CITIES IN EUROPE AND CENTRAL ASIA

GERMANY

METHODOLOGY

This country snapshot was produced as part of an Advisory Services and Analytics *(ASA)* work developed by the Urban, Social, Rural and Resilient Global Practice (GPSURR). The objective of this ASA is to analyze economic, spatial and demographic trends in the urban systems of countries in Europe and Central Asia. City-level population data was obtained from the National Statistics Institute. In the absence of city-level economic and spatial data over the period of analysis, nighttime light *(NLS)* satellite imaging was used to assess spatial and demographic trends in cities. In previous studies, NLS intensity has been found to be positively correlated with levels of economic activity as measured by GDP. Regional-level regressions of NLS and GDP were conducted to assess the validity of using NLS as a proxy for economic activity in Germany. The results suggest a significant and positive correlation between NLS intensity and GDP. In Germany, GDP to NLS elasticity was found to be 0.72 *(an increase in light intensity of 1 percent is associated with a 0.72 percent increase in GDP)*. This country snapshot presents its results at the city level. Due to measurement error, city-level economic and spatial results should be analyzed with caution; and when possible, additional city level data *(i.e. satellite imagery, firm-level data, and etc.)* should be consulted to corroborate results. This snapshot classified 1,014 settlements in Germany as cities. Demographic trends are available for all 1,014 cities but NLS analysis is only available for 954 cities; the remaining settlements did not produce enough light to be considered “urban” by the NLS threshold employed in this analysis. Similar assessments done for other countries suggest that NLS are able to capture most settlements with 30,000 inhabitants or more. For additional information on this ASA please contact Paula Restrepo Cadavid (prestrepocadavid@worldbank.org) or Sofia Zhukova (szhukova@worldbank.org)

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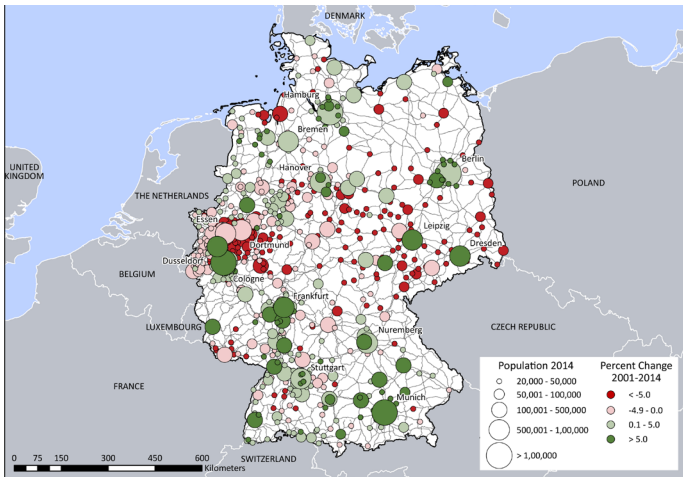
DEMOGRAPHICS

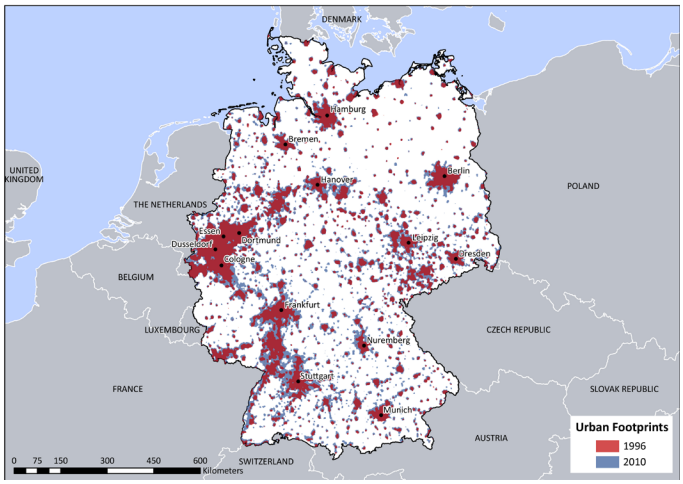
		BEFORE	RECENTLY
Fertility Rates	Germany	1.35[1]	1.38[2]
	ECA	1.55[1]	1.72[2]
Life Expectancy	Germany	78.32[1]	81.04[2]
	ECA	73.02[1]	76.77[2]
% of Population Above Age 65	Germany	16.62[1]	21.07[2]
	ECA	13.35[1]	15.37[2]
Population Growth (Average Annual %)	Germany	-0.11[3]	
	ECA	0.31[3]	
Urban Population Growth (Average Annual %)	Germany	0.07[3]	
	ECA	0.55[3]	
Urbanization Level (%)	Germany	73.11[1]	75.09[2]
	ECA	68.11[1]	70.52[2]
Annual Urbanization Rate (%)	Germany	0.19[3]	
	ECA	0.23[3]	
City Average Population	Germany	52,736[1]	52,508[2]
	ECA	61,105[1]	64,914[2]
% Cities With More Than 100,000	Germany	8.18[1]	7.59[2]
	ECA	10.41[1]	10.57[2]
% Cities With More Than 500,000	Germany	1.18[1]	1.38[2]
	ECA	1.56[1]	1.83[2]
% Cities losing Population	Germany	61.04[3]	
	ECA	61.07[3]	



SPATIAL

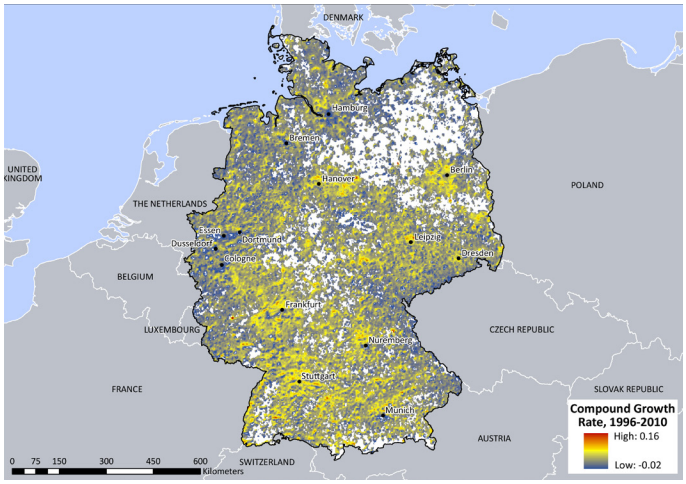
		BEFORE	RECENTLY
Built Up Area (100,000km²)	Germany	22,010[4]	28,662[5]
	ECA	213,244[4]	288,046[5]
Built Up m² Per Capita	Germany	267.73[4]	355.51[5]
	ECA	247.39[4]	320.89[5]
Built Up Area Growth (%)	Germany	30.22[6]	
	ECA	35.07[6]	
Built Up m² Per Capita Growth (%)	Germany	32.79[6]	
	ECA	29.54[6]	
Number of Cities in Analysis	Germany	1,014[3]	
	ECA	5,549[3]	
Number of Identified Cities (NLS)	Germany	954[7]	
	ECA	3,637[7]	
Number of Growing Cities (NLS Area)	Germany	286[7]	
	ECA	1,804[7]	
Number of Agglomerations(NLS)	Germany	107[7]	
	ECA	352[7]	

This section uses data from the Global Human Settlement layer (GHSL) developed by the Joint Research Centre of the European Commission. The GHSL extracts geospatial imagery to map and report on human settlements and urbanization.



ECONOMICS

		BEFORE	RECENTLY
Average Annual GDP growth (%)	Germany	1.07[3]	
	ECA	1.75[3]	
Average Annual GDP per capital growth (%)	Germany	1.19[3]	
	ECA	1.38[3]	
Estimated contribution of urban GVA to GDP growth (%)	Germany	99.57[8]	
	ECA	—	
Unemployment Rate (%)	Germany	5.30[2]	
	ECA	9.60[2]	
Poverty rate (% at national poverty line)	Germany	—	
	ECA	—	
Urban to rural GVA ratio	Germany	76.18[9]	
	ECA	—	
Urban NLS Intensity Growth (%, annual average)	Germany	6.84[7]	
	ECA	6.92[7]	
% City Economies Growing (in NLS intensity)	Germany	97.81[7]	
	ECA	95.92[7]	
GDP to NLS Elasticity	Germany	0.72[10]	
	ECA	0.37[10]	

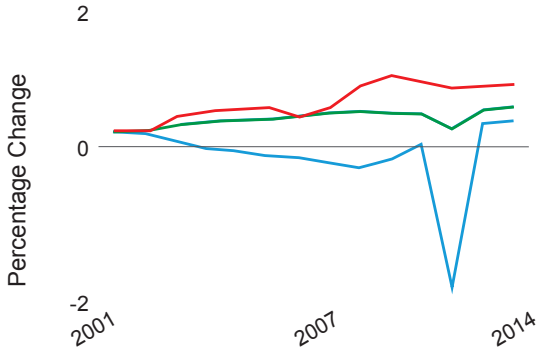


[1] 2001, [2] 2014, [3] 2001–2014, [4] 2000, [5] 2013, [6] 2000–2013, [7] 2000–2010, [8] 2001–2008, [9] 2008, [10] 1996–2010.

URBANIZATION TRENDS

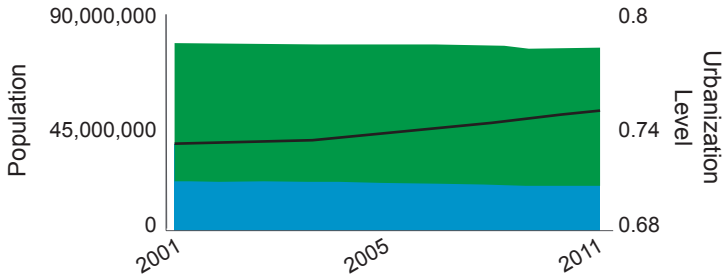
Germany's population is declining. Between 2001 and 2014, Germany's population declined by 1.47 percent for an average annual decline of 0.11 percent. In addition to population decline, the share of Germany's population above 65 years is 21.07—nearly 6 percent greater than the average share of population above 65 in ECA. Finally, although fertility rates have increased, they are below replacement levels and remain lower than the average fertility rate in ECA in 2014.

Germany continues to urbanize slowly despite its declining population. Germany's urbanization level increased by 1.98 percent to 75.09 percent in 2014. In 2014, the urban population was nearly three times greater than the rural population. Between 2001 and 2014 the rural population declined by 8.89 percent while the urban population increased by 1.26 percent.



Population Growth, 2001–2014

Germany — ECA *(All Income levels)* — ECA *(Developing Only)*



Urbanization Trends, 2001–2014

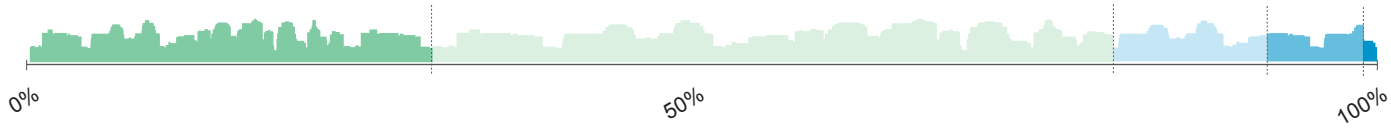
Rural Population — Urban Population — Urbanization Level

DEMOGRAPHICS OF THE URBAN SYSTEM

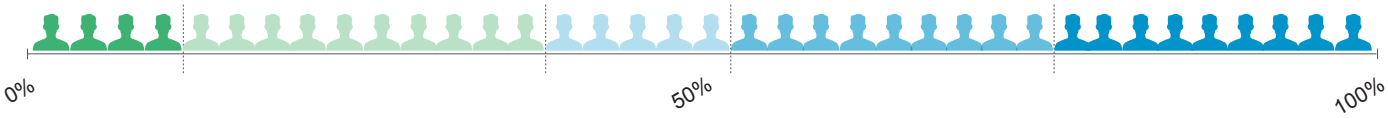
Population growth is concentrated in large cities in Germany. 81.85 percent of the urban system is comprised of settlements with less than 50 thousand inhabitants although 48.73 percent of the population live in settlements with more than 100 thousand inhabitants. Between 2001 and 2014, 61.04 percent of the cities used in this analysis declined in population. Cities with more than 500 thousand inhabitants continue to attract population and between 2001 and 2014 grew an average of 5.32 percent. In contrast, small cities with less than 100 thousand inhabitants have, on average, declined in population. In fact, settlements between 10 and 20 thousand inhabitants have declined the most, declining 4.07 percent between 2001 and 2014.

Agglomerations present the highest population growth numbers. According to the nighttime lights threshold used in this analysis, Germany has the highest number of agglomerations in the region (a total of 107 agglomerations were identified). Additionally, all of the 15 fastest growing cities belong to an agglomeration *(primarily Berlin or Munich, see table below)*. Two diverging dynamics can be observed within Germany's agglomerations. In some agglomerations, the main cities like Leipzig, Bielfeld and Hanover are growing in population while the cities surrounding them are losing population. In other agglomerations, like Berlin and Hamburg, surrounding cities are growing faster than or on pace with the population growth of their main city.

DISTRIBUTION OF CITIES BY CITY SIZE: **2014**



URBAN POPULATION DISTRIBUTION BY CITY SIZE: **2014**



Small Town (<10k) — Mid-Size Towns (10k–20k) — Large Towns (20k–50k) — Small Cities (50k–100k) — Mid Size Cities (100k–500k) — Major Cities (>500k)

LARGEST CITIES BY POPULATION

CITY	POPULATION 2014	% CHANGE 2001–2014
Berlin	3,469,849	2.40
Hamburg	1,762,791	2.11
Munich	1,429,584	16.42
Cologne	1,046,680	8.13
Frankfurt am Main	717,624	11.94
Stuttgart	612,441	4.31
Dusseldorf	604,527	5.92
Dortsmund	580,511	-1.48
Essen	573,784	-3.06
Bremen	551,767	2.00
Leipzig	544,479	10.43
Dresden	536,308	12.05
Hanover	523,642	1.40
Nuremberg	501,072	1.99
Duisburg	485,465	-5.19

LARGEST URBAN AGGLOMERATIONS*

AGGLOMERATION MAIN CITY	POPULATION 2014	% CHANGE 2001–2014	CITY COUNT
Leipzig	1,819,163	-0.06	59
Bielefeld	1,975,059	-0.01	58
Berlin	4,112,344	0.04	39
Hanover	1,897,169	0.00	38
Saarbrucken	747,297	-0.07	35
Munich	1,920,832	0.14	32
Hamburg	2,379,189	0.03	27
Nuremberg	1,018,436	0.03	24
Ulm	334,096	0.03	17
Dresden	729,879	0.07	13
Bremen	874,211	0.01	13
Augsburg	346,951	0.08	9
Gummersbach	188,376	-0.06	9
Kassel	263,898	-0.01	8
Siegen	218,806	-0.06	8

* The nighttime lights threshold used in this analysis identifies Cologne as a corridor of cities.

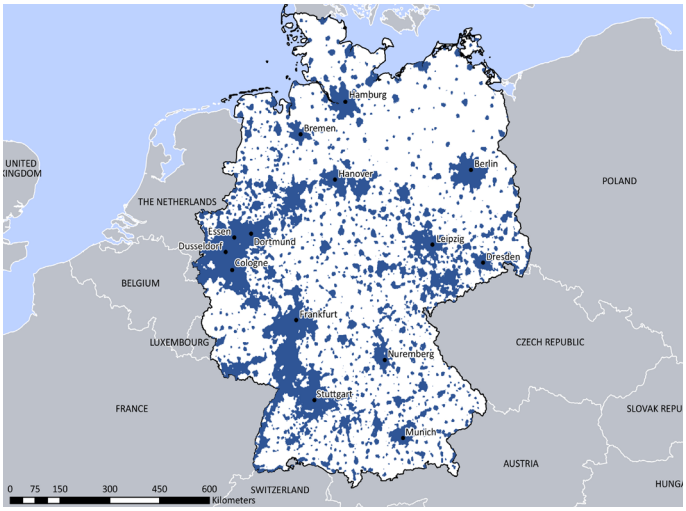
FASTEST GROWING CITIES

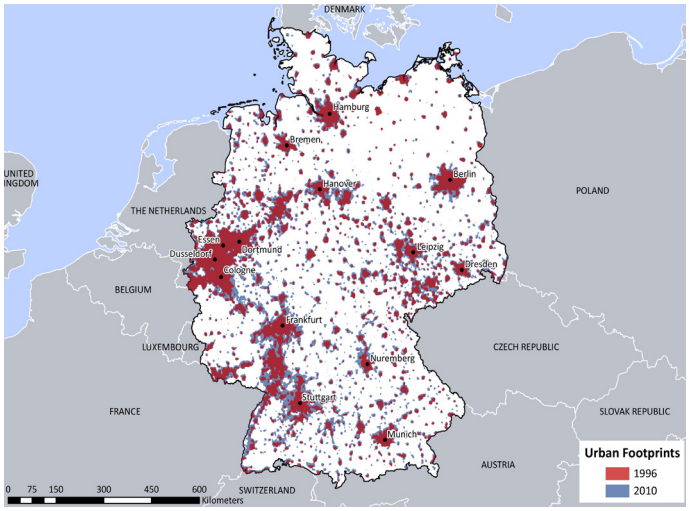
CITY	POPULATION 2014	% CHANGE 2001–2014	BELONGS TO AN AGGLOMERATION	AGGLOMERATION
Teltow	24,609	33.42	Yes	Berlin
Hoppegarten	17,002	29.55	Yes	Berlin
Hohen Neuendorf	25,239	28.03	Yes	Berlin
Kleinmachnow	20,562	24.57	Yes	Berlin
Ostfildern	37,785	18.95	Yes	Cologne
Falkensee	41,777	18.36	Yes	Berlin
Dachau	45,985	18.16	Yes	Munich
Blankenfelde-Mahlow	25,981	17.73	Yes	Berlin
Panketal	19,721	17.23	Yes	Berlin
Remseck am Neckar	25,042	17.14	Yes	Cologne
Bad Krozingen	17,839	17.13	Yes	Cologne
Haar	19,920	16.59	Yes	Munich
Munich	1,429,584	16.42	Yes	Munich
Potsdam	164,042	15.60	Yes	Berlin
Ranheim	15,270	15.11	Yes	Cologne

SPATIAL TRENDS OF THE URBAN SYSTEM

All of the cities in Germany's urban system are growing in area. 70.09 percent of identified cities despite losing population continue to grow in area, which is suggestive of urban sprawl. Between 2000 and 2010 the average annual area change *(footprint growth as measured by changes in nighttime lights area)* was 400.12 percent in Germany. Cities between 10 and 20 thousand inhabitants declined the most in population but increased the most in area.

Note: Night-Lights are used to define urban footprints and follow their change over time. A urban threshold *(above which a certain pixel is considered urban)* is estimated for each country and used to delimit cities' footprints. Agglomerations —as defined by NLS—are composed of cities whose NLS footprint merges. Single cities are cities who do not belong to any agglomeration.



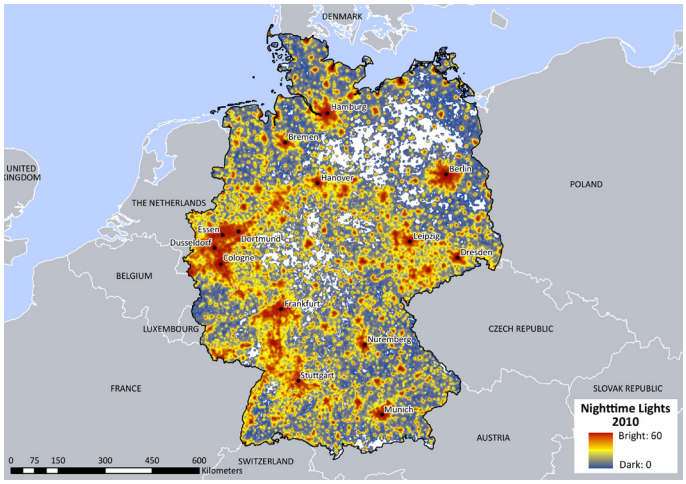


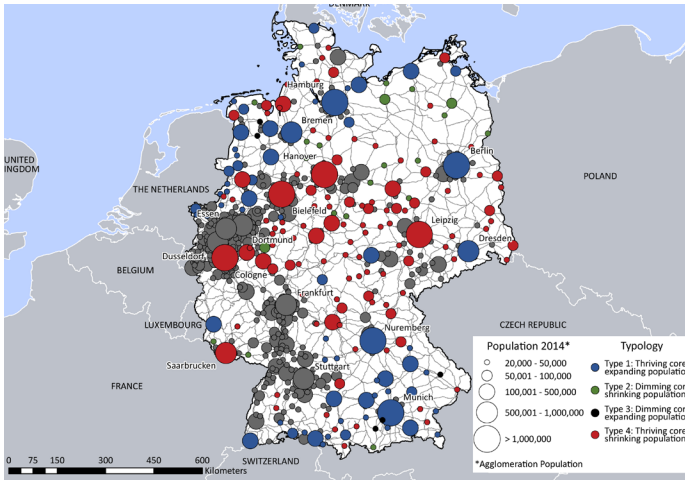
ECONOMICS OF THE URBAN SYSTEM

The urban sector is an important driver of economic growth in Germany. Between 2001 and 2008 the urban sector accounted for an estimated 99.57 percent of Germany's GVA growth. Additionally, although the urban population is more than three times greater than the rural population, the urban to rural GVA is 76.18 which suggest that urban areas are more productive than rural areas. In Germany, the contributions of the urban sector to the economy are substantially greater than what is observed in other countries in the region.

The majority of Germany's cities are growing in economic activity. Nighttime lights are used as a proxy for economic activity in this analysis *(please refer to page one for methodology)*. According to the nighttime lights threshold used in this analysis, 97.81 percent of identifies cities in Germany grew in economic activity between 2001 and 2010. Saarland, a small region east of Luxembourg had the highest average growth in nighttime lights between 2000 and 2010.

Note: Night-light intensity is being used as a proxy for economic activity at the city-level. For more information on the methodology please refer to page 1 of this snapshot. Gross value added *(GVA)* data by sector, as reported by the United Nations Statistics Bureau, is used to measure urban and rural production as a part of total production. The sectors were divided into those that are urban and those that are rural using the International Standard Industrial Classification of all economic activities *(ISIC)*, rev. 3.





CITY TYPOLOGIES

Two city typologies were created based on nighttime lights *(see below)*. These typologies are intended to shed light on economic and demographic trends in Germany's urban system. **Typology 1** divides cities based on whether they emit enough light to be considered as urban in 2000 and in 2010. In Germany, 94.08 percent of cities emitted enough light to be considered urban in both periods *(identified)*, 3.55 percent were considered urban only in 2000 *(submerging)* and the remaining 2.37 percent were not considered urban in both periods *(not identified)*. **Typology 2** classifies identified cities into four types based on their nighttime light trends *(thriving or dimming)*, which are used as a proxy for growing or declining levels of economic activity, and population trends *(growing or declining)*. In Germany, 28.22 percent of the identified cities have a growing population and growing economic activity *(type 1)*. Type 1 cities include Berlin and Hamburg. 13.59 percent of the identified cities have a declining population and declining economic activity *(type 2)*. Type 2 cities include Schweing and Neubrandenburg. 3.83 percent of cities have a growing population and declining economic activity *(type 3)*. 54.36 percent of the identified cities have a declining population and growing economic activity *(type 4)*. Type 4 cities include Biefled and Hanover. The typology 2 classification is calculated using the population changes of agglomerations or single cities. Since small cities in agglomerations are declining, on average, at rates that are higher than the main city, many agglomeration fall into type 4. Main cities like Hanover, which actually grew in population and economic activity between 2001 and 2014 would be type 1 cities but are type 4 because of population decline of smaller cities in its agglomeration.

Note: **TYPOLOGY 1:** Divides cities into types depending on whether they satisfy a minimum level of light brightness that is pre-defined for the settlement to be considered urban. IDENTIFIED indicates cities that have night-lights data for both periods used in this analysis *(2000 and 2010)*; EMERGING indicates cities that only have night-lights data for the second period; SUBMERGING indicate cities that only have night-lights data for the first period; NOT IDENTIFIED indicates cities that do not have night-lights data for either period.

TYPOLOGY 2: Divides the IDENTIFIED cities into types according to whether they have positive or negative growth in population and NLS brightness. Growth is calculated between 2000 and 2010.

TYPOLOGY 1

TYPOLOGY 1	DESCRIPTION	NUMBER	PERCENTAGE
Identified	City emits enough light in both 2000 & 2010	954	94.08
Emerging	City emits enough light only in 2010	36	3.55
Submerging	City emits enough light only in 2000	0	0.00
Non-Identified	City does not emit enough light in both 2000 & 2010	24	2.37

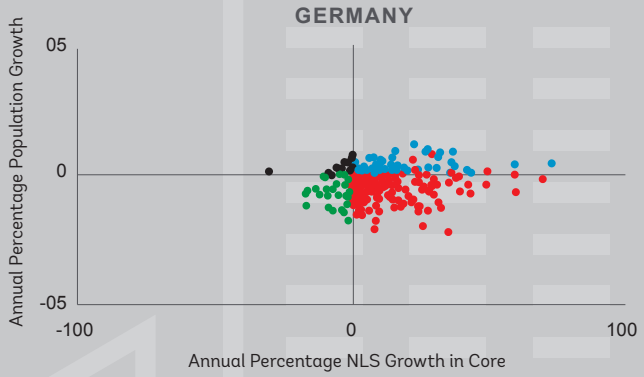
TYPOLOGY 2

TYPOLOGY 2	DESCRIPTION	NUMBER	PERCENTAGE
Type 1 (Blue)	Growing population & growing economic activity **(thriving core)**	81	28.22
Type 2 (Green)	Declining population & declining economic activity **(dimming core)**	39	13.59
Type 3 (Black)	Growing population & declining economic activity **(thriving core)**	11	3.83
Type 4 (Red)	Declining population & growing economic activity **(dimming core)**	156	54.36

	TYPE 1: Growing Population & Growing Economic Activity	**TYPE 2:** Declining Population & Declining Economic Activity	**TYPE 3:** Growing Population & Declining Economic Activity	**TYPE 4:** Declining Population & Growing Economic Activity
Population 2011 (000s)	**206.94** (572.37)	**26.04** (16.12)	**20.34** (4.63)	**219.41** (174.68)
Average Annual Population Growth (% 2001–2011)	**0.30** (0.24)	**-0.73** (0.49)	**0.26** (0.19)	**-0.68** (0.49)
Total NLS Value in 2010 (000s)	**31.45** (76.43)	**3.29** (2.70)	**2.32** (1.95)	**41.06** (298.80)
NLS per Capita (2010)	**0.19** (0.30)	**0.12** (0.06)	**0.11** (0.07)	**0.19** (0.12)
NLS Growth (% 2000–2010)	**61.53** (36.73)	**49.94** (32.05)	**52.16** (27.37)	**72.90** (27.08)
Examples of Cities	**Berlin, Hamburg, Munich**	**Schwerin, Lennestadt, Neubrandenburg**	**Deggendorf, Starnberg, Westerstede**	**Bielefeld, Hanover, Leipzig**

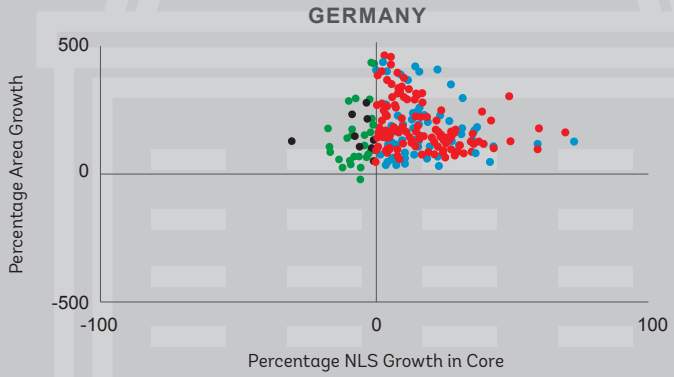
A spatial component added to the **Typology 2** classification provides insight into the interaction between spatial, economic and demographic trends across Germany's urban system. The spatial element reveals that no cities in Germany have declined in area between 2000 and 2010. **Type 3 cities**, which are growing in population and declining in economic activity, had the highest average area change in Germany. **Type 2 cities**, which are declining in population and declining in economic activity, increased in area the least.

POPULATION AND ECONOMIC DYNAMICS*



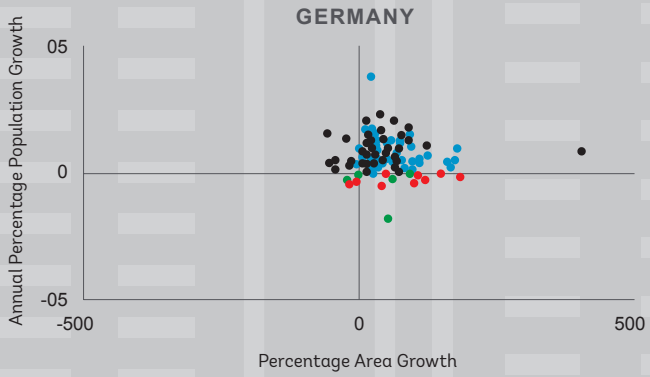
* Econ growth in NLS growth 2000–2010.
Population growth in annual avg. 2001–2014.

SPATIAL AND ECONOMIC DYNAMICS*



* Area growth in NLS footprint growth 2000–2010;
Econ growth in NLS growth 2000–2010.

POPULATION AND SPATIAL DYNAMICS*



* Area growth is NLS footprint growth 2000–2010;
Population growth in annual avg. 2001–2014.

- **Type 1:** Growing population, growing economic activity
- **Type 2:** Declining population, declining economic activity
- **Type 3:** Growing population, declining economic activity
- **Type 4:** Declining population, growing economic activity

CONCLUSIONS

Germany is highly urbanized but has been experiencing and overall population decline over the past decade. Fertility rates that are lower than replacement levels and an aging population exacerbate the demographic shift occurring in Germany. Decline in Germany is largely concentrated in rural areas, which constitute a small share of total population, and in small cities. As such, between 2001 and 2014 the urbanization level in Germany slightly increased. Across the urban system, small cities continue to lose population while large cities continue to attract population.

The nighttime lights threshold used in this analysis identified a large number of agglomerations in Germany. Unlike population dynamics observed in other countries in the region, population growth is uneven within Germany's agglomerations. Two distinct dynamics can be observed in Germany's agglomerations one of which suggest suburbanization is occurring in some cities. Despite uneven growth within agglomerations, the top 15 fastest growing cities all belong to an agglomeration, namely Berlin or Munich.

The urban sector continues to account for a majority of the country's economic growth. At the city level, the nighttime lights used in this analysis suggest that nearly all of the identified cities experienced economic growth between 2000 and 2010. Additionally, the identified cities in Germany have all increased in nighttime light footprint despite population growth or decline. For the cities that are declining in population, nighttime light footprint growth suggest urban sprawl. Furthermore, despite population decline a majority of Germany's cities are growing in economic activity. This suggests that in Germany urban population decline is not necessarily linked to economic decline.

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