

Demography, Urbanization and Development: Rural Push, Urban Pull and... Urban Push?*

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Abstract: Developing countries have urbanized rapidly since 1950. To explain urbanization, standard models emphasize rural-urban migration, focusing on *rural push* factors (agricultural modernization and rural poverty) and *urban pull* factors (industrialization and urban-biased policies). Using new historical data on urban birth and death rates for 7 countries from Industrial Europe (1800-1910) and 35 developing countries (1960-2010), we argue that a non-negligible part of developing countries' rapid urban growth and urbanization may also be linked to demographic factors, i.e. rapid internal urban population growth, or an *urban push*. High urban natural increase in today's developing countries follows from lower urban mortality, relative to Industrial Europe, where higher urban deaths offset urban births. This compounds the effects of migration and displays strong associations with urban congestion, providing additional insight into the phenomenon of urbanization without growth.

Keywords: Urbanization; Urban Mortality; Killer Cities; Mushroom Cities; Urban Push; Population Growth; Migration; Congestion; Slums

JEL classification: R11; R23; R58; O18; O1; J11

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Urban expansion in the developing world has been dramatic. Between 1950 and 2015, the total urban population in developing countries increased tenfold from about 300 million to 3 billion; the urban share tripled from about 17 to 50 percent (United Nations, 2013). Overall, there are many similarities with the urban expansion process of developed countries in the 19th century. Yet, there are also important differences.

First, urban expansion has been substantially faster in today's developing world. In Europe, urbanization accelerated with the advent of the Industrial Revolution, rising from 15% in 1800 to 40% in 1910. Both Africa and Asia reached the same rate in half the time, moving from 15% in 1950 to ~40% in 2010. Second, while income growth and urbanization tend to go hand in hand (Henderson, 2010), higher levels of urbanization are now also observed at low levels of income (Glaeser, 2013; Jedwab & Vollrath, 2015b). For example, in 1960, the 35 countries whose income per capita was less than \$2 a day had an average urbanization rate of 15% (WDI, 2013). In 2010, the 34 countries with comparable incomes had an average urbanization rate of 30%. So, why has post-1950 urban expansion in the developing world been so fast and does it matter for people's welfare?

Standard models explain urbanization largely through rural-urban migration in response to an expected urban-rural wage or utility gap (Harris & Todaro, 1970; Lall, Selod & Shalizi, 2006). Migration flows could, for example, result from a *rural push*. If the country experiences a Green Revolution, the rise in food productivity releases labor for the urban sector (Schultz, 1953; Gollin, Parente & Rogerson, 2002). But rural-urban migration may also be induced by poverty in rural areas due to land pressure or natural disasters (Barrios, Bertinelli & Strobl, 2006; da Mata et al., 2007; Henderson, Storeygard & Deichmann, 2013). Then there are various *urban pull* factors. If the country experiences an Industrial Revolution, the urban wage increases, which attracts workers from the countryside (Lewis, 1954; Lucas, 2004; Henderson, Roberts & Storeygard, 2013). If the government adopts urban-biased policies, urban utility also increases (Henderson, 1982; Ades & Glaeser, 1995; Davis & Henderson, 2003). A country that exports natural resources also urbanizes if the resource rents are spent on urban goods and services (Gollin, Jedwab & Vollrath, 2013; Jedwab, 2013; Cavalcanti, Mata & Toscani, 2014). While the Green Revolution, Industrial Revolution and resource export theories find that urbanization is associated with development, the rural poverty and urban bias theories imply that urbanization may occur "without growth" (Fay & Opal, 2000).

The aforementioned theories remain largely silent on the role of demography in urban expansion. However, rapid urban expansion in the developing world has been

accompanied by an equally dramatic expansion of the population overall. To begin addressing this void, we take an historically comparative perspective to understanding some key features of urbanization in today's developing world (i.e. much faster urban expansion at lower levels of development). To do so, we create an extensive new data set on the crude rates of birth and death for urban and rural areas of 7 European (or Neo-European) countries in the 19th century (every forty years in 1800-1910) and 35 countries that were still developing countries in 1960 (every ten years in 1960-2010).¹

Through decomposition analysis, we first illustrate that urban natural increase appears to have contributed importantly to fast urban growth in today's developing world (i.e. the *absolute* growth of cities). This contrasts with Industrial Europe where urban growth appears to have been solely driven by (rural-urban) migration. Through simulations, we further illustrate that faster urban natural increase may have also accelerated the change in urbanization rates, i.e. the *relative* growth of cities. We show that the differences in urban natural increase between today's developing countries and Industrial Europe originate from differences in urban mortality rates. While fertility in the developing world has remained high, urban mortality has fallen to low levels much earlier in the development process, due to the epidemiological transition of the 20th century. This has resulted in a high rate of natural increase in urban areas, which in turn appears to have compounded the effects of migration to yield much higher rates of urban expansion. Today's *mushroom cities* of the developing world, by reference to their apparent "overnight" appearance and their continuous fast expansion, are in sharp contrast to the *killer cities* of Industrial Europe, where high urban mortality rates offset the lower urban birth rate, resulting in much lower urban natural increase. This difference in urban rates of natural increase is hard to ignore in understanding why the urban population in today's developing world has doubled every 18 years, compared with every 35 years in Europe. Analogous to the notions of *rural push* and *urban pull*, the concept of *urban push* is used to describe this demographic mechanism of urban expansion.²

To shed further light on the plausibility of these decomposition findings, we undertake a series of multivariate explorations. In particular, we link decadal rates of urban growth and changes in urbanization to rates of urban natural increase for a panel of 35 developing countries (1960-2010), controlling for factors likely to affect both urban expansion and urban natural increase (e.g., income growth, rural push and urban pull factors, and regional characteristics). In addition, we test whether shorter-run effects of natural

¹Economic historians have focused individually either on England or the U.S. in the 19th century (Williamson, 1990; Haines, 2008). Our vastly expanded dataset thus allows us to significantly extend their work.

²While the latter two concepts imply that rural workers are pushed to (or pulled to) cities by changes in rural (urban) conditions, the former suggests that cities growing internally are pushing their own boundaries.

increase also hold in the longer-run in two ways. First, we use autoregressive distributed lag models (ADL) with lags of the urban and rural rates of natural increase (as well as the dependent variable); second, we implement cross-sectional long-run regressions of urban growth and changes in the urbanization rates over the 1960-2010 period on the initial urban rate of natural increase. Indeed, even if urban natural increase is significantly associated with urban growth and the change in urbanization rates in the short-run, these links may well disappear as migration and urban fertility behaviors adjust over time. Following rapid urban natural increase, cities may become increasingly congested, reducing the attractiveness of urban centers. This could slow down (accelerate) rural to-urban (urban-to-rural) migration, thereby reducing urban expansion (and the effects of urban natural increase) in the long run. Alternatively, urban residents may adjust their fertility patterns (e.g., have fewer children) in response to urban congestion. According to the estimated results, the long-run effects do not appear to be significantly different from the short-run effects, consistent with the descriptive decomposition results.

These findings raise a number of additional questions, which the paper briefly reflects upon. First, does high urban natural increase lead to congestion? Second, why do migration rates not adjust (more) in response to this rapid urban natural increase and higher congestion? Finally, why do urban fertility rates not come down faster? To shed some light on the first question, the link between the speed of urban growth and urban congestion is explored using a novel cross-sectional data set of urban congestion measures for 95 developing countries (1990-2010). Higher urban growth due to natural increase is associated with more congested cities today. Interestingly, the corresponding effects of migration on urban congestion tend to be smaller. We then discuss various potential explanations for why rural (urban) workers have kept migrating to (living in) these congested urban areas. Such explanations include increasing congestion in the countryside due to fast rural natural increase and valuation of higher urban life expectancy. We also hypothesize that urban fertility may remain high because fertility rates tend to stay high in low-income economies with low returns to education. If urban congestion prevents these economies from developing, the persistently high fertility in these cities is not necessarily surprising.

The paper adds to the literature on urbanization and growth in three ways.³ First, it draws attention to the possibility that rapid urban natural increase may create a

³The role of urban natural increase has been recognized by demographers (Rogers, 1978; Preston, 1979; Keyfitz, 1980; Fox, 2012), but is little discussed in economics (see surveys by Duranton (2008, 2013), Henderson (2010) and Desmet & Henderson (2014)). In a companion paper, Jedwab & Vollrath (2015a) use a theoretical model to study the “Malthusian” effects of the epidemiological transition on the rise of poor mega-cities. They focus their analysis on the absolute population growth of the largest cities in the world, hence *mega-city growth*, while here we look at both the absolute and relative growth of the total urban population, hence *urban growth* and changes in *urbanization rates*.

disconnect between urbanization and growth if urban areas expand without an increase in living standards.⁴ The speed of urban growth is an understudied dimension of urban expansion. Second, while there is an extensive literature measuring agglomeration effects in developing countries, little is known about the magnitude of congestion effects.⁵ Third, whether urban growth is mainly driven by migration or natural increase has implications for policy making. When urban congestion is the result of excessive migration, investment in urban infrastructure may be more difficult to justify if it fuels further migration (see Feler & Henderson (2011) for a discussion of urban policies in Brazil). However, if urban growth is due to urban natural increase, the resulting immediate increase in the urban population may necessitate such investment, as well as stronger urban family planning policies, or more deconcentrated urban development.⁶

The paper is organized as follows: Section 1 presents the data and decomposition results. Section 2 shows the econometric results and section 3 interprets and reflects on the findings. Section 4 concludes

1. MAIN DECOMPOSITION ANALYSIS

1.1 Data and Background

We use historical data on urbanization, and urban and rural fertility and mortality, first reconstructing the urban growth and urbanization rates for 19 European and North American countries from 1700-1950 (~every 40 years), and 116 African, Asian and non-North American countries that were still developing countries in 1960, from 1900-2010 (~every 10 years). This allows us to compare the urbanization process of five developing areas: “Industrial Europe” (which includes the United States in our analysis), Africa, Asia, Latin America (LAC), and the Middle-East and North Africa (MENA). Second, we obtain historical demographic data for 42 countries: 7 European countries for the 1700-1950 period, and 35 countries in Africa (10), Asia (12), the LAC region (8) and the MENA region (12) for the 1960-2010 period. For each country-period observation, we obtain the urban and rural crude rates of birth, death and natural increase (per 1,000 people). We recreated the data using historical sources, as well as the *UN Statistical Yearbooks* and

⁴In countries where urban growth comes from migration, it is possible that urban wages are rising, which given low rural wages attract residents to the cities. Eventually, as the urban-rural income gap closes, rural residents should cease migrating to the cities, and the urbanization rate and income should stabilize at a higher level. In countries where urban growth may come from urban natural increase, urbanization may occur because low-income urban families have high fertility rates. There is also migration if the countryside becomes too congested due to rural natural increase. Eventually, there may not be any urban-rural gap, but the country could be more urbanized, even if income has not increased.

⁵Likewise, there are few papers about the role of slums in developing countries. Notable exceptions are Lall, Lundberg & Shalizi (2008), Brueckner & Selod (2009), Brueckner (2013) and Cavalcanti & Da Mata (2013).

⁶See Henderson (1982), Christiaensen, Weerdt & Todo (2013) and Christiaensen & Todo (2013).

reports of the *Population Census*, the *Fertility Surveys* and the *Demographic and Housing Surveys* of these countries.⁷ We also collect the same type of data for 97 countries that were still developing countries in 1960 for the most recent period.

The most advanced civilizations before the 18th century had urbanization rates of around 10%-15% (Bairoch, 1988). Industrialization accompanied dramatic urbanization. Figure 1 (top panels) shows the urbanization rates for Industrial Europe (1700-1950) and four developing areas: Africa, Asia, LAC and MENA (1900-2000). The urbanization rate for Europe was stable (~10%) until 1800 and increased to ~40% in 1910. In 1950, countries in Africa and Asia were also predominantly rural (urbanization rate ~15%). By 2010, their urbanization rates had increased to ~40%. The LAC region had already surpassed the 40% threshold in 1950, while the MENA region did not surpass it until 1970. In our analysis, we focus on the 1800-1910 period for Europe and the 1960-2010 period for Africa and Asia. During these periods, the urbanization rates of the three areas increased from 15% to 40%. Figure 1 (bottom panels) also shows the urban growth rates for Europe (1700-1950) and the four developing areas from 1900-2010. In the 1800-1910 period, the overall urban growth rate in Europe was 2.2% per year, peaking during the Industrial Revolution. Conversely, the urban growth rate has been ~3.8% a year in today's developing world post-1960. A 3.8% growth rate implies that cities double every 18 years, while a 2.0% rate means that cities only double every 35 years. These rates peaked in the 1950s/60s, with the acceleration of rural-to-urban migration and the demographic transition.

1.2 Killer Cities vs. Mushroom Cities: Decomposing Urban Expansion

Note that urban and rural population growth can be written as an expression of urban and rural natural increase, internal migration, international migration, and urban reclassification:

$$\Delta U_{pop_t} = Uni_t * U_{pop_t} + Rmig_t + IUmig_t + Urec_t \quad (1)$$

$$\Delta R_{pop_t} = Rni_t * R_{pop_t} - Rmig_t + IRmig_t - Urec_t \quad (2)$$

where ΔU_{pop_t} (ΔR_{pop_t}) is the absolute growth of the urban (rural) population in year t , Uni_t (Rni_t) is the urban (rural) rate of natural increase in year t , U_{pop_t} (R_{pop_t}) is the urban (rural) population at the start of year t , $Rmig_t$ is the number of net rural-to-urban migrants in year t , $IUmig_t$ ($IRmig_t$) is the number of international-to-urban (rural) migrants in year t , and $Urec_t$ is the number of those rural residents reclassified as urban in year t .⁸ Abstracting from international migration, equations (1) and (2) can be simplified as:

⁷See Web Appx. Table 1 for details on the data sources used for each country.

⁸Births and deaths are registered using the place of residence. A child who is born in an urban-based family is counted as urban. Likewise, a child that follows her parents when they migrate to a city is counted as a migrant. The numbers of urban newborns and residents are estimated using permanent residence.

$$\Delta Upop_t = Uni_t * Upop_t + Mig_t \quad (3)$$

$$\Delta Rpop_t = Rni_t * Rpop_t - Mig_t \quad (4)$$

where Mig_t is the number of “residual migrants”, defined as the sum of rural migrants and rural residents reclassified as urban. When dividing equation (3) by the urban population at the start of year t , we obtain that the urban growth rate is the sum of the rate of urban natural increase (Uni_t) and the “residual migration” rate ($Mig_t/Upop_t$):

$$\frac{\Delta Upop_t}{Upop_t} = Uni_t + \frac{Mig_t}{Upop_t} \quad (5)$$

The rate of urban (rural) natural increase Uni_t (Rni_t) can be further decomposed as the difference of the Urban (Rural) Crude Birth Rate ($UCBR_t$) and the Urban (Rural) Crude Death Rate ($UCDR_t$) (i.e. the number of children born and the number of deaths per 1,000 people in year t). At 35 newborns per 1,000 people before 1910, fertility in Industrial Europe was relatively low, while mortality was high (Figure 2), especially in urban areas where death rates exceeded birth rates for much of the 19th century. Promiscuity, industrial smoke and polluted water sources all contributed to the high urban death rate (10 percentage points higher than in rural areas). With many European cities acting as “death sinks” during the 19th century, a phenomenon that became known as Europe’s *killer cities* (Williamson, 1990), Europe experienced an average urban natural increase of only 0.5 percent per year. At 2.2 percent per year during 1800-1910, Europe’s urban growth was also relatively low, and, as seen from an application of equation (5), largely accounted for by residual migration: 1.7 percent versus 0.5 percent from urban natural increase (see Figure 2, bottom panel).⁹

This contrasts with the urban demographic and growth patterns (1960-2010) observed in the developing world (Figures 3 and 4). Urban birth rates were initially higher than in 19th century Europe (up to 50 per 1,000 people in Africa), and have been declining since.¹⁰ Most striking, however, are the already substantially lower death rates in developing countries in 1960 (between 10 and 20). Acemoglu & Johnson (2007) show that the epidemiological transition of the mid-20th century (e.g. the discovery and consequent

⁹Web Appendix Table 2 shows the detailed decomposition of urban growth for the seven countries. Urban natural increase in 1800-1910 was 0.5% in England, 0.5% in Belgium, 0.1% in France, 0.6% in Germany, 0.4% in the Netherlands, 0.3% in Sweden and 0.4% in the U.S. It was thus the same whether we consider a country that received international migrants (the U.S.) or countries where outmigration was strong.

¹⁰Birth rates depend on total fertility rates (TFR) and the population shares of women of reproductive age (SWRA). The urban TFR is the main determinant of urban birth rates (CBR). For 97 countries for which we have data for the recent period, the correlation coefficient between the two is 0.93 (Web Appx. Fig. 1). The correlation between the urban CBR and SWRA is lower (-0.40). When regressing the CBR on the TFR, SWRA and their product, the product explains most of it, while the product is driven by the TFR (Web Appx. Table 4).

mass production of penicillin in 1945) and massive vaccination campaigns resulted in widespread and significant declines in mortality, irrespective of the income level.¹¹ These effects were magnified in cities and resulted in much higher rates of urban natural increase than those observed in Europe. Compounded by similar rates of migration as in Europe (1.5 percent on average in developing countries post 1960), much higher rates of urban growth would have resulted, giving rise to the notion of *mushroom cities* (see Figure 4, as well as Web Appx. Table 3 for decomposition results by country).

First, differences in urban natural increase across regions within the developing world are largely driven by differences in fertility, not by differences in mortality, which do not vary much across countries (Figure 3 and Web Appx Fig 3). The LAC and MENA regions experienced higher urban natural increase in 1960, and have been completing their fertility transition since. Asia started its fertility transition earlier and Africa still largely finds itself in the early stages. Figure 4 further shows the decompositions for Africa and Asia separately, in addition to Industrial Europe and today's developing world. To summarize, the difference in urban growth between the developing world and Europe (3.8% vs. 2.2%) seems to have arisen from differences in urban natural increase (2.3% vs. 0.5%) and not from differences in migration, which averaged 1.5% for developing countries post-1960, a rate similar to that of Industrial Europe (1.7 percent) during 1800-1910. Second, differences in urban growth (1960-2010) within the developing world, such as between Africa and Asia (4.9 percent and 3.5 percent respectively) also appear to be due to differences in urban natural increase (2.9 versus 1.7 percent) and much less due to differences in residual migration rates (2.1 and 1.8 percent respectively). To appreciate the compounding effects of such differences in urban growth rates note that with a migration rate of 1.5% and an urban rate of natural increase of 2.9% (1.7%), as in Africa (Asia), a family of five migrants in 1960 becomes a family of 43 (24) urban residents in 2010.

It can then be shown that changes in the urbanization rate depend on the difference between the urban and rural rates of natural increase (see Web Theory Appendix 1). Industrial Europe and the four developing areas had on average similar rural rates of natural increase. But they widely differed in their urban rates of natural increase. While “mushroom villages” have always existed, “mushroom cities” are the novel feature of the 20th century. We show in a calibration exercise that faster changes in urbanization are plausibly associated with higher urban rates of natural increase *ceteris paribus* (see Web Theory Appendix).

The decompositions suggest that urban natural increase may expand the urban population

¹¹The death rate depends on child mortality (age 0-5 years), youth mortality (age 5-15 years) and adult mortality (age 15 and above years). Urban child mortality is the main factor of urban aggregate mortality (Web Appx. Fig. 2). In our sample of countries in 2000, the correlation coefficient between the two is 0.81.

in both absolute terms (the urban growth rate) and relative terms (the change in the urbanization rate). For example, one urban (rural) newborn has an instantaneous effect of 1 on the urban (rural) population. However, in the long run, individuals choose their place of residence – urban vs. rural – depending on their utility in each location. The long-run equilibrium effect of urban natural increase thus depends on urban and rural utility levels and ultimately on the endogenous dynamic responses of migration and fertility to the increase in urban population. The long-term effects of urban natural increase could be smaller than its short-term effects. If urban newborns eventually congest cities as adults, urban natural increase could have a dissuasive effect on future rural-to-urban migration and/or future urban fertility, further reducing urban growth. However, the long-term effects could also be as high as the short-term effects if urban natural increase produces urban congestion that in turn reduces urban income. Due to the trade-off between child quantity and child quality (Galor, 2012), the lower income level could then prevent any adjustment in urban fertility, and both urban natural increase and urban growth would remain fast.¹²

To assess the extent to which these decomposition findings stand up to these dynamic adjustments over time as well as additional factors that may jointly affect urban growth and urbanization and natural increase, a series of multivariate (panel) specifications are explored. These additional exercises are not meant to establish causality, but rather to provide additional insight into whether the findings hold beyond the transition (i.e. in the longer run) and beyond an accounting sense.

2. MULTIVARIATE ROBUSTNESS ANALYSIS

2.1 Absolute Urban Growth

We use panel data for 35 countries that were still developing countries in 1960. We adapt equation (5) and run the following model for $t = [1960s, 1970s, 1980s, 1990s, 2000s]$:

$$\frac{\Delta Upop_{c,t}}{Upop_{c,t}} = \alpha + \beta Uni_{c,t} + \gamma_c + \delta_t + u_{c,t} \quad (6)$$

where $\Delta Upop_{c,t}/Upop_{c,t}$ is the annual urban growth rate (%) of country c in decade t . Our variable of interest is the urban rate of natural increase (per 100 people, or %) of country c in decade t ($Uni_{c,t}$). We include country and decade fixed effects ($\gamma_c; \delta_t$). Please note that we cannot include the residual migration rate since urban growth is, by construction, the sum of urban natural increase and residual migration. Table 1 shows the results.

In row (1), we include continent fixed effects (Africa, Asia, LAC, MENA) interacted with a

¹²Additionally, urban natural increase affects the age-sex composition of the cities while migration affects future urban fertility through crowding-out and age-sex structure effects.

time trend, and controls for rural push and urban pull factors, the urbanization rate at the start of the decade and income (log GDP per capita) at both the start and end of the decade. Thus, we capture the effect of income growth on urban growth, and the fact that initially less urbanized countries may see their urban population grow faster.¹³ The coefficient on urban natural increase is 0.92, and is not significantly different from one (F-test available upon request). The coefficient increases to exactly 1.00 (row (2)) if instead we use 13 region fixed effects interacted with a time trend.¹⁴ This result holds when adding the rural crude rate of natural increase in decade t (row (3)). The effect is, however, not causal if unobservable factors explain the correlation of urban natural increase and urban growth over time *within* countries, relative to the neighboring countries of the same region, *ceteris parabis*.¹⁵

But does the short term effect (of t on t) also hold in the longer term? We first use an autoregressive distributed lag model (ADL) with the second lags of both the dependent variable – the urban growth rate – and the main variables of interest – the urban and rural rates of natural increase. If urban natural increase endogenously affects future rural migration and/or urban fertility, and thus future urban growth, these effects should only be visible two decades later (a generation), when urban newborns become adults.¹⁶ It can then be shown that the long-term effect is a non-linear combination of the direct effect of urban natural increase in t on urban growth in t , and the indirect effects of urban natural increase and urban growth in $t-2$ on urban growth in t .¹⁷ Row (4) shows the implied long-term effect, 1.21 (see Web Appx. Table 8 for the coefficient of each lag). This effect

¹³The controls are: (i) Green Revolution: average cereal yields (hg per ha) in decade t ; (ii) Industrial Revolutions: share of manufacturing and services in GDP (%) 2010 interacted with decade fixed effects (the share is missing for many countries in earlier decades); (iii) resource exports: share of resource exports in GDP (%) in t ; (iv) rural poverty: rural density (1000s of rural population per sq km of arable area), number of droughts (per sq km), and a dummy equal to one if the country has experienced a conflict in t ; and (v) urban bias: a dummy equal to one if the country's average polity score is lower than -5 (the country is then considered autocratic according to *Polity IV*), and the primacy rate (%) in t . Including country fixed effects then controls for the fact that countries use different urban definitions, which affects urban reclassification.

¹⁴The regions are Central Africa, East Africa, South Africa, West Africa, East Asia, South-East Asia, South Asia, Oceania, the Caribbean, Central America, South America, Middle-East and North Africa.

¹⁵The results hold when instrumenting *Uni* with the initial religious and family planning conditions for each country in the 1960s, interacted with decade fixed effects, while simultaneously controlling for rural natural increase (Web Appx. Table 5). As the main driver of natural increase, the evolution of fertility was influenced by both the dominant religion in each country in the 1960s (fertility remained higher in the Catholic and Muslim countries, see Web Appx. Table 6) and whether the country had an anti-natalist policy in the 1960s (Web Appx. Fig. 4 shows how idiosyncratic the adoption of an anti-natalist policy adoption was back then). Thus, fast urban growth did not drive family planning policy adoption (Web Appx. Table 7). However, as we cannot be sure that the instruments satisfy the exclusion restriction, the IV results are only tentative.

¹⁶Following this economic reasoning and the results of the AIC and BIC criteria, which show that the crucial information is contained in the second lag, we omit the first lag. Moreover, the urban rates of natural increase in t and $t-1$ are highly correlated ($\rho=0.84$), which creates collinearity. The rates in t and $t-2$ are less correlated ($\rho=0.70$). We cannot include lags beyond $t-2$, due to insufficient observations.

¹⁷Greene (2008, p.683-684) shows that the long-term effect of a variable X on a variable Y is equal to the sum of the effects of X and its lags on Y , divided by $(1 - \text{sum of the effects of each lag of } Y \text{ on } Y)$, provided Y and X are both stationary, which we confirm using various tests for our analysis (not shown).

is also not significantly different from one (F-test available upon request).

As an alternative strategy to capture long-run effects, we use cross-sectional regressions for the 35 countries, with the annual urban growth in 1960-2010 as the dependent variable and the urban rate of natural increase in the 1960s as the variable of interest.¹⁸ If the effect of urban natural increase entirely attenuates over time due to endogenous migration and fertility responses, in 1960-2010, the effect of urban natural increase in the 1960s should be nil. The effect is ~0.69-0.74, depending on whether we control for rural natural increase (rows (5)-(6)), and is not significantly different from one (F-test available upon request).¹⁹

To take full advantage of our available data in the recent period (97 countries), we run an additional robustness check, regressing annual urban growth in 1960-2010 on urban natural increase in 2000, a proxy for urban natural increase in 1960-2010 (rows (7)-(8)). The effects remain high, at 0.77-0.80 depending on whether we include rural natural increase in 2000 (row (9)).²⁰ The long-term effect of urban natural increase thus falls in the range of [0.69,1.21] and is always significantly different from 0, but not from 1. Accordingly, the effect of natural increase does not disappear in the long run, and we cannot reject the hypothesis that the long-term effect is as high as the short-term effect. Assuming an average (of the above range) long-term effect of 0.95, a 1 standard deviation increase in urban natural increase is associated with a 0.48 standard deviation increase in urban growth. Then, if the urban natural increase of today's developing world had been the same as in Europe in the 19th century (2.3 vs 0.5), its annual urban growth rate would have been 2.1% instead of 3.8% *ceteris paribus*, and thus the same as in Industrial Europe (2.2%). Likewise, if Africa's urban natural increase had been the same as in Asia in 1960-2010 (2.9 vs 1.7), its annual urban growth rate would have been 3.7% instead of 4.9%, and thus the same as in Asia (3.9%).

¹⁸We add: (i) controls for income and urbanization in 1960, and income in 2010, (ii) region fixed effects, and (iii) controls that are the same as for the panel regressions (see footnote 13), except we use 2010 as the end year or 1960-2010 for the whole period to estimate them. We also control for the urban definition using dummies for each type of definition (*administrative*, *threshold*, *threshold and administrative*, and *threshold plus condition*) and the population threshold to define a locality as urban when this definition is used, as well as the country's area (sq km), and dummies equal to one if the country is landlocked or a small island (<50,000 sq km).

¹⁹Durantón (2015) finds that the effect of the log birth rate in 1993 on the change in log population between 1993 and 2010 for about 1,000 Colombian municipalities is 0.24, not one. However, there is significant migration across municipalities in Colombia, which attenuates the local effects of natural increase. Our regressions are at the country level, and people cannot migrate across countries as easily, so our effects are higher.

²⁰We also find a strong effect of the largest city's birth rate in 2000, a proxy for its rate of natural increase in 1960-2010 (death rates unavailable), on its growth rate between 1960-2010 (Web Appx. Table 9). However, urban natural increase does not modify urban primacy rates (Web Appx. table 10).

2.2 Relative Urban Growth

We now investigate the effects of urban natural increase and residual migration on the change in urbanization, a measure of relative urban growth. We run the following panel model for the same 35 countries and $t = [1960s, 1970s, 1980s, 1990s, 2000s]$:

$$\Delta U_{c,t} = a + \kappa Uni_{c,t} + \lambda Mig_{c,t} + \theta_c + \psi_t + v_{c,t} \quad (7)$$

where $\Delta U_{c,t}$ is the change in the urbanization rate (in percentage points) of country c in decade t . Our variables of interest are the urban rate of natural increase ($Uni_{c,t}$) and the residual migration ($Mig_{c,t}$) of country c in decade t (%). All regressions include country and decade fixed effects ($\theta_c; \lambda_t$) and aforementioned controls (Results in Table 2).²¹

Including region fixed effects and rural natural increase (row (3)), a one percentage point increase in the effect of urban natural increase is associated with a 1.63 increase in the change in the urbanization rate ($U_t - U_{t-1}$) (the coefficient of residual migration is 2.06). Unlike urban growth, urbanization rates are directly affected by rural natural increase, since rural newborns immediately expand the rural population. As urban and rural natural increase are positively correlated, not including rural natural increase leads to a downward bias when estimating the effect of urban natural increase (rows (1)-(2)). The long-term effect then ranges from 1.21 (ADL, row (4)) to 1.66-1.78 (cross-sections in 1960-2010, rows (5)-(6)), while for migration, the range is 1.62-3.28. The effects are not significantly different from the short-term effects (row (3)). The ADL effect is then not significantly different for urban natural increase, but the point estimate remains high. Results also hold if we use the 97 countries for which we have data on natural increase in 2000 (rows (7)-(8)).

These effects are suggestive, though not necessarily causal. Assuming average long-term effects of about 2.45 $((1.62+3.28)/2)$ and 1.50 $((1.21+1.78)/2)$ for migration and urban natural increase, respectively, one standard deviation increases in migration and urban natural increase are respectively associated with 0.70 and a 0.30 standard deviation increases in the change in urbanization. Migration is the main component of urbanization. Indeed, a migrant decreases the rural population by one and increases the urban population by one. Urban natural increase only increases the urban population; hence, it has a relatively larger effect on urban growth than on urbanization. Nonetheless, it remains a significant factor in urbanization. For example, Europe's urbanization rate rose by 2.5 percentage points every ten years during the 1800-1910 period, increasing from 15% in 1800 to 40% in 1910. Starting from similarly low levels (15% in 1960) urbanization rates in Africa and

²¹We cannot control for urbanization rates at the start of the decade, as the dependent variable – the change in the urbanization rate – is linearly defined. Results hold if we control for urbanization rates in 1960 interacted with decade fixed effects, to control for convergence in urbanization (Web Appx. Table 11).

Asia also increased by 25 percentage points, though they did so between 1960 and 2010, i.e. in about half the time. The decadal change was 4.5 percentage points in Africa and Asia post-1960. On average, urban natural increase was 1.7 percentage points higher in Africa and Asia than in Europe. Given an effect of 1.50, this gives a crude difference of $(1.7 \times 1.50 =)$ 2.5 percentage points of urbanization every ten years. Urban natural increase may thus contribute to explaining why today's developing world has urbanized at a much faster pace than the old developing world.

3. DISCUSSION

3.1 Potential Welfare Consequences

Given the high urban rates of natural increase in today's developing world (urban population doubles every 18 years), urban capital (e.g., houses, schools and roads) must grow as fast as the urban population. However, if capital investment cannot keep up with urban population growth, fast urban growth can lead to urban congestion, which may reduce urban utility.²² Panel data on the evolution of urban wages and amenities over time do not exist, so we use cross-sectional data on various measures of congestion for the most recent period. Our main measure is the share of the urban population living in slums (%) in 2005-2010. We have data for 113 low-income countries in 1960, but we focus our analysis on 95 countries for which we also have data on natural increase. We first regress the slum share on the urban growth rate and the change in the urbanization rate between 1960 and 2010. We control for income and urbanization in 1960 and 2010 and add the aforementioned controls and the regional fixed effects. Row (1) of Table 3 shows that slum expansion is associated with the urban growth rate, but not with the change in urbanization. Indeed, what matters for urban congestion is the absolute number of urban residents per sq km.²³ When decomposing urban growth into urban natural increase and residual migration, we find that the slum share today is disproportionately correlated with the urban rate of natural increase in 2000, which is used as a proxy for urban natural increase in 1960-2010 (row (2)).²⁴ The same general pattern holds when we choose other measures of congestion reflecting living standards, environmental degradation, and

²²We believe that these congestion effects are not just temporary, even if urban capital can adjust in the long-run. First, the population increase that we document is not just a one-time shock, but implies a continuous stream of new residents every period. Second, past population shocks may have long-run consequences. Past congestion in urban housing favors the development of slums, that will be costly to reorganize efficiently ex-post. Likewise, past underinvestments in human capital affect long-run productivity. Third, congestion effects can be avoided when urban growth is expected and when agents are forward-looking, with sufficient credit available to make the necessary investment in advance. These conditions may not have been met in developing countries.

²³If countries are unable to cope with fast urban growth, we expect non-linearities in the relationship between slums and urban growth. Web Appx. Table 12 shows some suggestive evidence that slum expansion is disproportionately associated with the number of years in which an urban population doubles.

²⁴We use data for the year 2000, because we have urban natural increase data for many fewer observations in the 1960s. Residual migration is defined here as the difference between annual urban growth between 1960 and 2010 and urban natural increase in 2000. Again, these effects are not necessarily causal.

economic sectors (Table 3, rows (3)-(11)).²⁵

Migration is less associated with urban congestion than urban natural increase. There are a few possible reasons for this. First, many rural workers migrate to the cities where productivity and income are rising. Second, urban natural increase (a disproportionately greater number of children) raises the dependency ratio (rows (1) and (2) of Table 4), possibly lowering incomes in the short-run.²⁶ Third, rising incomes imply that governments have resources to minimize the congestion effects.

3.2 The Puzzling Non-Adjustment of Migration?

The fact that urban natural increase has positive long-run effects on urbanization suggests that on average: (i) rural workers have kept migrating to congested urban areas, and (ii) urban newborns have not migrated out of these cities. What matters for the long-run equilibrium distribution of the population is the urban-rural utility (positive) gap. We reflect on potential explanations, but quantifying their contribution falls beyond the scope of the paper.²⁷

Urban agglomeration effects. The urban wage should increase with the size of the urban population as long as agglomeration effects dominate congestion effects. Agglomeration effects may still be strong. If congestion outweighs agglomeration, the urban wage decreases, but rural workers will still migrate to urban areas as long as it remains higher than the rural wage (plus migration costs). The urban newborns on the other hand may stay in urban areas even if the urban wage drops below the rural wage, given the costs of moving to rural areas. Given that much of the new urban population is urban-born, this is

²⁵The dependent variables in rows (3)-(7) are for the shares of urban inhabitants who (3) lack sufficient living-area, (4) live in a residence with a finished floor, (5) have access to an improved water source, (6) have access to improved sanitation facilities, and (7) use solid fuels (e.g., wood) as the main domestic source of energy. The dependent variables in rows (8)-(10) are as follows: (8) the urban share of 6-15 year-old children attending school (a proxy for congestion in human capital accumulation); (9) the level of particulate matter (PM) concentrations in the large cities (a proxy for road congestion); and (10)-(11) the urban employment shares of “manufacturing and FIRE” and “personal and other services”. The FIRE (finance, insurance, real estate and business services) sector serves as a proxy for tradable services. If cities grow too fast, urban labor demand will not rise as fast as urban labor supply, and the urban newborns will be eventually employed by the low-skill sectors such as “personal and other services” and not the high-skill sectors such as “manufacturing and FIRE”.

²⁶The urban child dependency ratio – the ratio of the number of (0-14 year-old) children to the (15-64 year-old) working population – is much higher in the countries where urban natural increase is high (row (1) of Table 4). Then, both urban natural increase and migration reduce the urban aged dependency ratio, the urban ratio of the number of 65 year-old and above people to the working population (row (2)). Since the former effect dominates the latter effect, urban natural increase raises the total dependency ratio (row (3)).

²⁷A proper model would consider both urban and rural utilities, which both depend on wages and amenities. Then wages and amenities both benefit from agglomeration effects and suffer from congestion effects. The effect of natural increase on the urban-rural utility gap then depends on where it is the fastest, as well as on the respective forms of the agglomeration and congestion effects in both locations. The main factor of production in the rural sector is land, which is non-reproducible, so rural congestion effects could be large. In cities, there are no non-reproducible factors *per se*, but the “urban space” can become highly congested, too.

important.

Rural congestion effects. In countries where both rural and urban natural increase were high, the rural congestion effects may have been as important as the urban congestion effects. Web Appendix Tables 13 and 14 show that the speed of urban growth (i.e. urban natural increase), and not the speed of rural growth, is the main determinant of urban congestion. Likewise, Web Appendix Tables 15 and 16 show that the speed of rural growth (i.e. rural natural increase) is the main determinant of rural congestion (when possible, we use the same outcomes as for urban congestion). Countries where both urban and rural natural increase have been fast have thus become highly congested as a whole, and migration may have remained positive because the countryside remained relatively more congested. The mean comparison for each variable between the urban and rural sectors suggests that this may be the case (see Web Appendix Tables 13 and 15).²⁸

Urban life expectancy. Europe's killer cities had to offer relatively high wages to urban residents in order to compensate for the fact that they had relatively higher mortality rates than the countryside (Williamson, 1990). Conversely, urban mortality rates are lower than rural mortality rates in today's developing world, and access to public social services is broader, which gives a direct incentive for rural residents to migrate to, and urban newborns to stay in, the cities (Ferré, Ferreira & Lanjouw, 2012; Dustmann & Okatenko, 2014).

Preferences. Unlike rural migrants, urban newborns initially have a strong preference for urban living, which increases urban-to-rural migration costs. There could also be a fixed cost for urban-born residents willing to enter the rural sector (acquisition of land and other agricultural capital). Urban newborns may thus prefer to stay in urban areas, even in those that are highly congested. Conversely, rural residents may not have a strong preference for rural living and face a low fixed cost of entering the urban sector.

3.3 The Puzzling Non-Adjustment of Urban Fertility?

Urban families are also not adjusting their fertility, although mortality rates have fallen and cities have become congested. One explanation for the high birth rate in fast-growing urban areas may be a high share of women of reproductive age. However, urban birth rates are mostly explained by urban fertility rates rather than by the population share of women of reproductive age (see footnote 9). A youth bulge effect is thus likely a marginal factor. Alternatively, an important reason why urban fertility may not respond much to urban natural increase and urban congestion may be the fact that fertility rates are high in low-income economies with low returns to education (see Galor (2012) for a thorough

²⁸Rural natural increase was also high in the old developing world, but high-mortality cities were eventually able to absorb the rural surplus labor. In the cities of today's developing world, the cities must absorb the surplus labor created by both rural natural increase and their own internal population growth.

review of the literature). If congestion prevents these urban economies from developing, and particularly from becoming skill-intensive, urban fertility rates may not adjust. This is consistent with the negative correlation between urban natural increase and urban school attendance (Table 3).

3.4 Conclusion

Starting from the observation that urban expansion in the developing world of the 20th century has been twice as fast as in the developing world of the 19th century, we take an historically comparative perspective on exploring the new features of fast urbanization at low levels of development and zoom in on the role of demographic factors. Through decomposition analysis of newly compiled data on urban growth, change in urbanization rates, crude urban birth and death rates from 7 countries from Industrial Europe (1800-1910) and 35 developing countries (1960-2010), we document that urban natural increase in the developing world has been much larger than in Industrial Europe, due to much lower urban mortality rates. While Europe's cities of the 19th century came to be known as *killer cities*, with high urban mortality rates offsetting urban fertility and urban expansion driven by migration, many cities of today's developing world can be classified as *mushroom cities* instead, with high urban fertility contrasted with much lower mortality, resulting in high urban rates of natural increase. With migration rates remaining at similar levels as in Industrial Europe, high urban growth and a more rapid change in the urbanization rate have resulted. We further show that rapid urban growth is correlated with indicators of congestion. These descriptive findings, complemented by those from a series of multivariate analyses, call attention to the notion of an *urban push* as an additional mechanism of urban expansion, whereby rapid urban natural increase contributes in itself to urbanization.

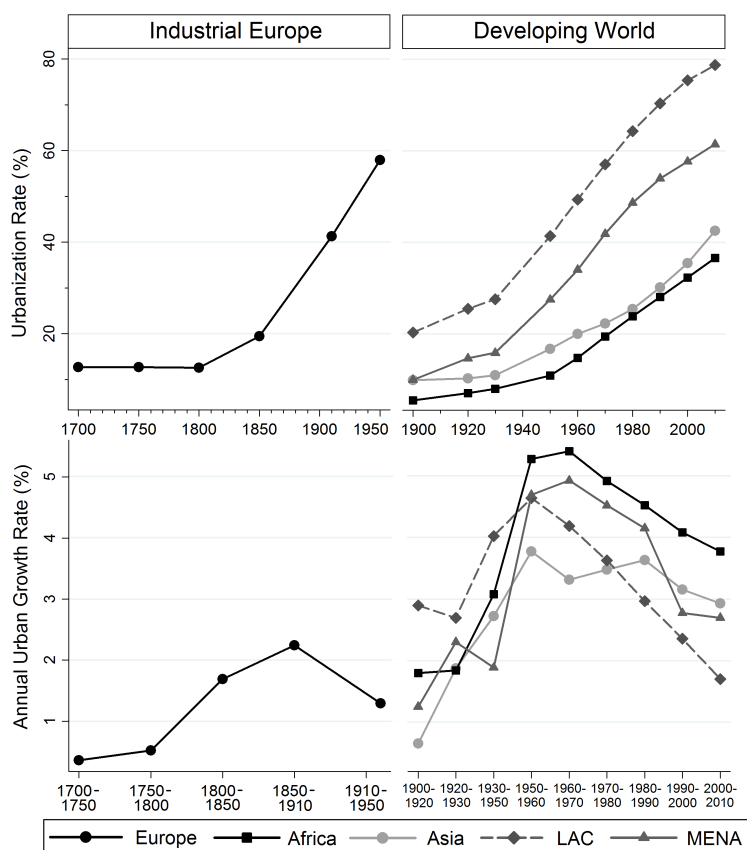
Our paper adds to the literature on *rural push* and *urban pull* factors of urbanization which emphasize migration. Urbanization may not come solely from migration. Internal urban population growth could also matter. Additionally, we contribute to the literature on the relationship between urbanization and development. Income growth may not be the only driver of urbanization, if urban areas in low-income countries expand mechanically through high fertility rates. The resulting urbanization *per se* may not necessarily be conducive to further economic growth, as urban congestion effects might limit the benefits from agglomeration. Therefore, the *urban push* may be one factor (among others) accounting for the phenomena of "urbanization without growth" and "poor country urbanization" highlighted by Fay & Opal (2000) and Glaeser (2013) respectively.

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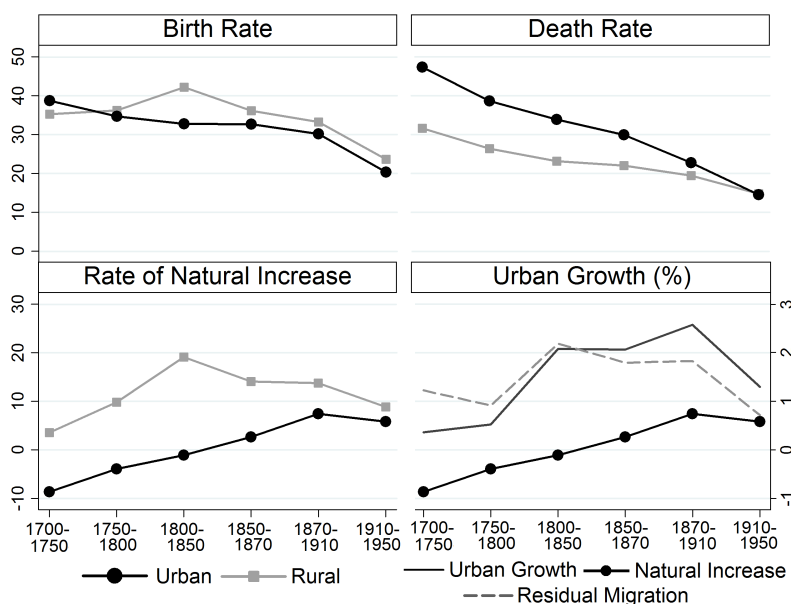
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Figure 1: Urbanization Rates (%) and Annual Urban Growth Rates (%) for Industrial Europe (1700-1950) and the Developing World (1900-2010)



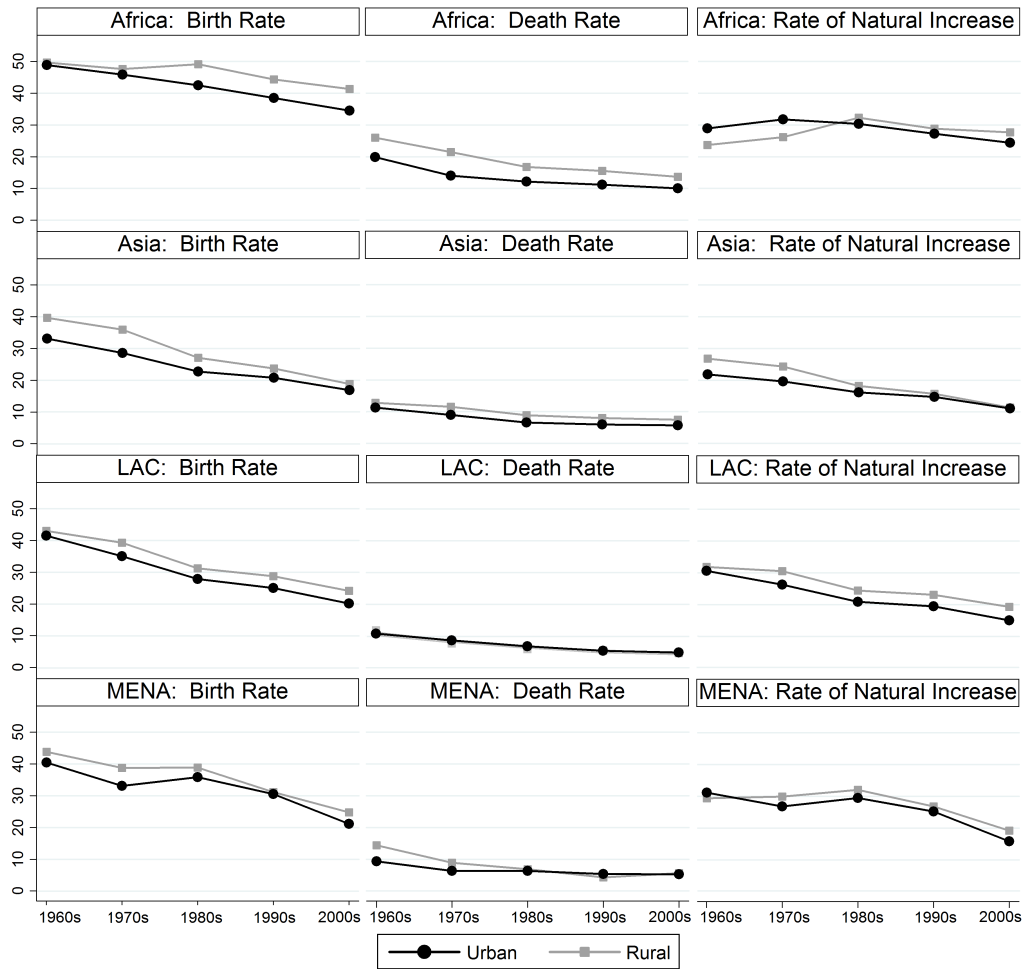
Notes: This figure plots the urbanization rate (%) and the annual urban growth rate (%) for Industrial Europe (1700-1950) and four developing areas (1900-2010): Africa, Asia, Latin America and the Caribbean (LAC) and Middle-East and North Africa (MENA). Europe includes 18 Western European countries and the United States, as one example of a Neo-European country. We then use data for 116 African, Asian and (non-North) American countries that were still developing countries in 1960. Averages are estimated using the population weights for the same year. See the Web Appendix for data sources.

Figure 2: Decomposition of Urban Growth for Industrial Europe (1700-1950)



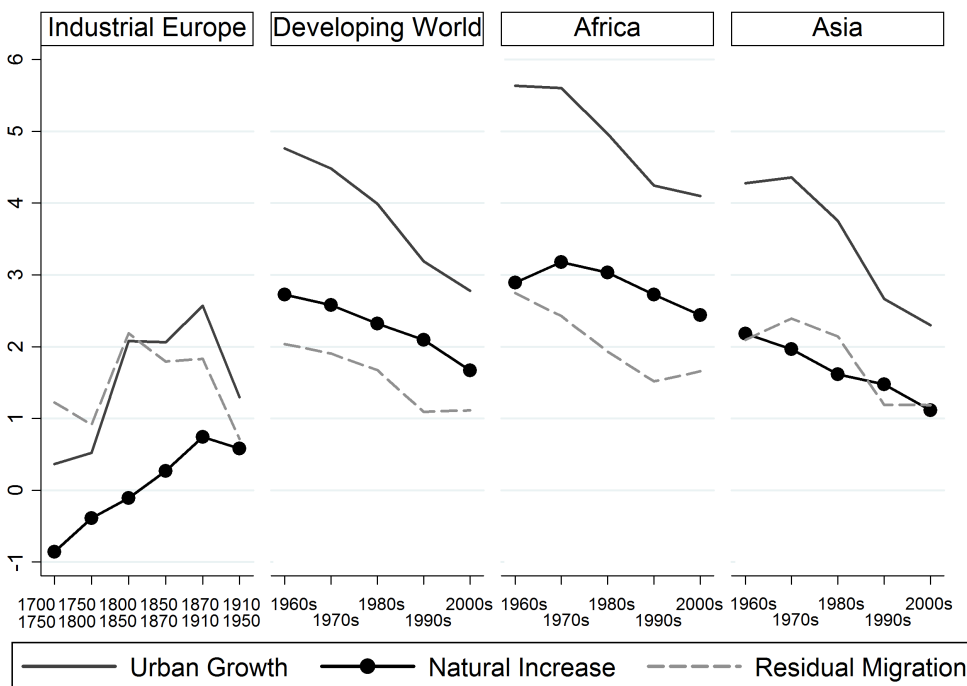
Notes: This figure plots the crude rate of birth, the crude rate of death and the crude rate of natural increase (per 1,000 people) for the rural and urban areas of Industrial Europe (1700-1950). This figure also plots the decomposition of annual urban growth (%) into the respective contributions of annual urban natural increase (%) and annual residual migration (%). Europe includes Belgium, England, France, Germany, the Netherlands, Sweden and the United States for this figure. See the Web Appendix for data sources.

Figure 3: Urban Demographic Patterns for the Developing World (1960-2010)



Notes: This figure plots the crude rate of birth, the crude rate of death and the crude rate of natural increase (per 1,000 people) for the rural and urban areas of four developing regions (1960-2010): Africa, Asia, Latin America and the Caribbean (LAC) and Middle-East and North Africa (MENA). We use historical demographic data for 35 countries that were still developing countries in 1960. See the Web Appendix for data sources.

Figure 4: Decomposition of Urban Growth for the Developing World



Notes: This figure plots the decomposition of annual urban growth rate (%) into annual urban natural increase (%) and annual residual migration (%) for Industrial Europe in 1700-1950 and the developing world as a whole, Africa and Asia in 1960-2010. See the Web Appendix for data sources.

TABLE 1: URBAN NATURAL INCREASE AND ABSOLUTE URBAN GROWTH, 1960-2010

Dependent Variable: Annual Urban Growth Rate (%; Row 1-4: t ; Row 5-8: 1960-2010)				
	Coeff. <i>Uni</i>	SE <i>Uni</i>	Obs.	Adj.-R2
1. Uni_t : Panel: Controls; Continent FE x Trend	0.92***	(0.27)	175	0.76
2. Uni_t : Panel: Controls; Region FE x Trend	1.00***	(0.28)	175	0.79
3. Uni_t : Panel: Controls; Region FE x Trend; Rni_t	1.08***	(0.30)	175	0.78
4. Uni_t : Panel-ADL(2,2): Controls; Region FE x Trend; Rni_t	1.21**	(0.57)	105	0.84
5. Uni_{1960} : Cross-Section: Controls; Continent FE	0.74**	(0.34)	35	0.80
6. Uni_{1960} : Cross-Section: Controls; Continent FE; Rni_{1960}	0.69*	(0.37)	35	0.80
7. Uni_{2000} : Cross-Section: Controls; Region FE	0.80***	(0.26)	97	0.76
8. Uni_{2000} : Cross-Section: Controls; Region FE; Rni_{2000}	0.77**	(0.36)	97	0.76

Notes: The sample consists of 35 countries that were still developing countries in 1960, for the following decades: 1960s, 1970s, 1980s, 1990s, 2000s in rows 1-4, and the period 1960-2010 in rows 5-8. Robust SEs (clustered at the country level in rows 1-4); * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. In rows 1-4 and 5-8, the dependent variable is the annual urban growth rate (%) in decade t and 1960-2010, respectively. The variable of interest is the urban crude rate of natural increase (%) in decade t (rows 1-4), the 1960s (rows 5-6) and the 2000s (rows 7-8). See text for specification details and Web Appendix for data sources.

TABLE 2: URBAN NATURAL INCREASE AND RELATIVE URBAN GROWTH, 1960-2010

Dependent Variable: Change in Urbanization Rate (Pct. Points; Row 1-4: t ; Row 5-8: 1960-2010)				
	Coeff. <i>Uni</i>	Coeff. <i>Migr</i>	Obs.	Adj.-R2
1. Uni_t : Panel: Controls; Continent FE x Trend	0.88 (0.55)	2.20*** (0.27)	175	0.68
2. Uni_t : Panel: Controls; Region FE x Trend	1.10* (0.55)	2.04*** (0.29)	175	0.69
3. Uni_t : Panel: Controls; Region FE x Trend; Rni_t	1.63** (0.61)	2.06*** (0.31)	175	0.70
4. Uni_t : Panel-ADL(2,2): Controls; Region FE x Trend; Rni_t	1.21 (1.12)	3.28*** (0.60)	105	0.83
5. Uni_{1960} : Cross-Section: Controls; Continent FE	1.66** (0.69)	1.62*** (0.42)	35	0.81
6. Uni_{1960} : Cross-Section: Controls; Continent FE; Rni_{1960}	1.78* (0.90)	1.66*** (0.43)	35	0.81
7. Uni_{2000} : Cross-Section: Controls; Region FE	0.75* (0.41)	1.23*** (0.21)	97	0.65
8. Uni_{2000} : Cross-Section: Controls; Region FE; Rni_{2000}	1.13** (0.50)	1.22*** (0.21)	97	0.65

Notes: The sample consists of 35 countries that were still developing countries in 1960, for the following decades: 1960s, 1970s, 1980s, 1990s, 2000s in rows 1-4, and the period 1960-2010 in rows 5-8. Robust SEs (clustered at the country level in rows 1-4); * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. In rows 1-4 and 5-8, the dependent variable is the change in the urbanization rate (%) in decade t and 1960-2010 (divided by 5 in order to be expressed in decadal terms), respectively. The variable of interest is the urban crude rate of natural increase (%) in decade t (rows 1-4), the 1960s (rows 5-6) and the 2000s (rows 7-8). See text for specification details and Web Appendix for data sources.

TABLE 3: URBAN NATURAL INCREASE AND URBAN CONGESTION, 1960-2010

Dependent Variable:	Coeff. <i>Ugr</i> 1960-2010	Coeff. ΔUrb 1960-2010	Obs.	Adj. -R2
1. Urban Population Living in Slums (% , 2005-2010)	6.5** (2.7)	0.0 (1.3)	95	0.79
Dependent Variable:	Coeff. <i>Uni</i> ₂₀₀₀	Coeff. <i>Migr</i>	Obs.	Adj. -R2
2. Urban Population Living in Slums (% , 2005-2010)	14.5*** (4.9)	4.6* (2.4)	95	0.80
3. Lack of Sufficient Living Area (Urban, %, 2000-2010)	8.9* (4.4)	3.3 (2.5)	57	0.70
4. Housing Unit with Finished Floor (Urban, %, 2000-2010)	-8.5 (5.7)	-3.0 (3.6)	66	0.64
5. Access to Improved Water Source (Urban, %, 2000-2010)	-3.7** (1.7)	-2.2* (1.2)	92	0.59
6. Access to Sanitation Facilities (Urban, %, 2000-2010)	-0.7 (2.8)	-1.7 (1.9)	92	0.85
7. Solid Fuels as Source of Energy (Urban, %, 2000-2010)	13.6* (7.5)	2.5 (5.2)	78	0.81
8. School Attendance for 6-15 y.o. (Urban, %, 2000-2010)	-10.8*** (3.7)	-2.4 (2.6)	65	0.76
9. PM10 Pollution (Urban, mg per m ³ , 2000-2010)	18.0* (10.1)	-0.0 (5.8)	94	0.49
10. Empl. in Manufacturing & FIRE (Urban, %, 2000-2010)	-3.1** (1.4)	-0.9 (0.9)	79	0.79
11. Empl. in Personal Services (Urban, %, 2000-2010)	3.8* (1.9)	1.1 (1.0)	76	0.43

Notes: The main sample consists of 95 countries that were still developing countries in 1960. Robust SEs; * p<0.10, ** p<0.05, *** p<0.01. The specification is the same as in row 7 of Table 2 (Cross-Section: Controls; Region FE) except we also include the decadal change in the urbanization rate between 1960 and 2010 (coeff. not shown in rows 2-11). Row 1: Regression of the slum share (%) on the annual urban growth rate (%), *Ugr*, and the decadal change in the urbanization rate (%), ΔUrb , between 1960 and 2010. Rows 2-11: Regression of urban congestion measures on the urban rate of natural increase in 2000 *Uni*₂₀₀₀ (which we use as a proxy for urban natural increase in 1960-2010), the residual migration rate *Migr* (here defined as the difference between the annual urban growth rate in 1960-2010 and the rate of urban natural increase in 2000), and the decadal change in the urbanization rate (%) between 1960 and 2010 (coeff. not shown). See Web Appendix for data sources.

TABLE 4: URBAN NATURAL INCREASE AND URBAN DEPENDENCY RATIOS, 1960-2010

Dependent Variable:	Coeff. <i>Uni</i> ₂₀₀₀	Coeff. <i>Migr</i>	Obs.	Adj. -R2
1. Child Dependency (0-14 y.o.) (Urban, %, 2000-2010)	10.2*** (2.7)	0.7 (1.2)	89	0.87
2. Aged Dependency (65+ y.o.) (Urban, %, 2000-2010)	-2.8*** (0.6)	-1.2*** (0.3)	89	0.79
3. Total Dependency (0-14 65+ y.o.) (Urban, %, 2000-2010)	7.4*** (2.7)	-0.5 (1.3)	89	0.84

Notes: The sample consists of 89 countries that were still developing countries in 1960. Robust SEs; * p<0.10, ** p<0.05, *** p<0.01. The specification is the same as in row 7 of Table 2 (Cross-Section: Controls; Region FE) except we also include the decadal change in the urbanization rate between 1960 and 2010 (coeff. not shown). We regress the urban dependency ratios on the urban crude rate of natural increase in 2000 *Uni*₂₀₀₀ (which we use as a proxy for urban natural increase in 1960-2010), the residual migration rate *Migr* (here defined as the difference between the annual urban growth rate in 1960-2010 and the rate of urban natural increase in 2000), and the decadal change in the urbanization rate (%) between 1960 and 2010 (coeff. not shown). See Web Appendix for data sources.