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Did cities increase skills during industrialization? Evidence from rural-urban migration

Jonatan Andersson [a,*], Jakob Molinder [b]

[a] Department of Economic History, Uppsala University, Sweden
[b] Department of Economic History, Uppsala University and Department of Economic History, Lund University, Sweden

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ABSTRACT

The process of industrialization is typically associated with urbanization and a large urban-rural gap in productivity and skills. To what extent were these disparities driven by the direct impact on occupational attainment of living in an urban area or the result of the positive self-selection of migrants moving to cities? In this paper, we leverage exceptional Swedish longitudinal data that allow us to estimate the impact of rural-urban migration on occupational attainment during Sweden's industrialization from the 1880s to the 1930s using a staggered treatment difference-in-differences estimator. We attribute roughly half of the urban premium to a direct impact of living in an urban area, whereas the other half is driven by self-selection into cities. A third of the direct impact of residing in cities is explained by a static effect, reflecting the urban advantage, while the rest is the result of a dynamic effect as individuals move into higher-skilled occupations over time in urban areas.

1. Introduction

Economists and other social scientists have long sought to understand the causes of the urban-rural gap in worker productivity and skills that arise as economies transition from agricultural to non-agrarian activities (Kuznets, 1955) and endure long after the transition is complete (Glaeser and Maré, 2001). In contemporary developed nations, individuals living in cities demonstrate higher productivity, indicated by the urban-wage premium, and are more skilled. This is defined by either educational level, or the cognitive, motor, or interpersonal skills required by urban occupations (Bacolod et al., 2009; Berry and Glaeser, 2005). In developing countries, the urban-rural gap is even more pronounced (Lagakos, 2020). Young (2013) argues that spatial disparities in developing countries are entirely driven by the elevated skill intensity in urban production and the sorting of workers between the urban and rural sectors. During industrialization in today's developed nations, historical accounts echoed similar sentiments regarding skill requirements and self-selection into cities (Marshall, 1890). Nevertheless, studies in the field of urban economics of contemporary developed economies have underscored the significance of improved learning among workers and better matching between firms and employees as key contributors to the higher productivity and skill levels in cities, alongside positive self-selection (Duranton and Puga, 2004; Combes et al., 2008; Glaeser, 1999). This raises the question of whether the influence of cities on skills is solely discernible in technologically advanced economies with high levels of human capital or whether the effect was also present during the industrialization of today's developed nations. However, this type of analysis is very data intensive. Notably, it requires information that follows individuals over time as they reside in both urban and rural areas, so far precluding an examination of past societies.

In this article, we contribute to this debate by employing unique longitudinal data from the late nineteenth and early twentieth century, containing detailed information on men and women who lived during Sweden's industrialization. Throughout this period, Sweden experienced a fundamental economic restructuring that coincided with massive, migration-led urban growth, rendering it a compelling historical case for analyzing the impact of urban residence on skills in an industrializing economy. To identify the effects that spending time in urban areas had on skills, we study the occupational attainment of rural-urban migrants several years before and after their move. We define skill attainment as upward movements across different occupations, using the median annual income of a specific occupation in 1900 to estimate the skill level of an individual in that occupation. This occupation-based income measure—referred to as 'occupational income'—is commonly used in economic history literature to study labor market outcomes

* Corresponding author.
E-mail addresses: jonatan.andersson@ekhist.uu.se (J. Andersson), jakob.molinder@ekhist.uu.se (J. Molinder).

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during periods when actual individual-level incomes cannot be directly observed (see, for example, Abramitzky et al., 2012). Moreover, following de la Roca and Puga (2017), we are interested in disentangling the static and dynamic effects of urban residence on skills from the sorting of high-ability individuals into cities.

We use two complementary datasets. The first is the novel Historical Swedish Population Panel (HISP), which offers a longitudinal sample of roughly 1500 individuals born between 1860 and 1900 with yearly observations from 1880 to 1930. This dataset allows us to pinpoint the timing and dynamics of skill attainment with a high degree of accuracy. The second is a panel of individuals across the four decadal censuses from 1880 to 1910. This dataset allows us to observe individuals only every tenth year, but is much larger than the longitudinal sample and offers information on almost 800,000 individuals. The large sample size enables us, in this case, to examine specific dimensions in greater detail, as the data can be broken down into subgroups without compromising statistical precision.

The fact that we can observe the same individual over several years or census waves provides us with two advantages. First, it allows us to investigate whether the impact of relocating from a rural to an urban area on skills is a one-off effect, or if it accumulates over time as the individual spends more time in an urban environment. Second, we can employ individual-fixed effects to assess any differences in trends between migrants and non-migrants before the migration event. We do this by implementing a staggered treatment difference-in-differences regression design.

Our findings reveal a substantial effect of living in an urban area on skill attainment during industrialization. First, we observe a static effect of migration on occupational upgrading. Rural-urban migrants did not exhibit differing trends in occupational income relative to non-migrants before their relocation but, immediately upon settling in the city, they experienced a 5 % increase in occupational income compared to the counterfactual scenario of remaining in the rural area. Second, we identify a dynamic effect of transitioning from a rural to an urban area. Over time, migrants acquired more skills compared to what they would have accomplished in the countryside. After spending 20 years in urban environments, they had about 10 to 15 % higher occupational incomes than if they had not moved.

The long-run effect of 10 to 15 % can be compared to the cross-sectional occupational income advantage, which was stable at about 30 % throughout the period. This implies that we can attribute about half of the cross-sectional difference to the direct effect of cities on individuals, while the remaining half was due to more-skilled individuals sorting into urban areas. Furthermore, while a third of the long-run effect of cities on skills is accounted for by the immediate upgrading in occupational status when relocating to an urban area, the remaining two-thirds is explained by the dynamic nature of urban economies. Over time, individuals moving to urban areas successfully moved up the occupational ladder faster than those who remained in rural areas.

We are also interested in the relationship between agglomeration size and skills—often referred to as scaling relationships—to determine whether our results are influenced by city size.[1] We divide our census dataset into two parts: one comprising Sweden's capital and largest city, Stockholm, and the other encompassing all other cities. We run separate regressions using the two datasets to analyze the potential benefits of moving from the countryside to a large city when compared to moving to all other urban areas. We demonstrate that movers to Stockholm experienced much larger increases in occupational income than other rural-urban movers, both immediately and over time. Moreover, in an alternative exercise, in which we calculate occupational incomes separately for Stockholm, our results point to an even greater effect of relocating to Stockholm. Thus, we conclude that a large-city premium was present also in industrializing economies.

Furthermore, we explore the extent that cities effectively facilitated occupational upgrading for individuals who initially possessed relatively low skills before entering the urban economy. In the context of industrializing economies, a significant proportion of the population had limited skills and was primarily engaged in the agricultural sector. To ascertain whether cities successfully enhanced the skills of the unskilled, we divide our linked census dataset into two categories: individuals whose occupational incomes before relocating to a city were higher than the overall median occupational income; and individuals with lower than median occupational income before the move. Our analysis reveals that living in a city had a more pronounced effect on skill attainment for those who were relatively unskilled before moving compared to those who were relatively more skilled. This finding leads us to conclude that cities played a fundamental role in increasing the skill attainment of the least skilled during industrialization.

Our article contributes to three bodies of literature. Specifically, our study addresses the debate on learning and matching in cities. Theory suggests that in urban areas, the larger pool of workers and firms should allow for more effective matches between employers and employees, as well as leveraging continuous learning among workers (Bacolod et al., 2009; Carlsen et al. 2016; Duranton and Puga, 2004; Glaeser, 1999; de la Roca and Puga, 2017; Yankow, 2006). The urban premium in contemporary Sweden has also been studied using data on internal migrants. However, given that cities are no longer recognized as administrative units, this research focuses on labor market regions—defined based on commuting patterns (e.g., Keuschnigg et al. 2019; Korpi and Clark, 2019). Consequently, these studies are not entirely comparable to this article. Nevertheless, Eliasson and Westerlund (2023) provide the closest parallel to our work. Their study examines the static and dynamic advantages of living in large, urban labor market regions, although on actual annual earnings. The authors find static and dynamic effects comparable in magnitude to those found in this article. We extend the test of this theory by examining urban skill acquisition in an industrializing economy during the late nineteenth and early twentieth centuries. This was a period when technology and human capital were considerably less developed than today and the workforce was transitioning from primarily agricultural activities. Therefore, our study adds to the urban economics literature by, for the first time, examining the causes of the urban premium in a yet-to-be-developed economy.

Second, we contribute to the debate in economic history on the effect of internal migration on labor market outcomes during industrialization. As the industrialization process unfolded in Europe and North America in the nineteenth and early twentieth centuries, new work opportunities emerged in cities and industrial towns. There is a rich literature dealing with the effects on social mobility and economic returns of moving to such places (Collins and Wanamaker, 2014; Eriksson, 2015; Long, 2005; Ward, 2022). This literature has relied on cross-sectional or, at best, brother-fixed effects to study the economic outcomes associated with migration. This paper advances this literature in two ways. First, we offer a novel perspective on the way that cities affected the skill attainment of urban migrants. Second, we provide longitudinal data that allow us to account for pre-existing trends and provide a more robust analysis. Thus, we are the first to study the long-term effects of living in a city on skills during industrialization.

Third, we contribute to the literature on urbanization and economic growth during industrialization. Seminal works by Kuznets (1955), Bairoch (1988), and Allen (2009) underscore the important role that cities played in enhancing efficiency and worker productivity, thereby fostering long-term economic development during the industrialization phase. In addition, the existence of urban wage premiums during the transition from agriculture to industry is well-documented for several countries (Boustan et al., 2018; Hatton and Williamson, 1993; Lundh and Prado, 2015; Williamson, 1988) However, the underlying reasons for this urban productivity advantage have remained relatively

[1] Scaling relationships of various strength are often found in studies of contemporary societies (see for example Bacolod et al., 2009; Baum-Snow & Pavan, 2012; Keuschnigg et al., 2019).

unexplored. It is unclear whether the boosted productivity of urban individuals simply reflects the sorting of workers or if it is derived from working and living in an urban environment, as was already suggested by Marshall (1890). Our study adds to this literature in two crucial ways. First, we leverage unique historical longitudinal data to examine the dynamic effects on skill attainment from living in a city during industrialization. Second, we use a state-of-the-art staggered treatment difference-in-differences technique to allow for a causal interpretation of our results.

The rest of the article is organized as follows. First, we introduce the concepts of learning, matching, and sharing in cities and its application in greater detail. Second, we provide a brief description of the historical context of urbanization and industrialization in Sweden from the middle of the nineteenth century to the interwar period. Third, we present the two datasets used in our analysis, along with our occupational income measure. Fourth, we describe our empirical strategy. We then present and discuss our results and run a series of robustness tests. Lastly, the final section gives conclusions.

2. Skills in cities

Cities were crucial in fostering economic growth during industrialization. Adam Smith (1776) claimed that the commerce and manufacturing activity of cities were the cause—not the effect—of economic growth. In terms of the urban labor force, in the late nineteenth century Alfred Marshall (1890) suggested that workers in urban environments benefitted from working in a dense environment because of the learning and spillover effects from other workers. Later works by Jacobs (1969) and Lucas (1988) emphasize the role of cities in fostering productivity and economic growth through group interactions. Building on these ideas, Glaeser (1999) develops a model focusing more on rapid human capital accumulation in cities as a result of urban people learning faster through the imitation of more-skilled individuals. Individuals become more skilled through random contact with skilled people. In urban areas the number of human interactions is higher and, thus, increases the pace of learning.

During industrialization, when educational attainment through formal schooling was limited, there is reason to believe that learning through the imitation of more-skilled co-workers was even more important than today. In apprenticeships, a common way of entering a skilled occupation at the time, imitating more-skilled workers was naturally a central feature. However, the majority of urban residents did not have the fortune of entering such a position. Instead, they must have been confined to 'learning-by-doing' and copying more-skilled workers in the workplace.

Although the share of skilled individuals in cities is greater than in the countryside, something also true during industrialization, to what extent can this be attributed to the effect of living in an urban environment? Indeed, there is reason to suspect that high-skilled workers may be disproportionately attracted to the amenities in cities. The gap in skills between cities and the countryside might, therefore, solely reflect positive self-selection on skills into cities. Moreover, if cities do influence the skills of individuals who are living there, how much of this effect can be attributed to static sources underlying the urban advantage, and how much can be attributed to the process of skill attainment over time?

Recently, trying to understand the productive advantage of big cities, de la Roca and Puga (2017) have developed a model to explain the reasons for higher earnings in cities. They consider three reasons that tie into the debate on the urban-rural gap: spatial sorting, static advantages from living in a city, and learning by working in a city. First, more productive individuals may choose to move to cities due to the reasons explained above. Second, there may be a static effect of production in cities that raises the earnings of urban workers, as in agglomeration economies. Third, there is a Glaeser-like dynamic effect, in which cities have an advantage in facilitating experimentation and learning, that increases the productivity and earnings of urban individuals over time.

Duranton and Puga (2004) recognize three micro-foundations that underpin the urban advantage, contributing to higher productivity of urban workers. First, urban environments enable the sharing of—among other things—indivisible goods and facilities, inputs, and the benefits from individual specialization. Second, cities facilitate a greater number of high-quality matches between workers and employers. Third, dense urban areas foster learning through increased interactions between workers. When related to the concepts of static and dynamic effects of urban residency, sharing contributes to static effects, learning plays a key role for the dynamic effects, and matching contributes to both.

Our analysis focuses on the impact of cities on skills. As the productivity of workers increases with their level of skill, we infer that income measures skills. Skilled workers, being more productive, have higher earnings. However, due to limitations in our historical data, we observe only median incomes by occupation rather than 'actual' individual-level earnings. As a result, as skill gains are reflected through occupational transitions, we cannot observe skill increases for individuals who remain in the same occupation, and our model therefore captures only part of the urban premium.

Let Y_j denote the median income associated with occupation j constant across urban and rural areas: $Y_j^U = Y_j^R = Y_j$, where Y_j^U and Y_j^R represent the median income for occupation j in urban and rural areas. When first moving from the countryside to a city, the migrant may retain their occupation j, resulting in no immediate gain. Alternatively, if urban areas have an advantage in rapidly facilitating more successful matches between workers and employers and increase the productivity of all workers, the migrant may transition into a higher-paying occupation k, leading to instant gains. The static effect thus captures the immediate gains associated with upward occupational mobility upon moving to an urban area and is defined as follows: $\Delta Y_{static} = \begin{cases} 0 \text{ if } k = j \\ Y_k - Y_j \text{ if } k \neq j \end{cases}$.

The dynamic effects of residing in cities arise if upward occupational mobility is more prevalent for workers in urban areas over time when compared to rural workers, $P_{jk}^U > P_{jk}^R$. These effects may arise if cities are places of human capital accumulation—learning—and/or are better in creating more successful matches over time. Ultimately, only if migrants experience immediate as well as long-term occupational upgrading, cities are sources of static and dynamic effects in our model. The dynamic effects are expressed as: $\Delta Y_{dynamic}(t) = Y(t) - \Delta Y_{static}$ where $Y(t)$ is the occupational income of a migrant after relocating to an urban area at time t minus the static effect, ΔY_{static}.

Yet, even in the absence of static and dynamic gains of migrants moving from the countryside to urban areas, an urban-rural gap may still be present. However, in that scenario, selective migration fully accounts for the disparities.

3. Cities and migration during Sweden's industrialization: a brief overview

For much of the nineteenth century, Sweden was one of the least urbanized countries in Western Europe (Bairoch and Goertz, 1986). In 1820, only one out of every ten individuals resided in an urban area. Moreover, most of Sweden's cities were small towns with <2000 inhabitants. However, a significant shift in urbanization began in the mid-nineteenth century. In 1880, the first year of our study period, urbanization rates had only started to show a recent upward trend, with approximately 15 % of the population living in urban areas. Over the following decades, Sweden's urbanization would undergo a remarkable transition. The urban population share in Sweden increased by 3.7 percentage points, on average, per decade. As a result, in 1940 nearly 40 % of Sweden's population resided in towns (Nilsson, 1992).

Throughout the article, we rely on the historical definition of a city, which was based on historical trade and crafts privileges rather than a population benchmark. Most Swedish cities have Medieval origins, with few areas granted city rights between the 1880s and 1930s. To illustrate, 85 % of the urban population in 1940 resided in a city that had been founded before 1880 and many Swedish cities remained small throughout the industrialization period (Nilsson, 1992). Therefore, neither the definition of an urban area nor the spatial concentration of urban people shifted much during our examination period. Nevertheless, in Figure A7, we run a robustness test in which all areas that were rewarded city rights after 1880 have been recoded as rural areas. As these places were few and small, the baseline results are not altered.

As in other European countries, the process of increasing urbanization rates was parallel to changes in the economic structure. Sweden, in the mid-nineteenth century, was essentially an agrarian country where three out of four individuals were employed in agriculture. However, the agricultural sector underwent several improvements during the first half of the nineteenth century. Increased demand for agricultural products and institutional change raised the earnings of farmers. This, in turn, stimulated domestic demand for consumer goods during early industrialization. Yet, the real industrial breakthrough did not take place until the 1870s with the expansion of the sawmill industry in northern Sweden and investments in the iron-industry and railroad system (Schön, 2000).

A large portion of the initial industrialization process was focused on export-oriented industries in forestry and iron products and was primarily situated in the countryside, which was common before the arrival of improved transportation technology (see, for example, Atack et al. (2022) for insights into the experience of U.S. manufacturing). However, a noticeable shift in economic activity towards cities began in the 1880s, coinciding with the start of our study, and continued through the early 1900s. This period was characterized by rapid urban growth. Notably, the fifteen fastest-growing cities contributed to half of Sweden's population growth. This urban expansion occurred simultaneously with the growth of both the manufacturing and the service sectors at the expense of agriculture. Furthermore, while the key sectors of industrial expansion—namely sawmills and iron production—stagnated, there was significant growth observed in manufacturing industries focused on shoes, textiles, cement, and pulp. However, the majority of Sweden's population still worked in farming as late as the 1920s (Schön, 2000). 'Farmer' was a very common career for countryside men throughout our study period so, in a robustness test, we show that our results are not solely driven by disparities in skill attainment between farmers and non-farmers; to be specific, we expect farmers to have been considerably less likely to change occupations when compared to others.

The emerging industries and growing demand for services presented new employment prospects within cities, drawing residents from the countryside. During the late nineteenth century, industrial towns absorbed half of the total urban migration influx. However, over time, Stockholm's attractiveness increased substantially. By the 1930s, migration to Stockholm alone constituted two-thirds of the total urban migration gains (Thomas, 1941). Despite the dominance of Stockholm as a destination for the rural born, historical research indicates that relocating to the city did not offer any particular advantage for skill attainment relative to other cities. For instance, Norman (1974) argues that internal migrants in the early twentieth century who headed for Stockholm did not experience better labor market outcomes compared to those migrating to other Swedish towns.

While there is no continuous data series on the costs of living in urban and rural areas in Sweden before the twentieth century, assessments by Allen (1955) for 1870 and 1900 suggest that these differences were relatively small during this period. According to Allen (1955), an agricultural worker needed to increase his monetary income by 6.5–7 % to maintain his real income if he transitioned to the industrial sector. Nevertheless, these estimates are based on extrapolated prices and assumed consumption patterns and should be interpreted cautiously. For 1911–1950, an annual real wage series by Lundh and Prado (2015)—calculated as the wage gap between unskilled agricultural and industrial workers, adjusted for living costs and unemployment risk—indicates that the real urban-rural wage gap was low, <20 %, before the interwar period and then steadily increased to around 50 % by 1930. Although our concern is not the potential increase in living standards of people relocating to urban areas, Figure A4 presents our estimates adjusted for living costs based on the data from Lundh and Prado (2015) for urban and rural areas in Sweden. We demonstrate that while the dynamic effects of urban residency are robust to these adjustments, the static effect is eliminated. Instead, there is an initial decline in real occupational income, while the increase in the long run is still substantial.

4. Data

4.1. Individual-level datasets

We use two complementary sets of data that build on the same original source material.[2] The first is the HISP longitudinal sample of men and women born in 1860, 1870, 1880, 1890, and 1900, derived from catechetical examination registers. Each individual is followed over time. The second is taken from linked populations censuses, taking cross-sectional excerpts from the catechetical registers in 1880, 1890, 1900, and 1910. The two datasets complement each other in that they originate from the same source material but have different properties.

On the one hand, the longitudinal HISP sample includes a smaller number of individuals (1431) but has a high number of yearly observations per individual (28 on average). On the other hand, the linked decadal censuses include a much larger number of individuals (791,058), but a small number of observations per individual (4). Thus, the yearly observations in HISP allow us to identify more precisely the dynamics of the impact of rural-urban migration on occupational income. Since it allows us to observe migrants in the years just prior to the migration event, we can address any suspicion that there are pre-event trends in the trajectory of occupational income, as well as to examine the immediate impact of rural-urban migration on occupational income. Additionally, HISP covers a longer time span, covering the period from the 1870s to the 1930s. The census data, by contrast, allow us to examine the varying impact related to the type of destination and the characteristics of the mover, such as gender and pre-migration occupational income.

The HISP dataset covers all migrations made by the randomly sampled individuals from birth until death, emigration, or censoring in the 1930s, which is the end of the period of interest. This allows us to observe all migrations that were made, in addition to information on occupation and demographical characteristics such as marital status, number of children, and socio-economic background, during the entire period before and after the rural-to-urban move occurred. The sample is representative in terms of rural and urban status, socio-economic background, geography, and gender. The data build on catechetical examination registers and parish books in which whole households have been reconstructed for many periods. The original source, the catechetical examination registers, is well known for its high quality (Dribe and Quaranta, 2020). The registers were kept by the local clergy, which documented parish members along with their occupations and, if they moved, migration destinations. Furthermore, historically, to relocate within Sweden, internal migrants were required to carry documentation that was signed by the clergy of the source parish, which was subsequently countersigned by the clergy of their destination parish (Eriksson and Rogers, 1978). These sources are, thus, deemed highly accurate even when dealing with a geographically mobile population.

The digitized population censuses for 1880, 1890, 1900, and 1910 are provided by Ruggles et al. (2024) and The Swedish National

[2] The replication package containing code and data making it possible to reproduce our results is available at openICPSR (Andersson & Molinder, 2025).

Archives et al. (2011a,b, 2014, 2016). Individuals observed in these records have subsequently been linked across the digitized censuses[3] and include almost the same variables as the longitudinal sample. Although the censuses do not provide information on the exact timing of rural-urban moves, they cover a larger portion of the population and, accordingly, allow us to break down the data into smaller groups. Since the timing of migration is unknown, we are only able to say for certain that an individual migrated between two censuses: ten years apart. Nevertheless, we believe that the combination of the HISP data and the population census gives us a unique ability to explore both longitudinal dynamics, as well as variation across different groups.

Both the census and HISP datasets were originally constructed using information excerpted from catechetical registers and are therefore comparable. Moreover, linking rates of historical records in Sweden have proven to be higher than those typically achieved for other countries.[4] Like all historical sources, our datasets do have some drawbacks, however. Most importantly, there may be concerns that the catechetical registers underreported occupations of adult sons and daughters living in the households of their parents. To assess whether our results are merely a consequence of underreporting, we conduct a robustness test in which we impute the occupational incomes of adult sons and daughters who lack occupational titles. For adult sons, we impute the occupational income of farmhands. For adult daughters, we impute the occupational income of domestic servants. This corresponds to the type of work that the sons and daughters of farmers were engaged in on the family farm.

4.2. Occupational income scores

To assess the skill levels of occupations, we match occupations with occupational income scores, representing the median income associated with each occupation. Using income scores to study labor market outcomes and occupational mobility has become the standard approach in the economic history literature when information on incomes is not accessible (see, for example, Abramitzky et al., 2012). Our occupational income scores for Swedish occupations are based on tax records for 1900 and have been obtained from Bengtsson and Molinder (2024).

Our coding procedure follows a two-step process. First, all occupations in the datasets have been assigned five-digit HISCO codes (Van Leeuwen et al., 2002). Second, we match the HISCO coded occupations with occupational income scores for each individual-year observation where information on occupation is available. The occupational income scores reflect only cross-sectional snapshots of incomes of occupations at a single point in time. The income scores do not capture changes in incomes over time, a limitation of our study that is shared by most historical studies employing individual-level data. However, we address this limitation by conducting a robustness test using an alternative occupational income score for 1930. Moreover, to ensure that our occupational income scores adequately capture skills, we conduct a robustness test, presented in Fig. 7, by examining the probability of transitioning into different occupational categories (white-collar, skilled, low-skilled, and unskilled occupations).

4.3. Descriptive statistics

Tables 1 and 2 summarize the mean occupational income of individuals by urban-rural residency and gender. The first table presents the descriptive statistics of the longitudinal HISP sample and the second table presents the descriptive statistics of the linked censuses. Mean occupational incomes are highly similar between the two datasets despite their different properties. This is also noticeable when looking at the most frequently observed occupational titles that are exactly the same in the two datasets. Rural men were predominately farmers, while urban men were predominately laborers. For urban and rural women alike, domestic servant was the most common occupation.

Table 3 presents the summary statistics of migration and urban-rural residency from the same samples. Geographical mobility was very high: >25 % of the whole longitudinal sample, at some point, migrated to an urban area. This is similar in developing nations today, where 20–25 %

Table 1
Occupational income by gender and rural-urban residency in longitudinal sample.

		Mean occupational income (in Swedish kronor)	Most frequent occupational title
Rural	All	613 (426)	
	Men	678 (344)	Land-owning farmer [*Hemmansägare*]
	Women	389 (579)	Domestic or farm servant [*Piga*]
Urban	All	903 (894)	
	Men	1038 (806)	Laborer [*Arbetare*]
	Women	634 (994)	Domestic servant [*Piga*]

Note: Pooled data of 18–70-year-olds. This table presents mean and standard deviations (within parentheses) of occupational incomes and the most frequently observed occupations in urban and rural areas by gender.
Source: For a presentation of HISP, see (Andersson, 2024).

Table 2
Occupational income by gender and rural-urban residency in linked censuses.

		Mean occupational income (in Swedish kronor)	Most frequent occupational title
Rural	All	562 (312)	
	Men	631 (252)	Land-owning farmer [*Hemmansägare*]
	Women	242 (358)	Domestic or farm servant [*Piga]*
Urban	All	703 (869)	
	Men	1002 (907)	Laborer [*Arbetare*]
	Women	277 (593)	Domestic servant [*Piga*]

Note: Pooled data of 18–70-year-olds. This table presents mean and standard deviations (within parentheses) of occupational incomes and the most frequently observed occupations in urban and rural areas by gender.
Source: Ruggles et al. (2024) and The Swedish National Archives et al. (2011a,b, 2014, 2016).

Table 3
Urban-rural status and migrations in longitudinal sample and linked census.

	Longitudinal sample		Linked census records	
	N	%	N	%
Urban born	203	14.2	50,502	6.4
Rural born	1228	85.8	739,805	93.6
Rural-urban migrants	377	26.3	75,568	9.6

Note: People born in areas defined as urban according to the official historical classification are coded as urban born, all others are rural born. Rural-urban migrants are people who move from rural to urban areas.
Source: Andersson (2024); Ruggles et al. (2024) and The Swedish National Archives et al. (2011a,b, 2014, 2016).

[3] The probabilistic approach employed to link individuals across the Swedish census records is described in Eriksson (2015), Dribe et al. (2019), and Ejermo et al. (2022).

[4] Berger et al. (2023) show that linkage rates between two Swedish censuses 30 year apart (1880-1910) is 57.1 percent. Linking rates for other countries during the same period, range from 20.3 percent for Britain and 21.9 percent for the U.S. to 37 percent for Norway.

of rural residents migrate to urban areas (Young, 2013).

The linked census data show a somewhat similar pattern in rural-urban and urban-rural migration, although the migration rates are much lower than in the longitudinal sample. About 9.6 % of the individuals in the linked census, at some time, moved to an urban area. We attribute the disparities between the linked census and panel datasets in migrant rates to three underlying factors: the censuses not capturing all transient moves, the extended time coverage of the longitudinal sample compared to the linked census data, and the longitudinal sample having a broader coverage of the life course.

Fig. 1 presents the cross-sectional difference in median occupational incomes between cities and the countryside, referred to here as the urban-rural skills gap. We use observations from both of our datasets to estimate a series of OLS regressions, defined in Eq. (1), and can conclude that the skill disparities are highly similar across time and between the datasets. There is a consistent difference of about 30 % in skills or occupational income. This is also true after controlling for demographic characteristics, gender, and age.

$$\textit{ln Occupational income}_i = \alpha + \beta \text{Urban}_i + \epsilon_i \tag{1}$$

For each regression m, we obtain the coefficient β^m_{urban} from the regressions without controls and compute the average urban-rural gap in occupational income separately for the panel and census data. This is calculated as

$$\overline{\beta}_{\text{urban}} = \frac{1}{M}\sum_{m=1}^{M} \beta^m_{urban} \tag{2}$$

Thus, in our identifying model, we aim to determine the causes of the urban-rural gap, denoted as $\overline{\beta}_{\text{urban}}$, for our two datasets.

5. Empirical strategy

The longitudinal properties of our datasets, in combination with a clearly specified event, provide an ideal setup for a difference-in-differences design. We exploit the fact that we can track the same individuals for several years both before and after their migration to an urban area. Simultaneously, we have a control group of non-migrants who are subject to the same duration of observation at our disposal. This allows us to observe individual-level occupational incomes among both migrants and non-migrants consistently over extended periods. If the trends in the occupational income of migrants and non-migrants were parallel before the event, it provides us with a unique opportunity to interpret causally the effect of rural-urban migration on skill attainment within the context of an industrializing economy in the nineteenth century.

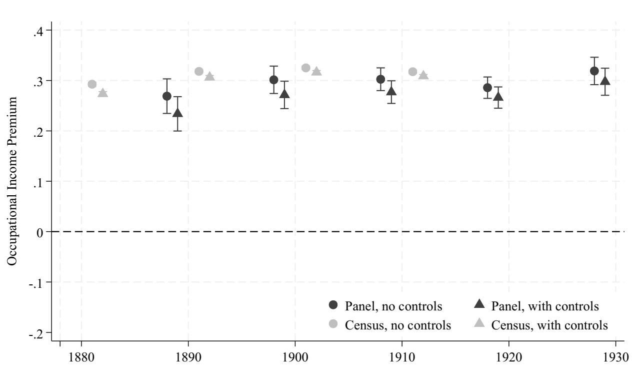

Fig. 1. Cross-sectional urban occupational income premium
Note: This figure displays the OLS estimates of four specifications. The first regression, without any controls, uses the panel data pooled by decade (e.g., all observations from 1880–1889, 1890–1899, etc.). The second specification is an unconditional model using the census data in a cross-section analysis. The remaining models are similar but incorporate controls, including polynomials for age, dummy variables for sex and marital status, and a continuous variable for the number of children.
Source: Andersson (2024); Ruggles et al. (2024) and The Swedish National Archives et al. (2011a,b, 2014, 2016).

In our specification, we estimate the following model:

$$\textit{ln Occupational income}_{it} = \gamma_i + \lambda_t + \delta \textit{Migrant}_{it} + X_{it} + \epsilon_{it} \tag{3}$$

where *ln Occuptional income*$_{it}$ is the natural log of the occupational income of individual i at time t. $\delta \textit{Migrant}_{it}$ equals 1 for rural-urban migrant i for the years t after the move took place; γ_i denotes individual fixed effects, capturing unobservable time-invariant individual-specific characteristics; and year fixed effects, λ_t, captures unobservable time-varying effects on occupational income. Finally, X_{it} is a vector that comprises time-varying individual-level control variables.

We recognize that the canonical difference-in-differences design—-with two groups and two time periods—produces unreliable results when applied to settings with multiple units and periods, usually referred to as the two-way fixed-effects (TWFE) estimator with leads and lags. The TWFE estimator can exhibit bias when treatment occurs over multiple years and treatment effects are heterogeneous over time, an issue that recently received much attention (see for example Callaway and Sant'Anna, 2021; de Chaisemartin and d'Haultfoeuille, 2020, 2024; Sun and Abraham, 2021). In such cases, the estimator essentially equals "a weighted average of all possible two-group/two-period DD estimators in the data" (Goodman-Bacon, 2021). Moreover, Goodman-Bacon (2021) notes that the weighted average is proportional to group size and variance of the treatment dummy, and is highest for groups treated in the middle of the panel. The most consequential implication of this is that if the treatment effect is heterogeneous across time then already treated units become controls and, as a result, negative weights can emerge.

The characteristics of a panel with multiple treatment periods are evident in both of our datasets. In the longitudinal sample, treatment can occur at any point during the period, whereas in the linked census data the treatment can take place in between the four snapshot observations in the censuses. Moreover, based on the observations by Glaeser and Maré (2001) on the wage growth effect of living in a city, we suspect that the effect of moving to an urban area on skill attainment varied over time. Consequently, if we were to use the canonical TWFE difference-in-differences methodology, our estimates would likely be biased. To address this issue, we employ the de Chaisemartin and d'Haultfoeuille (2020, 2024) estimator, applied to panels with multiple treatment periods and robust to the presence of heterogeneous treatment effects.

The de Chaisemartin and d'Haultfoeuille (2020, 2024) estimator has recently been utilized in several works (see for example Andersen, 2020; Braghieri et al., 2022). However, there are several alternative estimators that handle dynamic difference-in-differences designs, such as those devised by Callaway and Sant'Anna (2021) and Borusyak et al. (2021). In Appendix Figures A1 and A2, we show that the results are robust to using these alternative estimators.

In the difference-in-differences framework, a key assumption is parallel trends of the treated and untreated group prior to the event. Having access to longitudinal panel data with multiple yearly observations before the event, we can ensure that the parallel-trends assumption holds for a ten-year window in the case of the panel data, and for two census waves in the case of the census data.

We also include several time-variant control variables in our regressions that could influence skill attainment in our regressions, such as living in the parental home, age, age squared, and number of children. We run our models both with and without controls and find estimates of similar magnitude.

Our assumption is that the model should capture the effect of residing in an urban environment by controlling for unobservable individual-level and time-varying characteristics, pre-migration outcomes, and various observable time-dependent variables. Yet, it is possible that internal migrants and stayers differ from each other in ways that are not reflected by pre-migration outcomes. Notably, the most talented may have chosen to migrate based on the expected returns from relocating to an urban environment—returns that rural stayers would not have realized if they had moved to an urban area. If these returns could only be realized in urban areas, then these unobservable differences between migrants and non-migrants would not be captured by pre-migration outcomes.

While our TWFE strategy mirrors previous works in urban economics that address similar questions (Glaeser and Maré, 2001; de la Roca and Puga, 2017), it does not provide exogenous variation for migration. This is unlike studies that leverage natural disasters (Nakamura et al., 2022), randomized field experiments (Bryan et al., 2014), or sudden removal of institutional barriers to internal migration (Bakker et al., 2020) to explore the effects of migration on economic outcomes. Nevertheless, examining an exogenous shock that significantly impacted rural-urban migration, combined with accessing historical longitudinal data of individuals who experienced this event, remains challenging. Additionally, such studies are typically limited to specific segments of the population. Thus, even though there is a risk that selection on unobservable differences may bias the results, we believe that our empirical strategy provides the best possible estimate of the effects of urban residence on skill attainment in a historical setting.

6. Results

6.1. Baseline results

We begin our analysis by examining the impact on occupational income of movers in both datasets to study the effect of urban residence on skills. For the longitudinal HISP sample, the left panel of Fig. 2 shows the estimates by plotting the differences in occupational income of migrants and non-migrants up to ten years prior to the move, the year the move took place, and up until 20 years after the move. For the linked censuses, we plot the same estimates but for two census waves (decades) prior to the move up until three periods after the move took place. This is shown in the right panel in Fig. 2. The corresponding coefficients are presented in appendix Table B1.

The results show that individuals gained substantially from relocating to an urban area. Conditional on individual- and time-fixed effects, occupational income did not differ between migrants and non-migrants prior to relocating and, accordingly, migrants do not seem to have experienced different pre-event trends in occupational income. However, the occupational income of migrants increased immediately after arriving in cities and continued to grow over time. Occupational income increased by about 5 % directly upon arrival, increased to about 10 % after ten years and further to about 15 % twenty years after moving. The magnitudes of the static and dynamic effects of urban residency using our occupational incomes are slightly larger than the actual income gains of university graduates in contemporary Sweden. Eliasson and Westerlund (2023) demonstrate that university graduates working in Stockholm (at 8.8 years' experience) display a premium of 15.6 %—3.5 % static and 12.1 % dynamic—when compared to working in a rural labor market region.

The size of the estimates using the linked census data is similar to the results from the longitudinal data, although slightly smaller. The trends over time are very similar, however. Migrants increased their occupational income by 5 % when entering the urban environment and improved upon their occupational income over time. The difference in the results is likely due to the better coverage of the individuals in the longitudinal sample.

Controlling for potential confounders does not alter the results. In Fig. 2, the results that include controls for demographic characteristics are not markedly different from the baseline specification without controls.

The absence of pre-event trends in occupational income prior to the move, accompanied by a large effect right after the migration event, suggests that relocating to an urban area had a causal impact on skill attainment. Moreover, the results from our regressions suggest the existence of a dynamic growth effect: a substantial portion of the skills of rural-urban migrants accumulates over the time spent in urban areas.

Fig. 3 shows the components that produce the urban-rural gap. We obtain the static effect from the coefficient when $\delta Migrant_{it_0}$, the dynamic effect from the coefficient when $\delta Migrant_{i\tau} - \delta Migrant_{it_0}$,[5] and selection on unobservable differences from $\overline{\beta}_{\text{urban}} - \delta Migrant_{i\tau}$. These estimates are subsequently divided by the $\overline{\beta}_{\text{urban}}$. This simple exercise shows that the effect of living in a city explains about half of the urban-rural disparities in skills. First, we identify a static impact of living in an urban area. This effect is the immediate benefit of entering the urban labor market, denoted $\delta Migrant_{it_0}$, which is the advantages of moving into the relatively more-skilled urban sector. The other benefit of living in a city is the dynamic effects on skills, denoted $\delta Migrant_{i\tau}$. As individuals spend time in cities, they match with better and more skilled occupations. Consequently, individuals in cities initially increase their occupational income by 5 %. However, after twenty years in the urban environment, their occupational income grows to 10 to 15 % relative to what it would have been if they had remained in a rural area. The remaining difference in the 30 % urban-rural skills gap is attributed to unobservable heterogeneity in ability, captured by the individual fixed effects.

6.2. Heterogeneity

Drawing on insights from research on agglomeration economies regarding the relationship between city size and productivity (Duranton and Puga, 2004), as well as findings from the economic history literature concerning the greater economic gains from migration for those with the most economically disadvantaged backgrounds (Ward, 2022), we now move on to explore heterogeneity in treatment effects based on city characteristics and the skill level of individuals prior to relocating to a city. We also consider potential differences between men and women in the impact on skill formation due to spending time in urban areas.

6.3. Agglomeration size

To what extent did skill attainment vary by city size? A large literature, spanning both developing and developed economies, indicates that the effect of migration on income tends to be more substantial for those moving to densely populated and larger agglomerations (for a comprehensive discussion, see Henderson et al. (2021)). In the context of industrializing Sweden, we investigate this proposition by examining Stockholm separately from other towns. As previously mentioned, Stockholm was the sole Swedish city that attained a population of >500, 000 during the period. Stockholm, like other larger capitals such as London and Paris, also attracted rural-urban migrants hailing from across the country. Moreover, it was home to numerous large high-technology manufacturers that were at the forefront of the second industrial revolution, as well as the center for relatively human-capital intensive services such as banking, government agencies, and creative industries (William-Olsson, 1984).[6]

In Fig. 4, we present the outcomes depicting the effect of relocating from the countryside to Stockholm in comparison to moving from the countryside to any other city across Sweden, using the same difference-in-differences design as earlier. As in our previous analysis, we find that migrants had similar levels of occupational income as non-migrants

[5] Where τ denotes the final observation year. $\tau = 20$ in the estimates using the panel and $\tau = 4$ in the estimates using the census data.

[6] Examples of manufacturing firms that were active in the city are the Ericsson Phone Company and AB Atlas (today Atlas Copco).

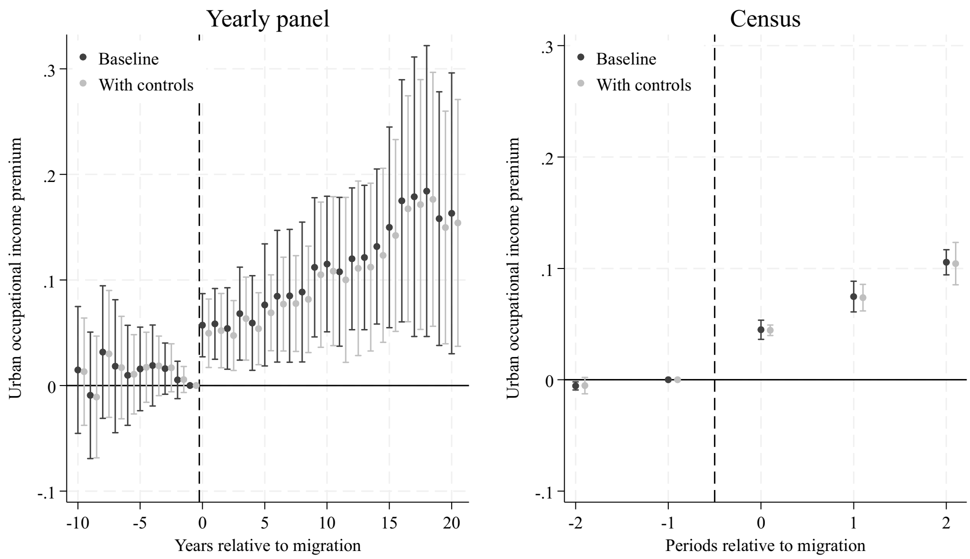

Fig. 2. Effect of rural-urban migration on occupational income
Note: This figure displays estimates of the dynamic treatment effects of rural-urban migration using the estimator developed by de Chaisemartin and d'Haultfoeuille (2020, 2024). In the estimation with panel data, the treatment is defined as the year when a rural-born migrant arrives in an urban area. In the estimation with census data, the treatment is defined as the first census in which an individual is observed in an urban area after previously being observed in a rural area. The outcome variable is log occupational income. Each figure presents the estimates both without and with controls. Controls are age, a polynomial for age, living with parental household, sex, marital status, and a continuous variable for the number of children.
Source: Andersson (2024); Ruggles et al. (2024) and The Swedish National Archives et al. (2011a,b, 2014, 2016).

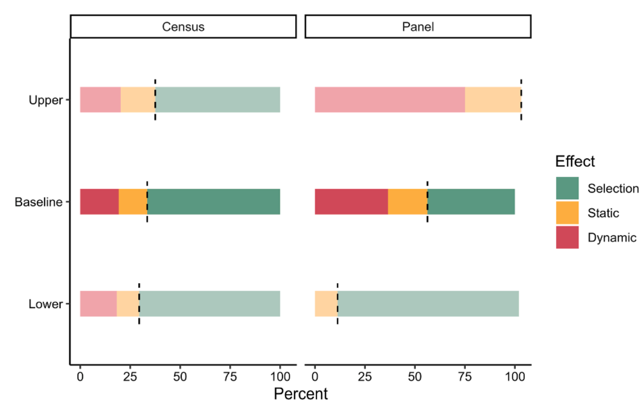

Fig. 3. Components disclosing the urban-rural gap
Note: The estimates have been derived from the regressions presented in Figs. 1 and 2. The estimate of each effect displayed in the figure represents the share of the urban occupational income premium that can be explained by that specific effect. The static effect is $\frac{\delta Migrant_{it_0}}{\bar{\beta}_{urban}}$, the dynamic effect is $\frac{(\delta Migrant_{it} - \delta Migrant_{it_0})}{\bar{\beta}_{urban}}$, and selection is defined as the unexplained differences in the urban-rural gap. The figure displays the baseline estimates and the upper and lower bounds (95 % CI).

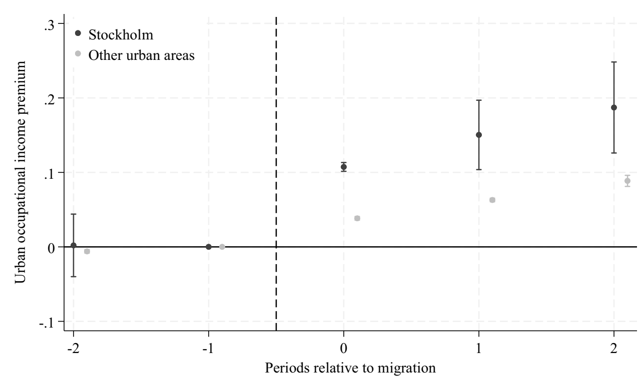

Fig. 4. The effect of urban residence on occupational income in Stockholm and other urban areas
Note: This figure displays estimates of the dynamic treatment effects of rural-urban migration using the estimator developed by de Chaisemartin and d'Haultfoeuille (2020, 2024). The treatment is defined as the first census in which an individual is observed in an urban area after previously being observed in a rural area. The outcome variable is log occupational income. The estimates have been obtained without any other controls.
The dataset has been split into two samples: individuals moving to Stockholm and those moving to any other urban area. The black points represent individuals moving to Stockholm, while the grey points represent individuals moving to any other urban area.
Source: Ruggles et al. (2024) and The Swedish National Archives et al. (2011a,b, 2014, 2016).

prior to relocating. Upon moving to a city, migrants experienced a substantial increase in their occupational income, which continued to grow over time. However, as is evident by the figure, the gains were substantially larger for those entering a large urban area than those moving to smaller cities.

We investigate the large-city premium further by calculating occupational incomes separately for Stockholm (presented in Figure A16) utilizing income data from the 1930 census. Using this measure, we show that rural-urban migrants moving to Stockholm experienced even larger static and dynamic effects when compared to migrants moving to other cities. Altogether, in our study of an industrializing society, we find evidence of a large-city premium that is in line with studies of the modern world (e.g., de la Roca and Puga, 2017).

6.4. Pre-migration skills

We now move on to examining treatment effects that vary based on pre-relocation levels of skill. We are especially interested in assessing the impact of relocating to an urban environment on skill attainment for individuals who possessed relatively limited skills, having low-paying occupations, prior to leaving a rural area. From history, we know that the more human capital-intensive industries of the second industrial revolution increased the demand for skilled workers, while a large share of people at the time were still employed in the agricultural sector as unskilled laborers. This area of investigation is compelling due to the potential of cities to transform those individuals who possessed the lowest levels of skills into skilled workers.

To explore this, we classify individuals into two groups: the 'skilled group', consisting of those with occupational incomes exceeding the median prior to the move; and the 'unskilled group', comprising those with occupational incomes below the median before their relocation. Our regression reveals significant differences in effects from relocating to an urban area between these two groups. The results are presented in Fig. 5. While both groups gained from relocating to a city, those who initially had lower levels of skills stood to gain considerably more, in relative terms, from moving than those with higher levels of skills. The long-run gain for the lower-skilled group was around 20 %, while the corresponding figure for the higher-skilled group was about 8 %. Moreover, we observe a striking skill-development pattern among the lower-skilled group, whereas the occupational income of the more-skilled group grew more slowly over time. Hence, cities played a particularly vital role in enhancing the skills of individuals who began with relatively limited human capital.

In Figure A3, we also consider the effect of rural-urban migration on occupational income by occupational skill group in 1880. We find substantial occupational income gains for all skill groups, with the largest gains found for those that were lower managers and professionals or farmers in 1880.[7]

6.5. Differences by gender

There might also be concerns regarding differences in treatment effects by gender. During the industrialization era, women faced legal barriers that prevented them from entering certain occupations and had, in practice, fewer options in the labor market when compared to men. Does the positive effect of cities on skills solely apply to men? To answer this question, we divide our data by gender. Given that the smaller number of individuals in the panel dataset means we have a limited number of observations of female occupational incomes, we exclusively utilize the linked census data in this analysis. The results, presented in Fig. 6, indicate that men and women actually seem to have benefited equally in terms of skill development from living in cities. While the estimate is less precise for women than for men, the size of the long-run effect is very similar for both genders.

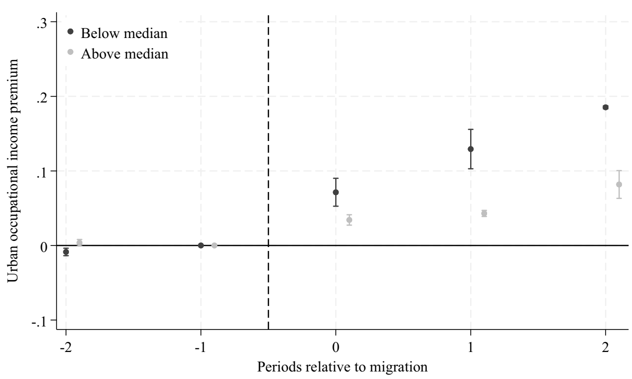

Fig. 5. The effect of rural-urban migration by occupational income in 1880
Note: This figure displays estimates of the dynamic treatment effects of rural-urban migration using the estimator developed by de Chaisemartin and d'Haultfoeuille (2020, 2024). The treatment is defined as the first census in which an individual is observed in an urban area after previously being observed in a rural area. The outcome variable is log occupational income. The estimates have been obtained without any other controls. The dataset has been split into two categories: individuals with occupational incomes above and below the median before relocating. The black points represent individuals with occupational incomes below the median, while the grey points represent individuals with occupational incomes above the median.
Source: Ruggles et al. (2024) and The Swedish National Archives et al. (2011a,b, 2014, 2016).

7. Robustness

In this section we perform a series of sensitivity tests to probe the robustness of our results. We start by considering the impact of using an alternative measure of occupational income and then move on to test whether the results are robust to the exclusion of farmers and the imputation of occupational income for the sons and daughters of farmers.

7.1. Using a direct measure of skill

In our baseline analysis, we use income scores as a continuous measure of skills embodied in different occupations. However, there may be a worry that median incomes of occupations do not fully capture the skill dimension. To ensure that we are indeed observing attainment of skills of rural-urban migrants, we perform an alternative exercise where we use the HISCLASS (Van Leeuwen and Maas, 2011) scheme instead of occupational incomes as the outcome variable. This scheme classifies occupations into 12 different categories based on skill level, manual/non-manual work, and the degree of supervision. We use an abbreviated version to look at the direct impact of rural-urban migration on the probability of belonging to each of the five groups: *Higher managers and professionals, Lower managers and professionals, Foremen and medium skilled workers, Lower-skilled workers*, and *Unskilled workers*. The results are shown in Fig. 7.

The impact on skill upgrading of rural-urban migration is clearly

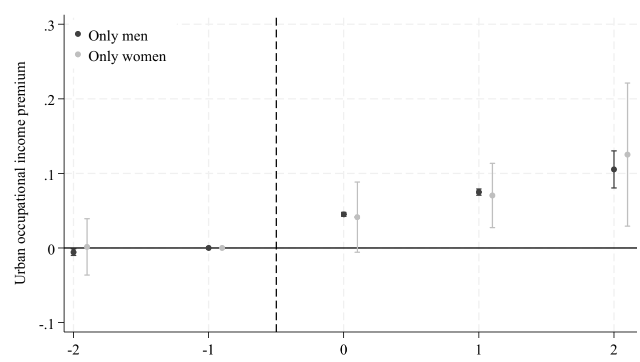

Fig. 6. The effect of rural-urban migration on occupational income for men and women
Note: This figure displays estimates of the dynamic treatment effects of rural-urban migration using the estimator developed by de Chaisemartin and d'Haultfoeuille (2020, 2024). The treatment is defined as the first census in which an individual is observed in an urban area after previously being observed in a rural area. The outcome variable is log occupational income. The estimates have been obtained without any other controls.
The dataset has been separated by gender. The black points represent the male sample, while the grey points represent the female sample.
Source: Ruggles et al. (2024) and The Swedish National Archives et al. (2011a,b, 2014, 2016).

[7] If we look at the impact of moving to Stockholm for those below and above median occupational income in 1880, as shown in Figure A5, we find that both the immediate and long-run impacts for those below the median were larger when moving to Stockholm compared to other urban areas, whereas there were larger dynamic effects for those above median occupational income and who moved to Stockholm.

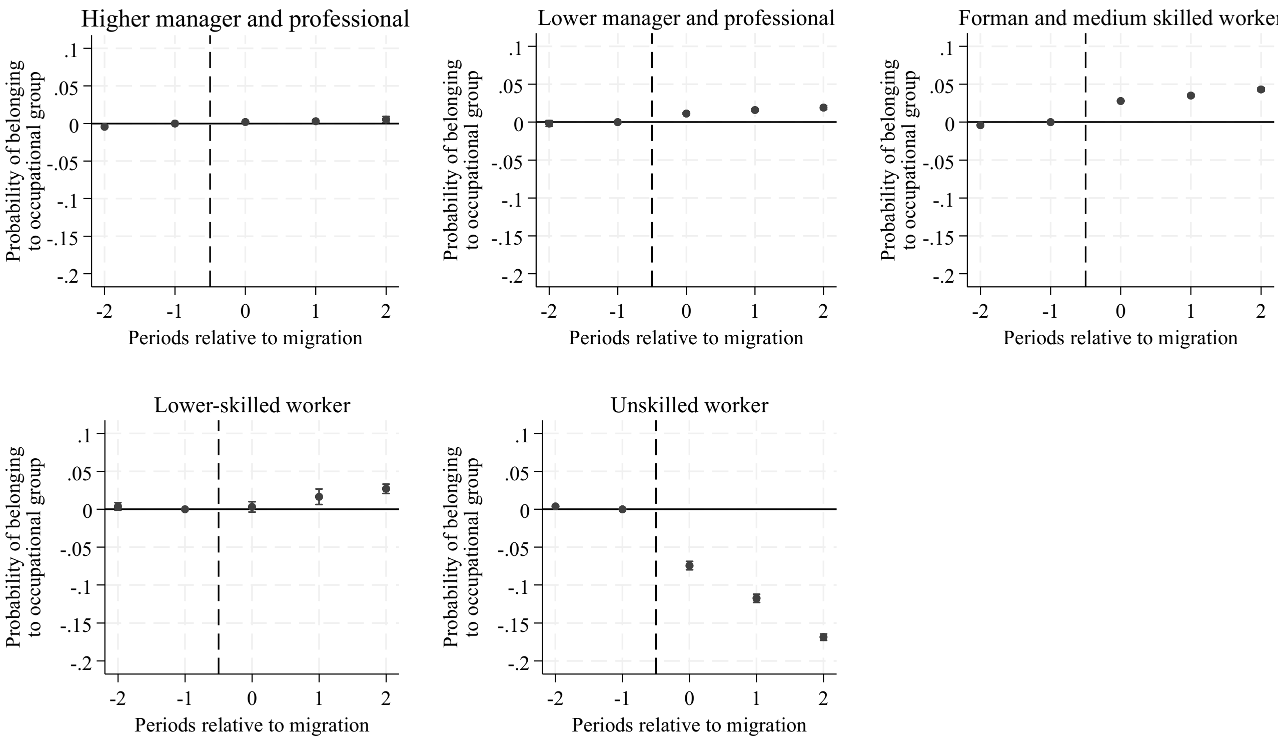

Fig. 7. The effect of rural-urban migration on probability of belonging to different occupational skill groups
Note: This figure displays estimates of the dynamic treatment effects of rural-urban migration using the estimator developed by de Chaisemartin and d'Haultfoeuille (2020, 2024). The treatment is defined as the first census in which an individual is observed in an urban area after previously being observed in a rural area. The outcome variable takes the value 0 or 1, conditional on having an occupation in the occupational category being examined. The estimates have been obtained without any other controls. The first panel, to the upper left, shows the probability of having an occupation in the *Higher managers and professionals* category; the second panel shows the probability of having an occupation in the *Lower managers and professionals* category; the third panel shows the probability of having an occupation in the *Foremen and medium skilled workers* category; the fourth panel, to the lower left, shows the probability of having an occupation in the *Lower-skilled workers* category; finally, the panel to the lower right shows the probability of having an occupation in the *Unskilled workers* category. These five models have been executed separately.
Source: Ruggles et al. (2024) and The Swedish National Archives et al. (2011a,b, 2014, 2016).

visible. Notably, the probability of having an unskilled occupation decreases by slightly >15 % in the long run, while there is an increased chance of holding a more skilled occupation. The positive impact is greatest for the probability of being a lower-skilled worker and for foreman and medium-skilled worker.

7.2. Alternative occupational income scores

To what extent are our estimates influenced by the choice of using occupational incomes from the year 1900?[8] To test the robustness of our dependent variable, we run our baseline regression again, this time employing occupational income data from the 1930 census.[9] In Fig. 8 we present the estimates from our baseline regression using 1900 occupational incomes alongside results from the regression that uses 1930 occupational incomes.

As is evident from the figure, using the alternative income scores for 1930 suggests an even greater impact of moving to an urban area on occupational incomes. The long-run impact is estimated to be around 30 % in both HISP and the linked censuses. Using the 1930 income scores likewise suggests the absence of pre-migration differences in the occupational income trajectory of migrants and non-migrants. When using the 1930 occupational income scores, the larger impact on long-run occupational income is likely a result of occupations that are more common in cities experiencing greater income growth between 1900 and 1930.

7.3. Removing farmers

Another concern pertains to the possibility that our estimates are solely driven by differences in skill attainment between farmers—the most common occupation among rural men—and non-farmers. Given our expectation that farmers are considerably less likely to change their occupation compared to other groups due to heavy investments in immovable property, our results potentially do not truly represent distinctions between urban and rural individuals, but rather show differences between farmers and non-farmers.[10]

To address this concern, we re-run our baseline regression and remove everyone who was ever a farmer during the period under study. The results shown in Fig. 9 indicate that the impact is slightly larger when excluding farmers, but the overall trends are very similar.

8 The caveats of occupational incomes as a proxy for status and incomes are demonstrated by Feigenbaum (2018) in a study of intergenerational mobility in early twentieth century Iowa. He finds substantially different results depending on whether he uses occupational incomes from 1915 or 1950, and, as a result, leads to vastly different interpretations of historical intergenerational mobility.

9 The 1930 census includes total income drawn from taxation records for all enumerated individuals. We take the median income by 5-digit HISCO to calculate the income score.

10 Pérez (2018) shows in the context of 19th century Argentina that farmers were slow to respond to the opportunities that came with local access to the railway, while he estimates a large effect on the second generation that moved away from farming.

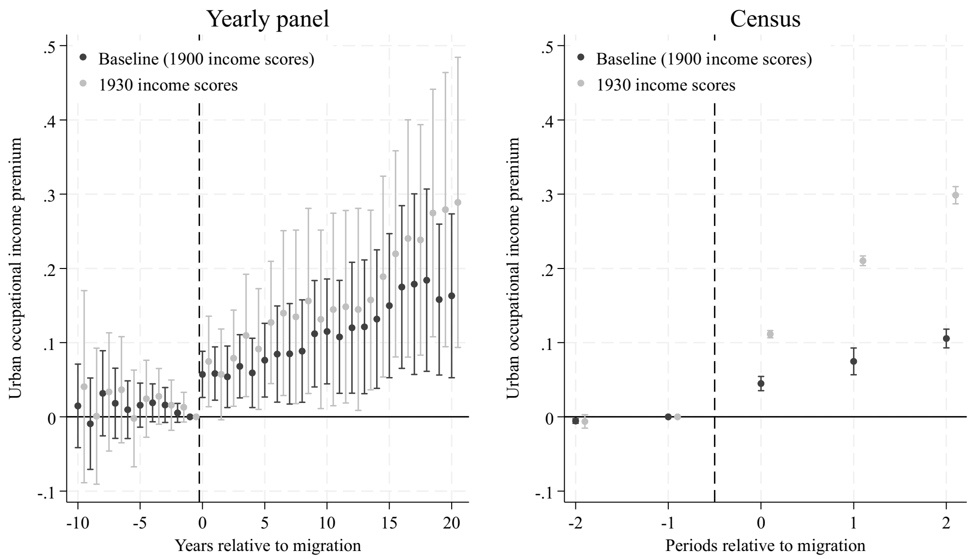

Fig. 8. The effect of rural-urban migration on occupational income using 1930 census income data
Note: This figure displays estimates of the dynamic treatment effects of rural-urban migration using the estimator developed by de Chaisemartin and d'Haultfoeuille (2020, 2024). In the estimation with panel data, the treatment is defined as the year when a rural-born migrant arrives in an urban area. In the estimation with census data, the treatment is defined as the first census in which an individual is observed in an urban area after previously being observed in a rural area. The outcome variable is log occupational income using occupational incomes from the Swedish 1930 census in grey and log occupational income in 1900 occupational income in grey. The estimates have been obtained without any other controls.
Source: Andersson (2024); Ruggles et al. (2024) and The Swedish National Archives et al. (2011a,b, 2014, 2016).

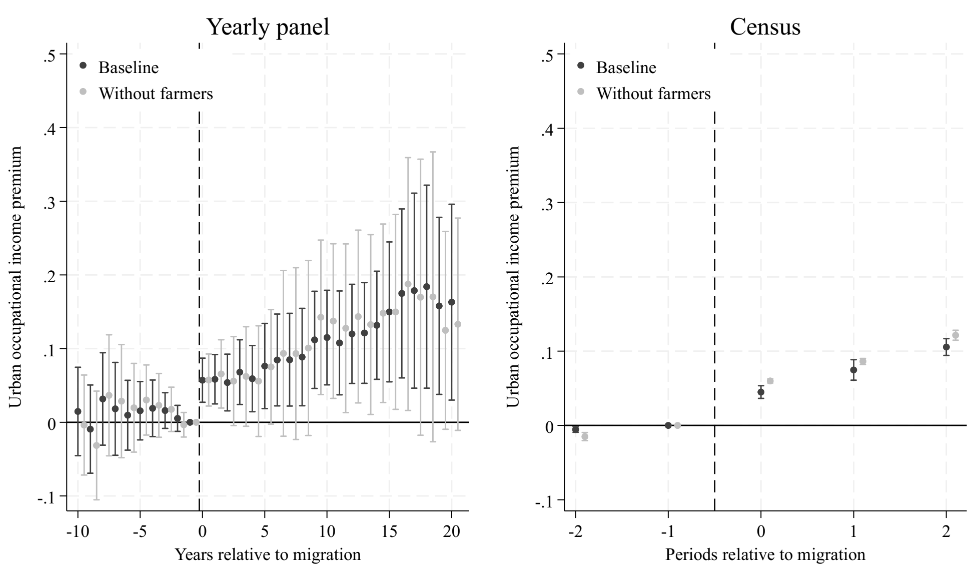

Fig. 9. The effect of rural-urban migration on occupational income after removing farmers
Note: This figure displays estimates of the dynamic treatment effects of rural-urban migration using the estimator developed by de Chaisemartin and d'Haultfoeuille (2020, 2024). In the estimation with panel data, the treatment is defined as the year when a rural-born migrant arrives in an urban area. In the estimation with census data, the treatment is defined as the first census in which an individual is observed in an urban area after previously being observed in a rural area. The outcome variable is log occupational income. The estimates have been obtained without any other controls. The datasets have been split into two categories: the full sample and a restricted sample excluding individuals who were observed as farmers at least once. The black points represent the baseline estimates, while the grey points represent the datasets without farmers.
Source: Andersson (2024); Ruggles et al. (2024) and The Swedish National Archives et al. (2011a,b, 2014, 2016).

7.4. Imputing incomes for sons and daughters of farmers

Another concern pertains to the absence of recorded occupational titles for the adult sons and daughters of farmers residing in the parental household. As the Data section outlines, catechetical examination registers—the primary sources for our datasets—did not often document the occupations of individuals in this category. We employ an imputation approach to assess the potential influence of undocumented occupational titles for adult sons and daughters in farming households. Specifically, we impute occupational incomes corresponding to 'farmhands' for sons and 'farm servants' for daughters in farming households who lack recorded occupational titles. These imputed skill levels align with the predominant activities of adult children in farmer households, prevalent during our study period, who performed duties very similar to those of farmhands and farm servants.[11]

We re-run our regression with these imputations and present the results in Fig. 10. Notably, the inclusion of imputed occupational incomes yields a larger long-run effect of rural-urban migration. However, our basic interpretation, emphasizing that urban residence experienced both a static and a dynamic effect, remains unaltered.

7.5. Alternative estimators

A final concern is that our results are dependent on the choice of difference-in-differences estimator. While our baseline estimator from de Chaisemartin and D'Haultfœuille (2020, 2024) already addresses the issue of weights that might appear in a regular TWFE model, several other alternatives to the TWFE model have been developed in recent years. To make sure our results are not driven by the particular choice of the de Chaisemartin and D'Haultfœuille (2020, 2024) estimator, we also estimate our model using the methods devised by Callaway and Sant'Anna (2021) and Borusyak et al. (2021). The results are shown in Figure A1 and Figure A2 in the appendix. The magnitude and trends of the estimates are very similar when using the two alternatives. This suggests that our baseline results are not driven by the particular choice of estimator.

8. Urban dynamics and economic development

The dynamic impact of living and working in cities accounts for approximately one-third of the observed 30 % disparity in occupational incomes between urban and rural areas. Given that a growing portion of economic activity shifted to urban areas during the examined period, a key question emerges: what trajectory might economic development have taken if cities had not presented a dynamic advantage to workers residing there? To provide approximate figures on the role of urban dynamics in economic growth, we consider projections of GDP per capita across various urbanization rates. We perform the following exercise:

First, we calculate share of the urban-rural gap attributed to the dynamic effects—explaining about one-third of the urban advantage—of cities where y_u is urban GDP pc and y_r is rural GDP pc:

$$\begin{aligned} \textit{Dynamic component} &= 0.33 \times (y_u - y_r) \\ &= 0.33 \times (1.3y_r - y_r) \\ &= 0.33 \times 0.3y_r \\ &= 0.099y_r \end{aligned} \tag{4}$$

Second, the urban advantage without the dynamic effects:

$$y_u^{'} = y_u - \textit{Dynamic component} = 1.3y_r - 0.099y_r = 1.201y_r \tag{5}$$

Third, GDP pc without the dynamic effects of cities:

$$GDP_y = u_y \times y_u^{'} + (1 - u_y) \times y_r \tag{6}$$

Where GDP_y is GDP pc in year y and u_y is the urbanization rate in that same year. For example, in 1880, the urbanization rate was 15.1 % with a GDP pc of $2359 (in $2011).[12] Excluding the dynamic component results in a 1.4 % reduction, lowering GDP pc to $2325. By 1930, as urbanization rose to 32.5 %, GDP pc without the dynamic effects declined by 2.9 %, from $6755 to $6557. It is worth noting that this is a conservative estimate; the baseline GDP pc would likely be even lower since annual growth rates would diminish without the dynamics of cities. Nonetheless, even using this conservative approach, the dynamics of cities contribute to a fair portion of GDP pc, particularly as urbanization intensified in the twentieth century.

9. Conclusion

In this paper we have investigated the causes of the urban-rural gap in skills that emerge as countries shift from agricultural to non-agricultural activities. While some researchers attribute spatial disparities solely to positive self-selection into urban areas, others have underscored the benefits of living in cities on skills. Notably, the literature on learning in cities postulates that individuals in urban areas experience gains in productivity and human capital as a direct effect of living in an urban environment. However, this debate concerns rich countries in today's developed world. We know much less about the effects of cities on skills at the time when most of today's rich countries began to industrialize around the turn of the nineteenth century and when human capital and technology were less developed.

In this paper, we add to this debate by studying the effects of relocating to an urban environment on skill attainment during industrialization. As a measure of skills, we employ occupational incomes, a standard approach in the economic history literature when actual incomes or wages cannot be observed, and show that the urban-rural occupational income gap was approximately 30 % during the entire industrialization phase. We study the causes of this gap by leveraging uniquely detailed historical Swedish longitudinal data and exploit the fact that we can estimate the skills of rural-urban migrants before and after moving. Using a state-of-the-art difference-in-differences estimator with individual and time-fixed effects, which allows for staggered treatment, we address the worry that people are sorted into cities on skills. Moreover, the same estimator allows us to estimate the immediate and long-term effects of living in a city on skills.

Our results show that cities did indeed have a positive effect on skills during industrialization. First, conditional on individual-fixed effects, rural-urban migrants did not outperform never-migrants before moving. Their skill trajectories did not differ significantly. Second, we observe an immediate increase in the skills of rural-urban migrants directly upon arriving in an urban environment. We attribute this effect to the static advantages of working in a city relative to the countryside. About one-third of the effect of living in a city on skills can be explained by the static advantages. Third, as individuals spend more time in an urban area, their skill levels further increase. We attribute this effect to the dynamic advantages of working in a dense environment, in which individuals accumulate experience and, ultimately, skills over time. Moreover, we find that those who possessed the lowest levels of skills when living in the countryside experienced the largest gains from relocating to a city. We also test the presence of a big-city premium by investigating Stockholm, the only large city in Sweden at the time, separately from other cities. This alternative exercise shows that people moving to Stockholm experienced higher gains when compared to other rural-urban movers, indicative of a large-city premium during industrialization. Finally, we run a series of alternative specifications to ensure that our results are robust to the choice of estimator, the measure of skills, discrimination by gender, and career alternatives of individuals in rural areas, which do not alter our interpretation.

As a whole, our results strongly suggest that cities played an important role in the development of human capital during the industrialization period, especially for those individuals who initially possessed relatively low levels of skills. While half of the urban-rural gap in skills can be attributed to unobservable differences in ability between urban and rural individuals, the remaining half is explained by the static and dynamic effects of cities on skills. Our results ultimately suggest that the benefits of living in an urban environment were not exclusive to large cities—although the gains were likely greater for movers to large cities—and most individuals stood to gain from urban residency. Finally, economic growth would likely have been slower if not for the dynamics

[11] See, for example, Morell (2001) for a discussion. Tasks performed on farms were predominately gender separated. For instance, feeding horses and ploughing were performed by a son or a farm servant, while tasks such as raking hay, cooking, and sewing were performed by daughters or farm servants.

[12] GDP pc estimates have been obtained from Schön and Krantz (2015) and Bolt and van Zanden (2020) and urbanization rates from BISOS (1880) and Statistics Sweden (1933).

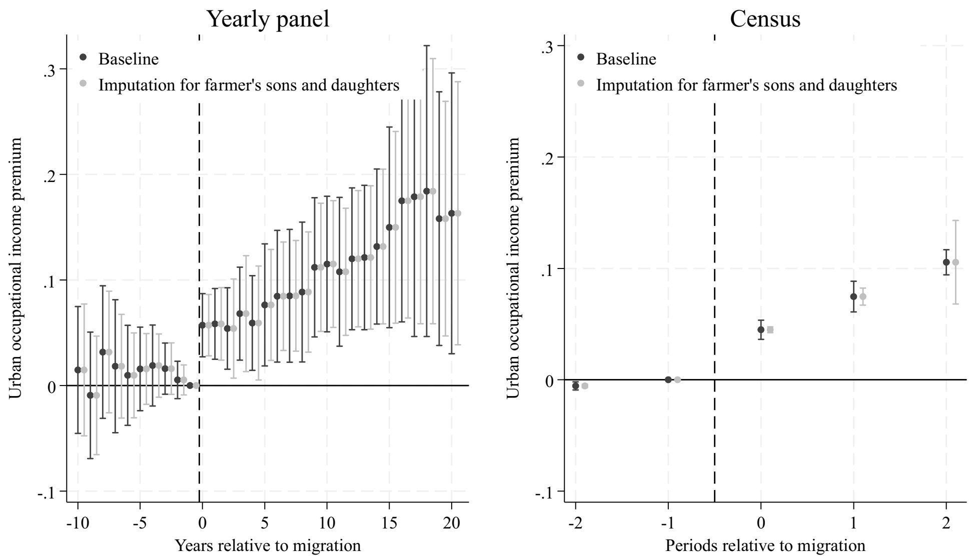

Fig. 10. The effect of rural-urban migration on occupational income with imputed income scores for the sons and daughters of farmers
Note: This figure displays estimates of the dynamic treatment effects of rural-urban migration using the estimator developed by de Chaisemartin and d'Haultfoeuille (2020, 2024). In the estimation with panel data, the treatment is defined as the year when a rural-born migrant arrives in an urban area. In the estimation with census data, the treatment is defined as the first census in which an individual is observed in an urban area after previously being observed in a rural area. The outcome variable is log occupational income. The estimates have been obtained without any other controls. The datasets have been split into two categories: the sample used in the baseline estimates and a sample where occupational incomes have been imputed for adult children of farmers residing with their parents. The black points represent the baseline estimates, while the grey points represent the datasets with imputed occupational incomes.
Source: Andersson (2024); Ruggles et al. (2024) and The Swedish National Archives et al. (2011a,b, 2014, 2016).

of urban residence.

CRediT authorship contribution statement

Jonatan Andersson: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Conceptualization. **Jakob Molinder:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Conceptualization.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jue.2025.103772.

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