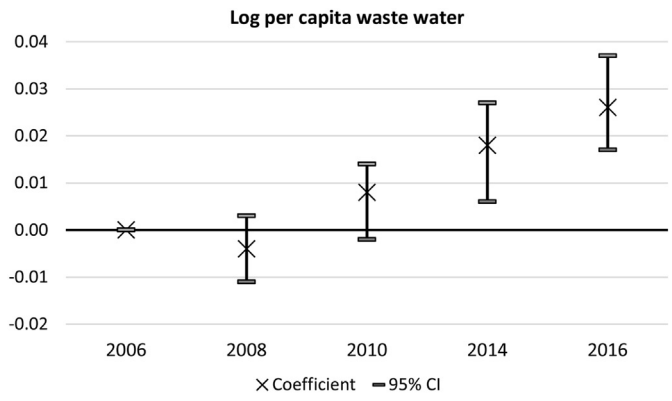
Our sample sizes change across models due to data unavailability. Thus, the results could conceivably be biased by heterogeneous, non-comparable samples across the six outcome variables. We, therefore, check the robustness our results by focusing on a sample (*N*: 403) where we observe all of our response variables in the same years for all municipalities. The results reported in Appendix Tables A7 and A8 confirm that our findings are robust across overlapping samples.

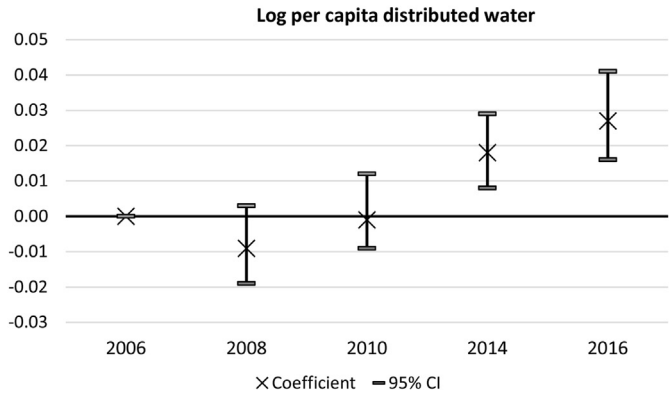
5.3. Robustness to conley correction for spatial correlation

We have addressed the issue of the non-independence of observations by reporting Conley standard errors in Appendix Table A9. Our results do not change.

5.4. Robustness to excluding provinces that received first wave of refugees

One may be concerned that refugee presence may also impact governance quality (by, for instance, creating opportunities to take bribes from refugees, or stealing funds that become available from higher levels of government) in the medium-term. To alleviate these concerns, we dropped provinces that received the first wave of refugees in 2012. Our results remain unchanged (see Appendix Table A10).





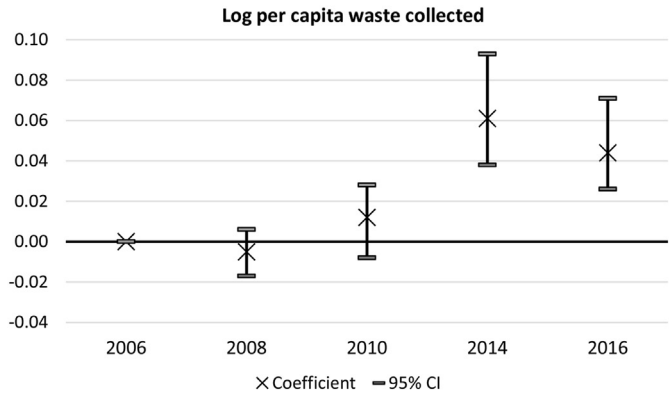
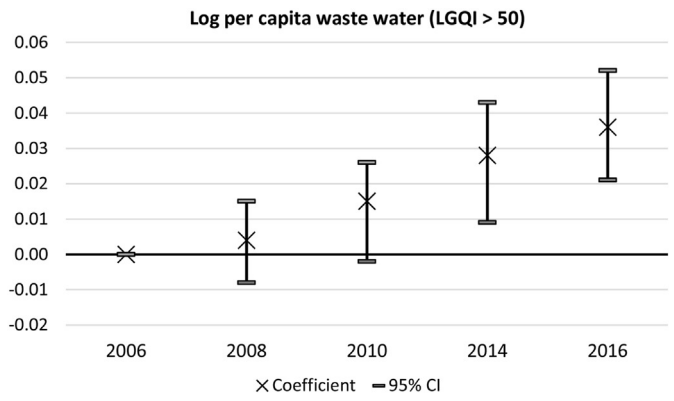
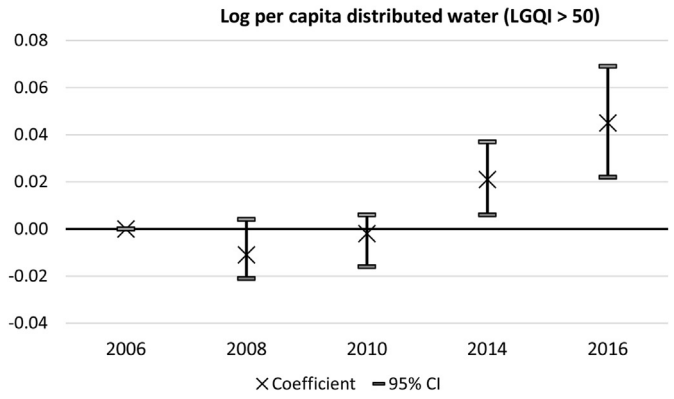


Fig. 10. Testing for common trends I. The figures display the tests of common trends for three outcome variables measured in per capita terms: waste water, distributed water, and waste collected (for the entire sample). Estimated coefficients of the interaction between treatment and year dummies are plotted together with the 95 percent confidence intervals. Standard errors are clustered at province level. The estimation procedure is described in Section 4.





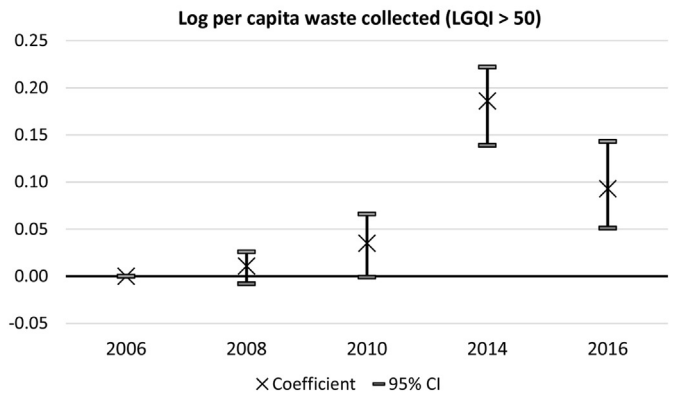


Fig. 11. Testing for common trends II. The figures display the tests of common trends for three outcome variables measured in per capita terms: waste water, distributed water, and waste collected (for provincial mu-nicipalities with good governance practices, i.e., LGQI > 50). Estimated coefficients of the interaction between treatment and year dummies are plotted together with the 95 percent confidence intervals. Standard errors are clustered at province level. The estimation procedure is described in Section 4.

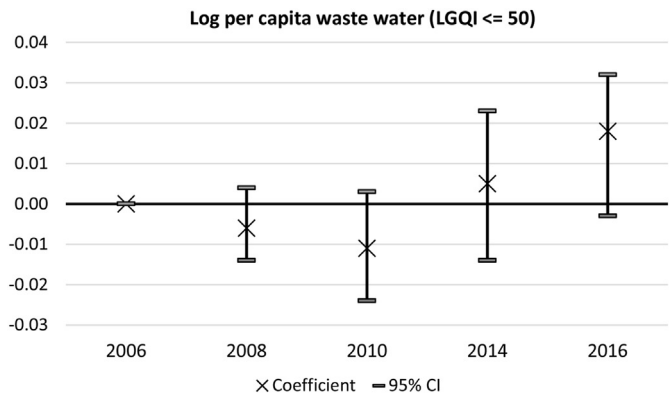
5.5. Robustness to using continuous governance quality index

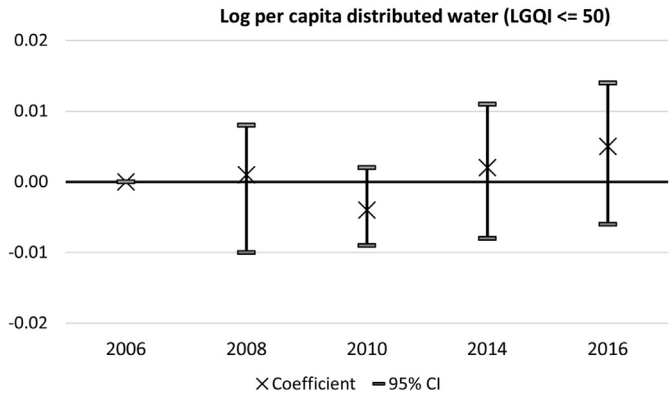
We also estimate the differential impact of better governance by interacting the local governance quality index with refugee-to-population ratio (as opposed to splitting the sample based on median governance quality index scores). In line with our main findings, the results presented in Appendix Table A11 suggest that higher refugee share leads to worse environmental outcomes in poorly governed municipalities.

5.6. Robustness to alternative governance quality index

Throughout the analysis, we split the sample based on median governance quality index scores.

However, one might be concerned that a cutoff based on median can group the very worst and very best municipalities into separate categories, with some "in-between" municipalities also going in on either side. As a robustness check, we also defined municipalities with bad





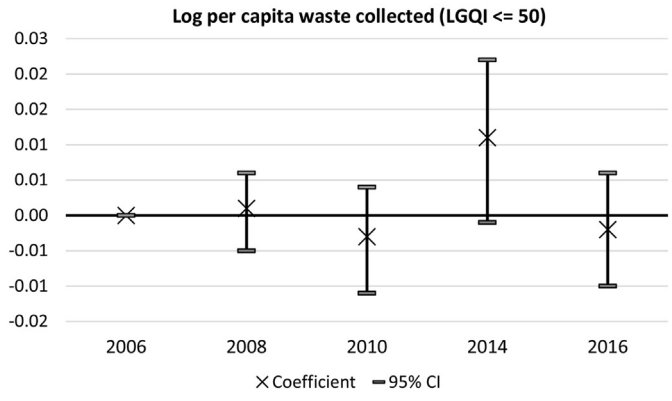
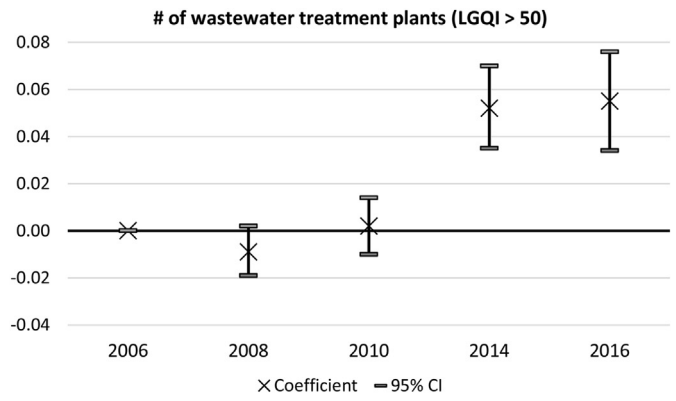


Fig. 12. Testing for common trends III. The figures display the tests of common trends for three out-come variables measured in per capita terms: waste water, distributed water, and waste collected (for provincial municipalities with bad governance practices, i.e., LGQI 50). Estimated coefficients of the interaction between treatment and year dummies are plotted together with the 95 percent confidence intervals. Standard errors are clustered at province-level. The estimation procedure is described in Section 4.



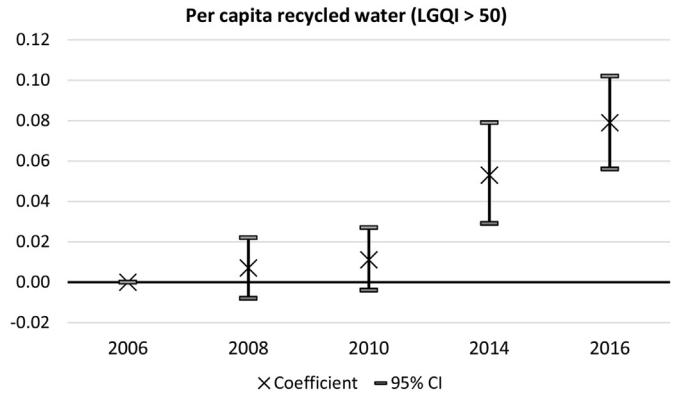


Fig. 13. Testing for common trends IV. The figures display the tests of common trends for two outcome variables: number of waste water treatment plants and recycled water (for provincial municipalities with good governance practices, i.e., LGQI $>$ 50). Estimated coefficients of the interaction between treatment and year.

governance as index score$>$60 and municipalities with good governance as index score$\leq$40. We find that our results are robust to this alternative definition—see Table A12.

6. Concluding remarks

The sudden inflow of refugees to Turkey after January 2012 increased pressures on already-strained municipal infrastructure services such as water, sanitation and solid waste. Indeed, we find that, on average, the Syrian refugee influx has increased solid waste, waste water, and distributed clean water levels in Turkey. However, environmental degradation is almost entirely driven by municipalities with low LGQ, while there is no change in environmental outcomes in the municipalities with high LGQ. Our analysis suggests that additional waste treatment plant investments in well-governed municipalities explain this finding.

The quality of governance varies significantly not just across countries, but also within them, reflecting local responsibilities in public good provision, as well as variation in the enforcement and implementation of national regulations. Our results are also in line with this observation: well-governed municipalities were better at tackling the challenges from rapidly increasing population density and investing in infrastructure to keep pace with population growth. The results thus suggest that there is scope for improving local governance, even conditional on country-level institutions.

Our findings imply that part of the policy challenges and pressures generated by increased refugee concentration can be absorbed by local governments through improved quality of local governance practices along various dimensions. This could involve benchmarking the municipality's performance, reducing red tape and increasing the transparency of the regulatory process. In particular, improved local governance quality can increase the refugee absorption capacity of the host regions, which might mitigate the burden on central government units. The results can be generalized to other refugee hosting countries in the Europe, the Middle East and certain regions of Africa and Asia.

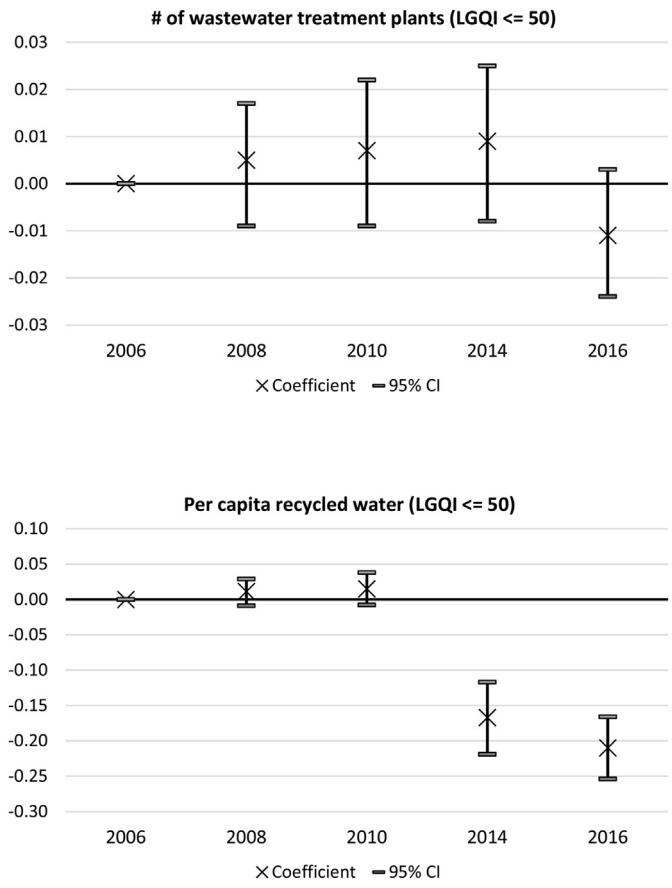


Fig. 14. Testing for common trends V. The figures display the tests of common trends for two outcome variables: number of waste water treatment plants and recycled water (for provincial municipalities with bad governance practices, i.e., LGQI $\leq$ 50). Estimated coefficients of the interaction between treatment and year.

Author statement

We, as authors of the manuscript "Local Governance Quality and the Environmental Cost of Forced Migration", declare no conflict of interest. All authors contributed equally.

Data availability

Data will be made available on request.

A Appendix Tables

Balance on badly and well governed provinces by observable characteristics.

Table A1
Means (standard deviations). This table shows the balance on badly and well governed municipal-ities by observable characteristics. OLS Estimation: Relationship between governance quality and refugees' location choice

Variables	Mean (Standard deviation)
Municipalities with bad governance (index score>50)	
Log of exports	11.29 (2.56) – *N*: 529
Log of imports	11.04 (2.85) – *N*: 531
Log of nighttime light density	1.25 (0.84) – *N*: 570
Log of population	13.34 (1.00) – *N*: 570
Municipalities with good governance (index score≤50)	11.16 (2.63) – *N*: 597
Log of exports	
Log of imports	10.85 (2.48) – *N*: 599
Log of nighttime light density	1.17 (0.76) – *N*: 645
Log of population	12.98 (0.95) – *N*: 645

Table A2
***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. All models include year-fixed effects and sub-region by year fixed effects. Province level controls are log of exports, log of imports, log of mean nighttime light density, and log of population. The period of analysis is 2013–2016. Source: TurkStat, Turkish Directorate General of Migration Management, and Turkish Court of Accounts auditors' reports. IV Assumptions: Suggestive evidence on exclusion restriction

	Governance quality	Governance quality
Refugee/population ratio	0.393	0.029
	(0.464)	(0.361)
Refugee/population ratio*2014	−0.040	−0.042
	(0.265)	(0.185)
Refugee/population ratio*2015	0.258	−0.614
	(0.763)	(0.614)
Refugee/population ratio*2016	0.002	0.035
	(0.021)	(0.036)
# of obs.	324	324
Province level controls	No	Yes

Table A3
***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, and sub-region specific linear time trends. Source: TurkStat, Turkish Directorate General of Migration Management, and Google Maps. IV Assumptions: Suggestive evidence on the monotonicity

	Log of province level exports	Log of province level imports	Log of nighttime light density
Instrument	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
# of obs.	1215	1215	1215

Table A4
***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, and sub-region specific linear time trends. Regions 1–3 include Istanbul and provinces in West Marmara and Aegean sub-regions; Regions 4–6 include provinces in East Marmara, West Anatolia, and Mediterranean sub-regions; Regions 7–9 include provinces in Central Anatolia, West Black Sea, and East Black Sea sub-regions; Regions 10–12 include provinces in Northeast Anatolia, Central East Anatolia, and Southeast Anatolia sub-regions. Source: TurkStat, Turkish Directorate General of Migration Management, and Google Maps. IV Estimation: Results with an alternative instrument (predicted refugee inflows)

	Refugee/population	Refugee/population	Refugee/population	Refugee/population
Sample is	Regions 1-3	Regions 4-6	Regions 7-9	Regions 10-12
Instrument	0.003	0.001***	0.001***	0.003***
	(0.001)	(0.000)	(0.000)	(0.000)
# of obs.	90	285	360	360

Table A5
***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. The instrument, predicted refugee inflows, is constructed as the interaction of the number of Syrians who left their country each year and the share of Arabic speaking populations in Turkish provinces in 1965 following Altindag et al. (2020). Standard errors are clustered at the province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. Source: TurkStat, Turkish Directorate General of Migration Management, and Turkish 1965 Population Census. IV Estimation: Results with an alternative instrument (predicted refugee inflows) and by LGQI

	Log of per capita waste water	Log of per capita distributed water	Log of per capita waste collected
Refugee/population ratio	0.018** (0.009)	0.025*** (0.008)	0.038* (0.017)
First-stage coefficient	0.002*** (0.000)	0.001*** (0.000)	0.003*** (0.000)
First-stage *F* -stat	11.21	10.48	11.21
# of obs.	642	483	642
	Log of per capita exp. on municipal waste water management services	Log of per capita exp. on municipal water supply works and services	Log of per capita exp. on municipal waste management services
Refugee/population ratio	0.029 (0.081)	0.047 (0.071)	−0.008 (0.017)
First-stage coefficient	0.000*** (0.000)	0.002*** (0.000)	0.002*** (0.000)
First-stage *F* -stat	15.49	14.62	15.49
# of obs.	907	1026	1036

Table A6

***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. The instrument, predicted refugee inflows, is constructed as the interaction of the number of Syrians who left their country each year and the share of Arabic speaking populations in Turkish provinces in 1965 following Altindag et al. (2020). Standard errors are clustered at the province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. Source: TurkStat, Turkish Directorate General of Migration Management, and Turkish 1965 Population Census. IV Estimation: Robustness to using comparable samples

	Log of per capita waste water		Log of per distributed	Capita water	Log of waste	per capita collected
Municipalities with bad governance (index score>50)						
Refugee/population ratio	0.019*	0.048***				0.062*
	(0.011)	(0.016)				(0.036)
First-stage *F* -stat	8.44	9.71				8.44
# of obs.	301	226				301
Municipalities with good governance (index score≤50)						
Refugee/population ratio	0.007	0.020**			−0.001	
	(0.006)	(0.008)			(0.008)	
First-stage *F* -stat	24.13	34.39			24.13	
# of obs.	341	257			341	

Table A7

***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. Source: TurkStat, Turkish Directorate General of Migration Management, and Google Maps. IV Estimation: Robustness to using comparable samples and by LGQI

	Log of per capita waste water	Log of per capita distributed water	Log of per capita waste collected
Refugee/population ratio	0.014** (0.006)	0.026*** (0.010)	0.055** (0.028)
First-stage *F* -stat	33.28	33.28	33.28
# of obs.	403	403	403
	Log of per capita exp. on municipal waste water management services	Log of per capita exp. on municipal water supply works and services	Log of per capita exp. on municipal waste management services
Refugee/population ratio	−0.079 (0.101)	0.049 (0.089)	0.008 (0.012)
First-stage *F* -stat	33.28	33.28	33.28
# of obs.	403	403	403

Table A8

***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. Source: TurkStat, Turkish Directorate General of Migration Management, and Google Maps. IV Estimation: Robustness to Conley corrections for spatial correlation

	Log of per capita waste water		Log of per distributed	Capita water	Log of waste	per capita collected
Municipalities with bad governance (index score>50)						
Refugee/population ratio	0.019**	0.039***			0.102***	
	(0.008)	(0.015)			(0.026)	
First-stage *F* -stat	10.32	10.32			10.32	
# of obs.	187	187			187	
Municipalities with good governance (index score≤50)						
Refugee/population ratio	0.014		0.011		−0.007	
	(0.008)		(0.010)		(0.005)	
First-stage *F* -stat	561.48		561.48		561.48	
# of obs.	216		216		216	

Table A9

***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are calculated using corrections for spatial correlation (Conley, 1999). Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. Source: TurkStat, Turkish Directorate General of Migration Management, and Google Maps. IV Estimation: Robustness to excluding provinces that received the first wave of refugees

	Log of per capita waste water	Log of per capita distributed water	Log of per capita waste collected
Refugee/population ratio	0.010* (0.006)	0.018** (0.007)	0.058** (0.028)
First-stage *F* -stat	19.46	16.74	19.46
# of obs.	642	483	642
	Log of per capita exp. on municipal waste water management services	Log of per capita exp. on municipal water supply works and services	Log of per capita exp. on municipal waste management services
Refugee/population ratio	−0.018 (0.086)	0.061 (0.076)	0.006 (0.011)
First-stage *F* -stat	71.89	83.39	45.04
# of obs.	907	1026	1036

Table A10

***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. Source: TurkStat, Turkish Directorate General of Migration Management, and Google Maps. IV Estimation: Robustness to using continuous governance quality index

	Log of per capita waste water	Log of per capita distributed water	Log of per capita waste collected
Refugee/population ratio	0.019*** (0.007)	0.025** (0.011)	0.146*** (0.028)
First-stage *F* -stat	19.46	16.74	19.46
# of obs.	626	471	626
	Log of per capita exp. on municipal waste water management services	Log of per capita exp. on municipal water supply works and services	Log of per capita exp. on municipal waste management services
Refugee/population ratio	0.042 (0.126)	0.085 (0.105)	0.001 (0.015)
First-stage *F* -stat	71.89	83.39	45.04
# of obs.	888	1007	1010

Table A11

***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. Source: TurkStat, Turkish Directorate General of Migration Management, and Google Maps. IV Estimation: Robustness to alternative LGQI definition

	Log of per capita waste water	Log of per capita distributed water	Log of per capita waste collected
Refugee/population ratio*LGQI	0.051**	0.027*	0.103*
	(0.025)	(0.013)	(0.060)
Refugee/population ratio	−0.022	0.002	−0.006
	(0.017)	(0.017)	(0.032)
LGQI	0.002	−1.355	−0.023***
	(0.006)	(0.943)	(0.006)
First-stage coefficient	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)
First-stage *F* -stat	20.21	17.14	20.21
# of obs.	642	483	642

Table A12

***, **, *, indicate 1%, 5%, and 10%, significance levels, respectively. Standard errors are clustered at province level. Controls include year-fixed effects, province-fixed effects, sub-region by year fixed effects, sub-region specific linear time trends as well as time varying province level variables, which are log of exports, log of imports, log of mean nighttime light density, and log of population. Source: TurkStat, Turkish Directorate General of Migration Management, Turkish Court of Accounts auditors' reports, and Google Maps.

	Log of per capita waste water		Log of per distributed	Capita water	Log of waste	per capita collected
Municipalities with bad governance (index score>60)						
Refugee/population ratio	0.019**	0.041***			0.149***	
	(0.008)	(0.011)			(0.044)	
First-stage *F* -stat	11.99	12.52			13.87	
# of obs.	268	198			256	
Municipalities with good governance (index score≤40)						
Refugee/population ratio	0.011		0.022		0.009	
	(0.012)		(0.016)		(0.010)	
First-stage *F* -stat	23.46		36.49		36.79	
# of obs.	312		213		312	

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